The Republic of Serbia

Ministry of Mining and Energy

Project for Assistance of Enhancement of Energy Management System in Energy Consumption Sectors in the Republic of Serbia

Project Completion Report

February 2018

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Company Holdings (TEPCO HD)

YSK Consultants

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JR
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Table of Contents

Abbreviation

COC	Chamber of Commerce
DB	Database
DO	Designated Organization
EA	Energy Auditor
EAR	Energy Audit Report
EM	Energy Manager
EMS	Energy Management System
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
MEDEP	Ministry of Energy, Development and Environmental Protection
METI	Ministry of Economy, Trade and Industry (Japan)
MFBU	Mechanical Faculty of Belgrade University
MOME	Ministry of Mining and Energy
PDM	Project Design Matrix
PO	Plan of Operation
PT	Project Team
R/D	Record of Discussion
SEEC	Serbian Energy Efficiency Center
SEIO (MEI)	Government of Serbian European Integration Office (since June 2017 Ministry for European Integrations)
TEPCO	Tokyo Electric Power Company
TO	Training Organization
TOE	Ton of Oil Equivalent
UNDP	United Nations Development Programme

Chapter 1 Introduction

1.1 Background of the Project

The Republic of Serbia has been using the Coal for 50% out of the total supply of the primary energy, however, about 79% of oil and 90% of Natural gas have been imported from Russia, therefore the reliability of importing resources of the primary energy is almost 40%. From the energy security point of view, diversification of energy sources and promotion of the energy efficiency (hereinafter, EE) have been becoming the necessary issues.

Since the energy law established on 2004, the reformation of the energy sector framework has been made. In May 2005, “Energy sector development strategy 2005-2015”and in January 2007, “Energy strategy implementation program 2007-2012”have been formulated, and promotion of the energy efficiency has been the most prioritized issue.

From above circumstances, Japan International Cooperation Agency (JICA) has been implementing the technical cooperation of the development plan study called “Study for Introduction of Energy Management System in Energy Consumption Sectors in the Republic of Serbia” (hereinafter, the Study) from June 2009 to June 2011. Through the Study, it was found that the energy consumption in the industrial sector became 25% of its final energy consumption, and the specific energy consumption of the industrial sector was quadruple compared to Japan. Therefore, it is clearly seen that the potential of the EE of the industrial sector is large.

Based on the outcome of the Study, the institutional design of the Energy Management System (EMS) and its construction support, the National Assembly of the Republic of Serbia has adopted the , “Law on Efficient Use of Energy” (hereinafter the Law) in March 2013. It has been an urgent necessity to have the development of the framework of the energy management and audit system, and the human resource development. The Government of Serbia has requested the assistance through “The Project for Assistance of Enhancement of Energy Management System in Energy Consumption Sectors” (hereinafter, the Project) in September 2010, and the request has been adopted on August 2011.

Since adoption of the Law, the Ministry of Energy, Development and Environmental Protection (MEDEP) has been gearing up at a rapid pace to introduce and implement the EMS, and the necessity of implementation of early procurement of training facility and more determined for the system implementation has been confirmed.

1.2 Objective and Target Area

1.2.1 Objective

The Project aims to introduction and implementation of the EMS, supports human resource development and the building of institutions. The implementation structure of the Japanese side, in addition to the Project Team (hereinafter, PT) is supported by JICA who procures practical training

facilities. The Project Team also implements the assistance of this procurement.

1.2.2 Target Area

The whole country is targeted.

1.2.3 Counterpart

The counterpart is Ministry of Mining and Energy (MOME). The name of the Ministry has been changed from the MEDEP to MOME since April 2014 due to the Government reorganization.

1.2.4 Project Overview

(1) Overall Goal

Under the EMS, Designated Organization (hereinafter, DO) promotes the EE.

(2) Project Purpose

The EMS is introduced and implemented.

(3) Expected Output

Output 1: Scheme design of energy management and audit system is established.

Output 2: Classroom training program of Energy Managers (hereinafter, EM) and Auditors (hereinafter, EA) is established.

Output 3: Practical training program of EMs and EAs are established.

Output 4: Qualification and examination systems of EMs and EAs are institutionalized.

Output 5: Capacity of MOME to implement energy management and audit system is strengthened.

(4) Overview of Activities

Based on the Record of Discussion (R/D) agreed with MOME (MEDEP at the time) in December 2013, PT had to implement the following activities.

1. Discussion and Finalization of the Work Plan
2. Scheme design of the Energy Management and Audit System (Output 1)
   (a) To conduct survey on energy consumption in order to identify DOs
   (b) To prepare guidebooks for DOs
   (c) To program the database for EMS
3. Classroom Training Program of EMs and EAs (Output 2)
   (a) To prepare the curriculum of classroom training for EAs
   (b) To prepare the textbooks and subtexts of classroom training for EAs
   (c) To instruct trainers how to perform the training program for EMs
   (d) To implement training for trainers for EAs
   (e) To implement the classroom training for EMs
   (f) To implement the classroom training for EAs
4. Practical Training Program of EMs and EAs (Output 3)
   (a) To design details of training facilities
   (b) To prepare the training site
   (c) To procure training facilities
      ・To support the procurement of practical training facilities "Boiler and Steam Trap", "Pump" and "Compressor"
      ・To procure the measurement equipment
   (d) To prepare the curriculum of practical training
   (e) To prepare the textbooks and subtexts of practical training
   (f) To implement a training for trainers for training facilities
   (g) To implement the practical training for EMs and EAs
5. Qualification and Examination System of EMs and EAs (Output 4)
   (a) To prepare examination of EAs
6. Capacity of MOME to Implement Energy Management and Audit System (Output 5)
   (a) To plan dissemination and awareness seminars for DOs and EMs
   (b) To implement dissemination and awareness seminars for DOs and EMs
   (c) To conduct monitoring DOs
   (d) To conduct performance check of EAs
   (e) To review implementation of EMS and training program
   (f) To make necessary revisions on EMS
   (g) To prepare SEEC Business Plan and SEEC Annual Action Plan

1.3 Implementation Formation

1.3.1 Implementation Formation

This Project was implemented by three teams of PT; 1) Designing details of the EMS, 2) Procurement of the training facilities, 3) Settling of the training programs. 4) Supporting of implementation of training, and 5) Settlement and implementation of classroom training for EMs and EAs.

The Working Group on the Serbian side of the Project consisted of MOME (Assistant Minister, Chief of Department for Energy Efficiency, Energy Management Group Manager), staff of the related

departments.

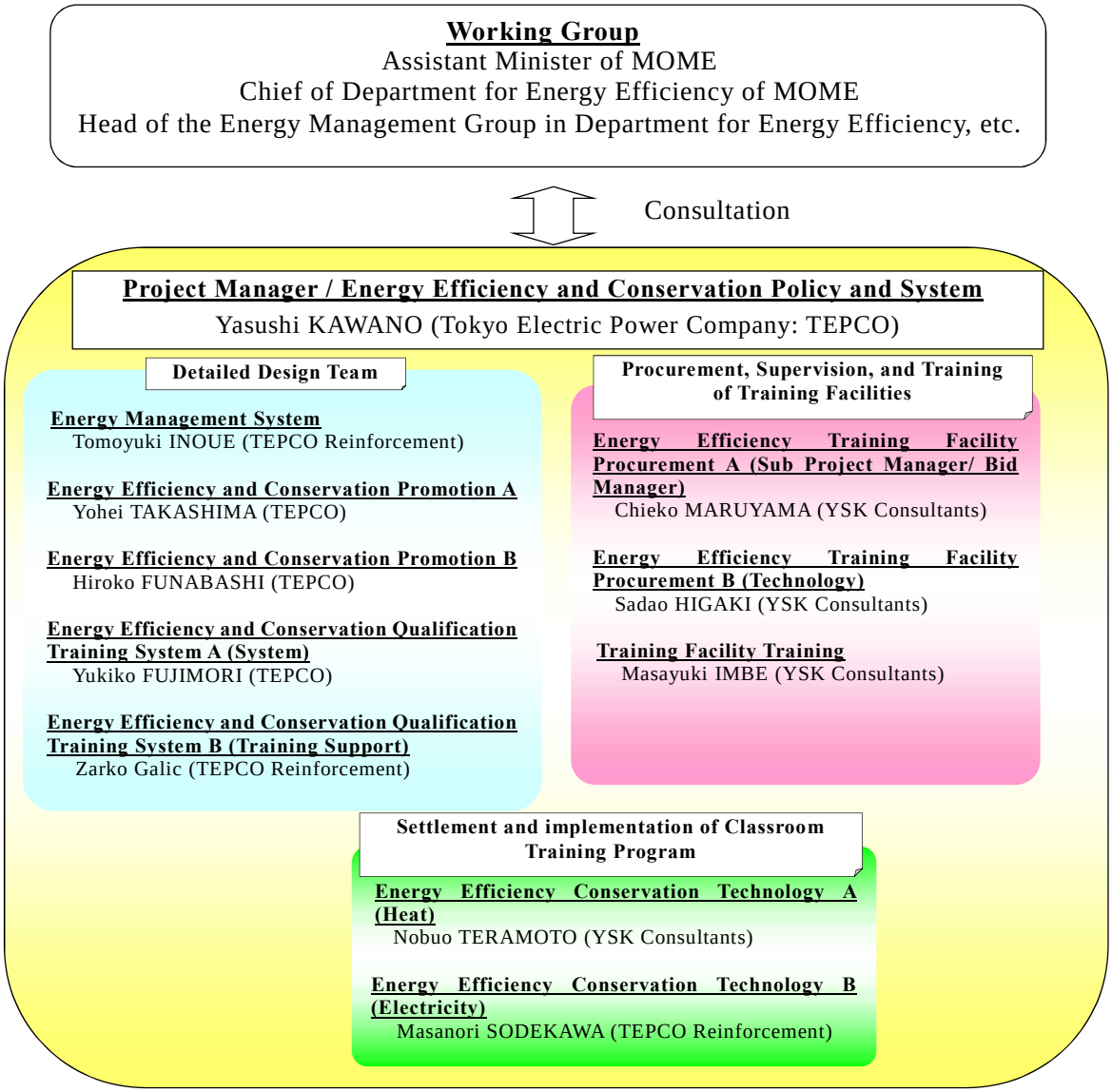


Figure 1- 1 Implementation Formation

1.3.2 Positioning and Setting up of the Joint Coordinating Committee (JCC)

The JCC was set up based on the R/D in order to discuss the project plan and progress. Positioning and composition of JCC, and the holding meeting times are mentioned below.

(1) Positioning of JCC

The JCC position was to discuss the important topics that affect the direction of the Project within Authority Members of the related organizations, the Working group, and the PT.

In accordance with the progress of the Project, the following topics were discussed.

- Confirmation of schedule for implementation of the EMS

- Confirmation of the project activities following above mentioned schedule
- Final confirmation of schedule before the introduction of EMS
- Confirmation of the reviews of activities and improvements after introducing the EMS, etc.

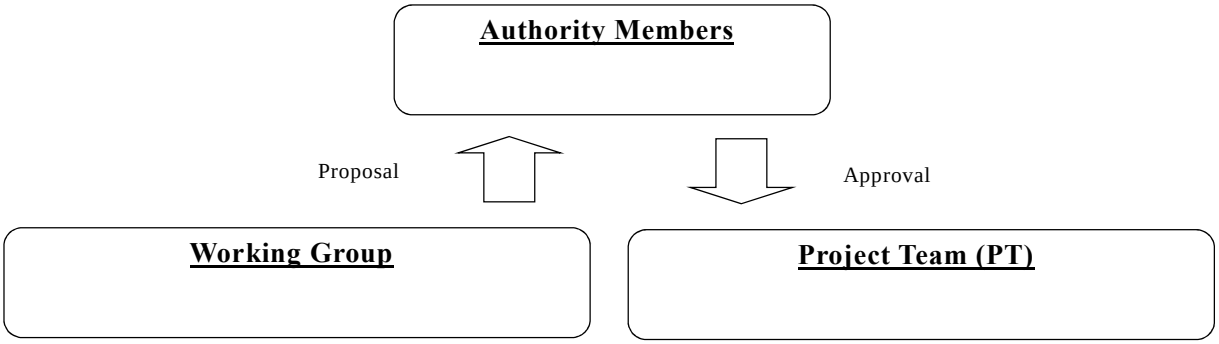


Figure 1- 2 Operation Structure of the JCC Meeting

(2) JCC Members

The JCC consisted of the following members.

(Authority Members)

- MOME (State Secretary of MOME)
- Training Organization: TO
- JICA Balkan Office

(Proposer)

- MOME Working Group
- JICA Project Team: PT

(Observer)

- Embassy of Japan in Serbia
- Government of Serbian European Integration Office (SEIO), since June 2017 Ministry for European Integrations (MEI)
- Mechanical Faculty of Belgrade University (MFBU)

(3) JCC Schedule

The meetings of JCC were held as follows.

- May 2015: To authorize the revised schedule of the Project, etc.
- March 2016: To propose acceleration plan of the Project, etc.
- October 2016: To evaluate the achievement of the Project and make change of schedule, etc.
- June 2017: To examine the schedule of the project and report on the activities conducted in the previous year, etc.
- December 2017: To confirm the achievements of the Project and assure the sustainable operation of the EMS in the future, etc.

1.4 Basic Policy for Implementation of the Project

MOME needs to develop the secondary legislation to regulate the detailed EMS and the implementation method. The secondary legislation is divided into three components: Decree, Rulebooks, and Decision.

Table 1- 1 Contents of the Secondary Legislation

No	Title	Legislation Number
1	**Qualification of the training organization for implementation of trainer for Energy Manager (EM) and Energy Auditor (EA)** Rulebook on conditions in terms for identification and selection of personnel, equipment and facilities of the Organization implementing for theoretical and practical training for EM and EA	Rulebook 9.3
2	**Programs and fees of the training for EM** Rulebook on the contents of the training program for EM, fees and means of payment the training	Rulebook 9.1
3	**Conditions for attending and taking the training and exam for EM** Rulebook on rules, conditions and program for taking the examination for EM	Rulebook 10.1
4	**Selection of Designated Organization (DO) and the goal of the energy saving** Decree on defining planned energy savings on annual level, and threshold for DOs and application form for energy consumption	Decree 2
5	**Detailed conditions for assignment of the selection of the EMs (Municipality)** Rulebook on detailed conditions for assignment of Municipality EM	Rulebook 3.1
6	**Detailed conditions for assignment of the selection of the EMs (Factory/Public Company)** Rulebook on detailed conditions for assignment of Factory/Public Company EM	Rulebook 3.2
7	**Detailed conditions of the selection assignment of the EMs (Building)** Rulebook on detailed conditions for assignment of Building EM	Rulebook 3.3
8	**Format of the Periodical Report** Rulebook on the format of Periodical Report	Rulebook 4
9	**Method of the Energy Audit** Rulebook on methodology for energy audit	Rulebook 7
10	**Contents of the Energy Audit Report** Rulebook on the contents of report on performed energy audit for DO	Rulebook 6
11	**Form for submitting the Energy Audit results to MOME** Rulebook on the of data, deadline, means and form for submission the data of performed energy audit to MOME	Rulebook 5
12	**Programs and fees of the training for EA** Rulebook on the contents of the training program for EA, and fees of the training and means of payment	Rulebook 9.2
13	**Conditions for attending and taking the training and exam for EA** Rulebook on rules, conditions and program for taking the examination for EA	Rulebook 10.2
14	**Selection of the specific Training Organization (TO)** Decision of the organization authorized for conducting training and examination for EM and EA	Decision 8

1.5 Introduction of Training Facilities

1.5.1 Introduction of Training Facilities

(1) Overview of the Facilities

MOME has agreed with JICA to introduce below components for the training facilities, and these were introduced during the Project period.

Table 1- 2 Components of the Training Facilities

No.	Unit Name	Major Equipment	Major Training Items
1	Boiler Unit	• Boiler - Evaporation : 250 kg/h - Steam Press : 0.8 MPaG • Water Softener • Boiler Water Feed System	• Boiler system and operation • Energy saving effect by adequate excess air ratio operation • Energy saving effect of economizer • Energy saving effect by insulation on non-insulated valve • Usage of instruments for energy audit
2	Steam Trap Unit	• Five kinds of steam traps	• Structure of various kinds of steam traps and selection • Inspection method of the steam traps • The energy saving effect of the steam valve warmth • Usage of instruments for energy audit
3	Air Compressor Unit	• Inverter and Load / Unload Air Compressor（Total 2） - Screw Type - Motor : 11 kW - Air Press: 0.8 MPaG • Air Dryer • Air Holder	• Air compressor system and operation • Effective operation way of air compressor • Energy saving effect of inverter air compressor • Leaking air volume from small openings • Pressure drop calculation of compressed air pipe lines • Energy saving effect of high efficient air blow nozzles • Usage of instruments for energy audit
4	Pump Unit	• Water Pump - Type: Centrifugal - Motor: Inverter - Flow Rate : 18 m3/h - Head : 30 m • Water Circulation Tank	• Characteristics of centrifugal pump • Energy saving effect of inverter pump • Pressure drop calculation of water pipe lines • Usage of instruments for energy audit

(2) Policy for Introducing the Training Facilities

JICA Balkan Office implemented the procurement of above facilities using the local contractor. PT supported the procurement of the technical documentations, technical evaluation, and construction supervision on behalf of JICA Balkan Office.

(3) Purchase of the Measurement Equipment

There are two types of measurement equipment introduced by this project, 1) Being used together with training facilities during the practical training of EMs and EAs 2) Being lent to EAs for energy audit purpose. Both were purchased by PT in Japan and brought into TO.

Table 1- 3 List of the Auditing Equipment (including the equipment for use of training facilities)

No.	Name of the Equipment	Amount	Purpose	
			Training	Energy Audit
Tools				
1	Portable Data Logger	5	4	1
2	Current Sensor	30	2	28
3	Pressure Sensor (and Power Unit)	4 (2)	2 (1)	2 (1)
4	k-Thermo Couple	5	2	3
5	Thermo Camera	2	1	1
6	Infrared Thermometer	2	1	1
7	Clamp Tester	2	1	1
8	Portable Power Meter	3	3	-
9	Portable Ultrasonic Leak Detector	2	1	1
10	Portable Ultrasonic Flow Meter	1	1	-
11	Portable Exhaust Gas Analyzer	2	1	1
12	Steam Trap Checker	2	1	1
13	Multi-Function Thermometer / Hygrometer / Lux Meter / Wind Velocity Meter	1	-	1
14	Multi-Function CO2 / Temp. / Humidity Logger	2	1	1
Accessories				
1	Tools and Aluminum Cases	2 sets	1 sets	1 sets
2	Fittings	2 sets	1 sets	1 sets
3	Consumables	2 sets	1 sets	1 sets

1.6 Task Allocation of the Project

Task allocation for the PT is shown below;

Table 1- 4 Task Allocation for PT

Items of Work Instructions	Input of Japanese Side	Tasks for PT
1. Discussion and Finalization of the Work Plan	—	Discuss the schedule, work flow, items of work at the beginning of the Project.
2. Scheme design of the Energy Management and Audit System (Output 1)		
(a) To review the decrees, decision, regulations, etc.	Support	PT gives advices on secondary legislations.
(b) To conduct survey on energy consumption in order to identify DOs	Support	The survey is mainly done by MOME, PT supports for planning, proposing of questionnaire, and analysis of survey results, and also confirming the necessity of changes of the system and the administration organization after the when fixing the number of DOs.
(c) To prepare guidebooks for DOs	Support	Guidebook has already been proposed. PT is requested to advice the correction that MOME makes.
(d) To program the database for EMS	Support	MOME implements the public procurement procedure - documentation of the bid for database, assists programming of the Database procurement, installation, and inspections, and PT is requested to support the technical specification of the bid documents.
3. Classroom Training Program of EMs and EAs (Output 2)		
(a) To prepare the textbook and subtext of classroom training for EMs	Support	PT assists for creation of training materials for EM.
(b) To prepare the curriculum of classroom training for EAs	Main	Since EA does not exist in Serbia, mainly PT examines the curriculum and proposes to MOME.
(c) To prepare the textbook and subtext of classroom training for EAs	Main	After having been agreed by MOME about the curriculum, mainly PT prepares the specific textbook and subtext.
(d) To instruct trainers how to perform the training program for EMs	Main	The possibility that the professors at the University become the trainers for EM training is high. Therefore PT only needs to introduce Japanese way of guiding and knowledge, not the technical support.
(e) To implement training for trainers for EAs	Main	PT implements the training for EA trainers, the method and standard of EE auditing (questionnaire, check points, reporting etc.). Expecting to plan for cooperate audit at the model site.
(f) To implement the classroom training for EMs	Support	Basically PT advises the comments and notices factors at the implemented training mainly done by TO.
(g) To implement the classroom training for EAs	Support	Basically PT advises the comments and notices factors at the implemented training mainly done by TO.
4. Practical Training Program of EMs and EAs (Output 3)		
(a) To design details of training facilities	Main	PT implements the 4 detailed designing of the practical training facilities.
(b) To prepare the training site	Support	Ancillary preparation construction is mainly done by Mechanical Faculty of the Beograd University (MFBU), PT only advices the necessary points.
(c) To procure training facilities ・ To support the procurement of practical training facilities “Boiler and Steam Trap”, “Pump” and “Compressor”	Main	Practical training facilities are mainly procured by JICA Balkan office. Therefore PT supports the preparation of the bid documents, bid, and technical evaluations. In addition, measurement equipment should be

・ To procure the measurement equipment		procured by PT, predetermined devices should be estimated by at least 3 companies, and procured and brought into Serbia.
(d) To prepare the curriculum of practical training	Main	Mainly PT creates the curriculum.
(e) To prepare the textbooks and subtexts of practical training	Main	Mainly PT creates the curriculum.
(f) To implement a training for trainers for practical training facilities	Main	Trainings are implemented by TO, but the training for trainers is done by PT.
(g) To implement the practical training for EMs and EAs	Support	Basically PT advises the comments and notices factors at the implemented training mainly done by TO.
5. Qualification and Examination System of EMs and EAs (Output 4)		
(a) To prepare examination of EAs	Support	EA exam is planned to be evaluated by practical result. Evaluation methods need to be discussed with MOME.
6. Capacity of MOME to Implement Energy Management and Audit System (Output 5)		
(a) To plan dissemination and awareness seminars for DOs and EMs	Support	Before starting to introduce the system, MOME makes a plan to have seminar for promoting the EMS (Introduction and Practical). PT supports the planning of this seminar, and will be held across the country by MOME.
(b) To implement dissemination and awareness seminars for DOs and EMs	Support	PT supports the planning of this seminar, and will be held across the country by MOME
(c) To conduct monitoring DOs	Support	Periodical report from the DOs should be submitted from the first year of EMS start. Submission situation and check for description should be done by MOME. PT supports this when MOME requests to do so.
(d) To conduct performance check of EAs	Main	After the introduction of the EMS, the data (summary report) on energy audit done by EA should be reported to MOME. PT checks the contents and quality of the data.
(e) To review implementation of EMS and training program	Support	PT supports MOME to discuss with DOs for administration of the system, and planning and administration of the training.
(f) To make necessary revisions on EMS	Support	If necessary, PT supports MOME to discuss with DOs for administration of the system, and planning and administration of the training.
(g) To prepare SEEC Business Plan and SEEC Annual Action Plan	Support	For sustainable operation of TO and training facilities, TO conducts official training as well as voluntary business.

Chapter 2 Detailed Activity Contents

2.1 Discussion and the Development of the Work Plan

2.1.1 Work Flow

MOME implemented the work of Project separating into three blocks as below.

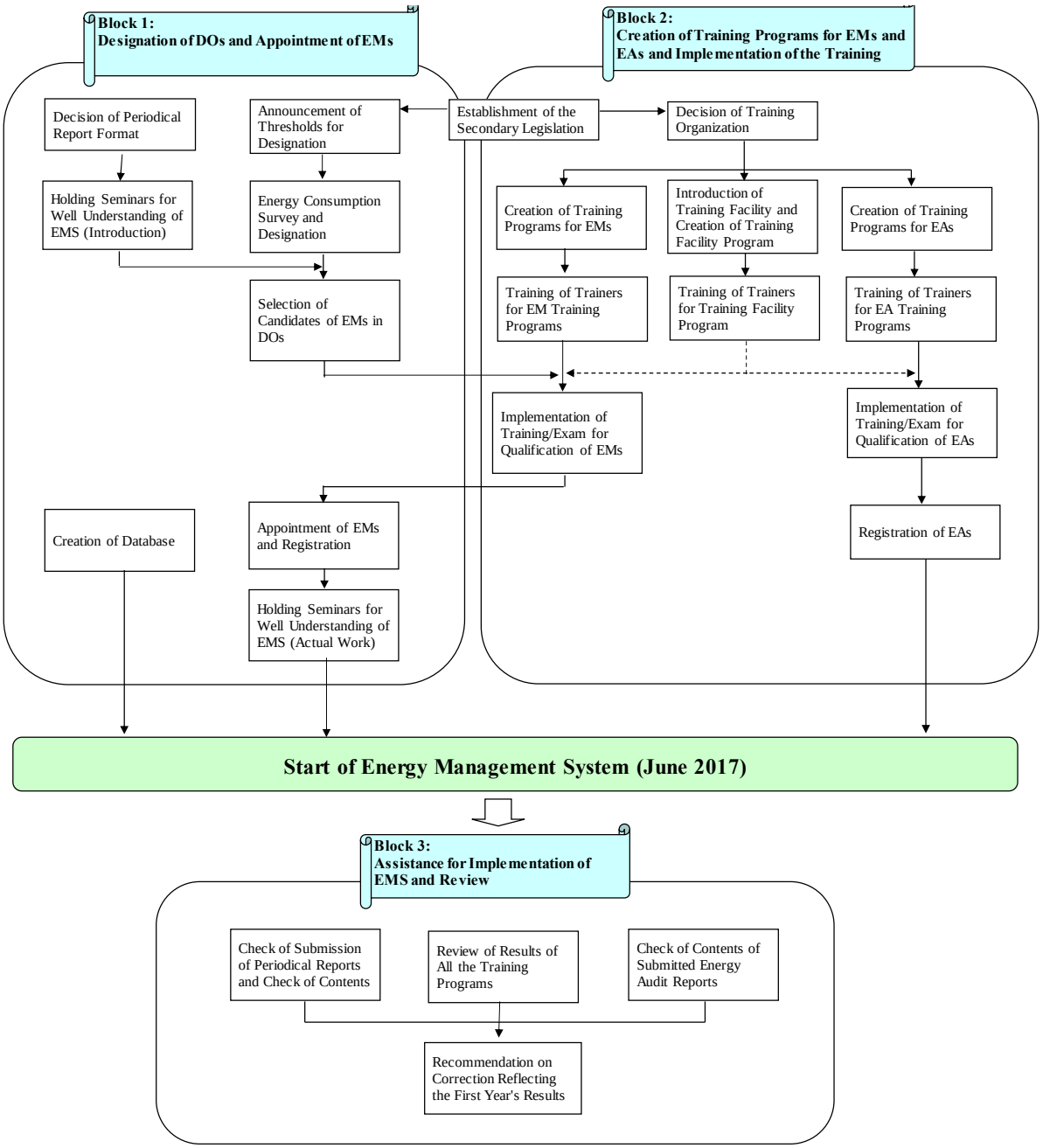


Figure 2- 1 Work Flow

2.1.2 Current Situation of the Development for Secondary Legislation

(1) Authorized Secondary Legislation

It was assumed at the preparation stage of the Project that the secondary legislation relating to it would be completed by the beginning of the Project. However, due to the effects of restructuring of the Government, establishment of the secondary legislation was delayed and it was conducted during the Project period. At the preparation stage, the EMS was planned to start from early 2015. Due to the delay of secondary legislation adoption and textbook creation, the EMS start was shifted to early 2017 in accordance with the approval of the 2nd JCC meeting held on March 16, 2016.

At the 3rd JCC meeting (October 14, 2016), it was confirmed that EMS for Municipality and Factory would be started in 2017 and EMS for building (including Ministry's facilities) would be started in 2018. By December 2017, 9 rulebooks have been issued, that means all planned rulebooks except for 5 regarding EA, after received approval from the Legal Secretariat of Serbia. PT proposed the original design of the rulebooks and made comments on the text of the rulebooks created by MOME. After finalizing the rulebooks, MOME officially made them publish in the government's Official gazette.

Table 2- 1 Issue of the Secondary Legislation

No	Title	Issued	Legislation Number
1	Qualification of the training organization for implementation of trainer for Energy Manager (EM) and Energy Auditor (EA)	January 2015	Rulebook 9.3
2	Programs and fees of the training for EM	January 2015	Rulebook 9.1
3	Conditions for attending and taking the training and exam for EM	January 2015	Rulebook 10.1
4	Selection of Designated Organization (DO) and the goal of the energy saving	February 2016	Decree 2
5	Detailed conditions for assignment of the selection of the EMs (Municipality)	March 2016	Rulebook 3.1
6	Detailed conditions for assignment of the selection of the EMs (Factory/Public Company)	December 2016	Rulebook 3.2
7	Detailed conditions of the selection assignment of the EMs (Building)	September 2017	Rulebook 3.3
8	Format of the Periodical Report	March 2016	Rulebook 4
9	Method of the Energy Audit	March 2018 (planned)	Rulebook 7
10	Contents of the Energy Audit Report	March 2018 (planned)	Rulebook 6
11	Form for submitting the Energy Audit results to MOME	March 2018 (planned)	Rulebook 5
12	Programs and fees of the training for EA	March 2018 (planned)	Rulebook 9.2
13	Conditions for attending and taking the training and exam for EA	March 2018 (planned)	Rulebook 10.2
14	Selection of the specific Training Organization (TO)	November 2015	Decision 8

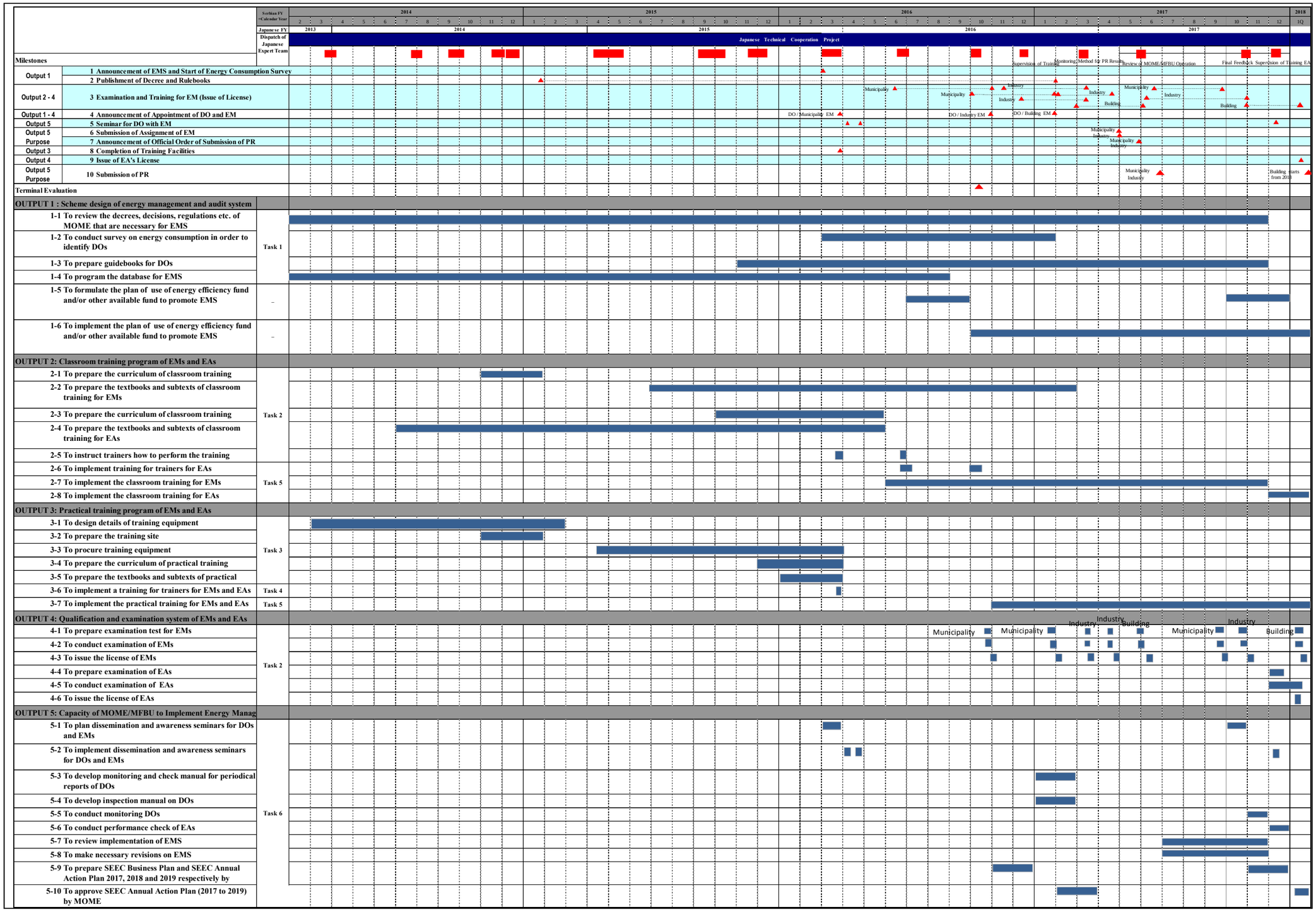
(2) Public Call for Training Organization (TO)

Based on Rulebook 9.3, the legal basis for establishment of TO was set up. PT proposed the original design of the public call (PC) for selection of TO and made comments on the text of the document created by MOME.

2.1.3 Revision of Overall Schedule

Due to the delay in establishment of the secondary legislation, etc., the Project overall schedule had to be revised. The final revised schedule is shown in the next page.

Table 2- 2 Final Schedule (Actual)



2.2 Scheme Design of the Energy Management and Audit System (Output 1)

2.2.1 Scheme of Energy Management System

(1) Overview of the Scheme

The scheme of EMS is explained as follows.

- MOME: The Implementation Agency for creation of laws, regulations and policy; creation of textbooks and examinations; performance check of DO's activities; issue of licenses; inspections, etc.
- Designated Organization (DO): An owner or operator of site facilities or buildings designated by the criteria in Decree, which must have an EM on site, implement measures of energy efficiency and submit a PR created by the EM, as an actor in energy efficiency.
- Training Organization (TO): The Organization authorized by the Ministry to conduct training for Energy Managers and Energy Auditors.
- Energy Auditor (EA): A consultant who implement Energy Audit, drafts an Energy Audit Report (EAR) and submits the report to DO or other natural or legal person who orders Energy Audit, as well as a summary report (prescribed data) to the Ministry. They also act as an adviser on appropriate energy efficiency measures and as an evaluator of the performance of energy efficiency activities.

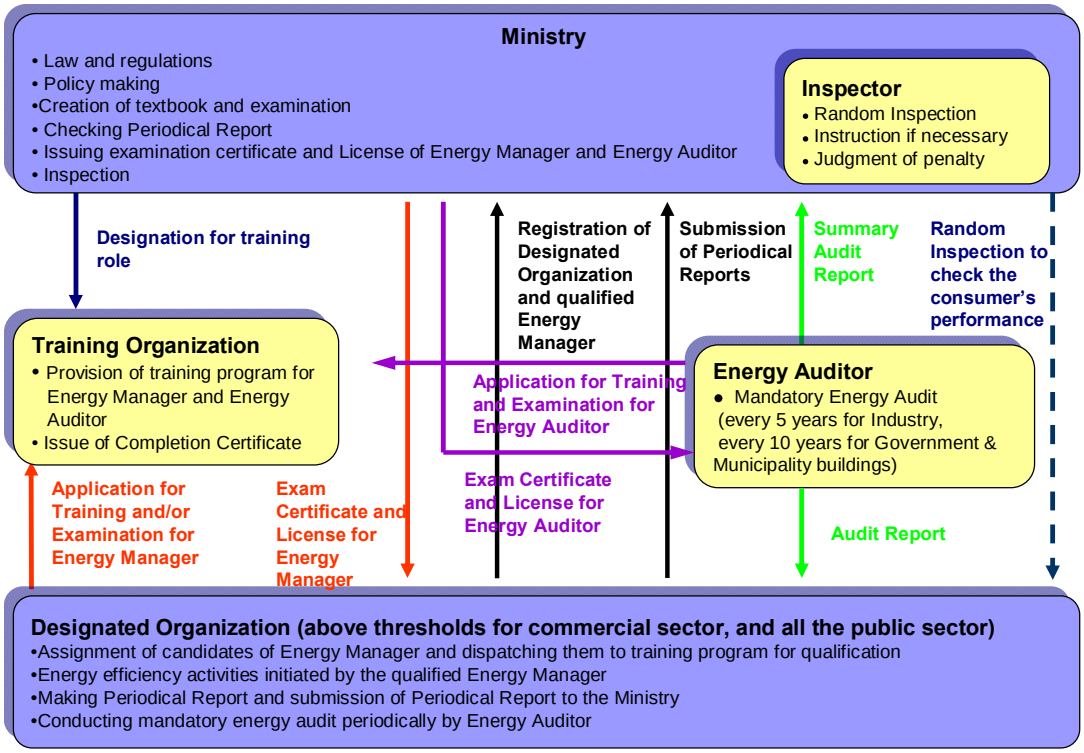


Figure 2- 2 Schematic Flow of the EMS

(2) Designated Organization (DO)

DO was defined in Decree 2, issued in March 2016. DO is grouped into 4 categories. Category A-1 is for commercial or public companies (manufacturer and mining sector, transformation sector-power, heat supply, oil refinery) which have at least one designated site above a certain amount of energy consumption per year (threshold). Category A-2 is for commercial companies (trade or services) and public institutions (public schools, hospitals, buildings in sport, culture sector etc.) which have at least one designated site above a certain amount of energy consumption per year.

Category B-1 is for municipalities (more than 20,000 inhabitants) and Category B-2 is for each ministry (including state administration bodies, other public service bodies and autonomous province's bodies) which have more than 2,000 m2 of total floor area.

Table 2- 3 Category of Designated Organization

Category	Target Sector	Threshold
A-1: Factory Factory EM PR Type 1	Manufacturer and mining sector	2,500 toe **for site**
	Transformation sector (power, heat supply, oil refinery)	
A-2: Building Building EM PR Type 1	Commercial building sector	1,000 toe **for site**
B-1: MNP MNP EM PR Type 2	All the buildings and facilities for which the Municipality covers maintenance and energy costs	Municipalities more than 20,000 habitants
B-2: Ministry Building EM PR Type 2	All the buildings and the facilities (more than 2,000m2) for which the Ministry covers maintenance and energy costs	Ministry Sector is - State Administration Bodies - Other Public Service Bodies - Autonomous Province's Bodies

(3) Energy Manager (EM)

Rulebook 9.1 and Rulebook 10.1, issued in January 2015, stipulated the three types of EM licenses. These licenses are obtained via different training and qualifications.

- Factory EM (Category A-1)
- Building EM (Category A-2 and B-2 are included)
- Municipality EM (Category B-1)

A Factory owner DO assigns a Factory EM, a building owner or ministry organization assigns a Building EM and a Municipality DO assigns a Municipality EM.

(4) Assignment of EM

Assignment of EM is stipulated in Rulebook 3.1 – 3.3. An EM in Category A is required to be assigned to each site when the sites are beyond the threshold. An EM in Category B is required to be assigned to the headquarters of municipalities and ministries. An EM in Category B can be

outsourced.

Table 2- 4 Assignment of Energy Manager

	Public Sector				Industry and Building			
	Municipality (B-1)	Public Institution (A-2)	Ministry (State AD Body, Public Service or APB) (B-2)	Public Company (A-1)	Factory more than 2,500 toe (A-1)		Building more than 1,000 toe (A-2)	
					HQ	Site	HQ	Site
Energy Manager								
Outsourced Energy Manager	or	or	or	or				

Type of Energy Manager (EM)

Factory EM Building EM Municipality EM

(5) Creation of Periodical Report (PR)

PR is stipulated in Rulebook 4, issued in March 2016. Submission flows are different in Category A and Category B. A PR for Category A is submitted, compiling reports for all sites beyond the threshold with a cover letter from headquarters, to MOME.

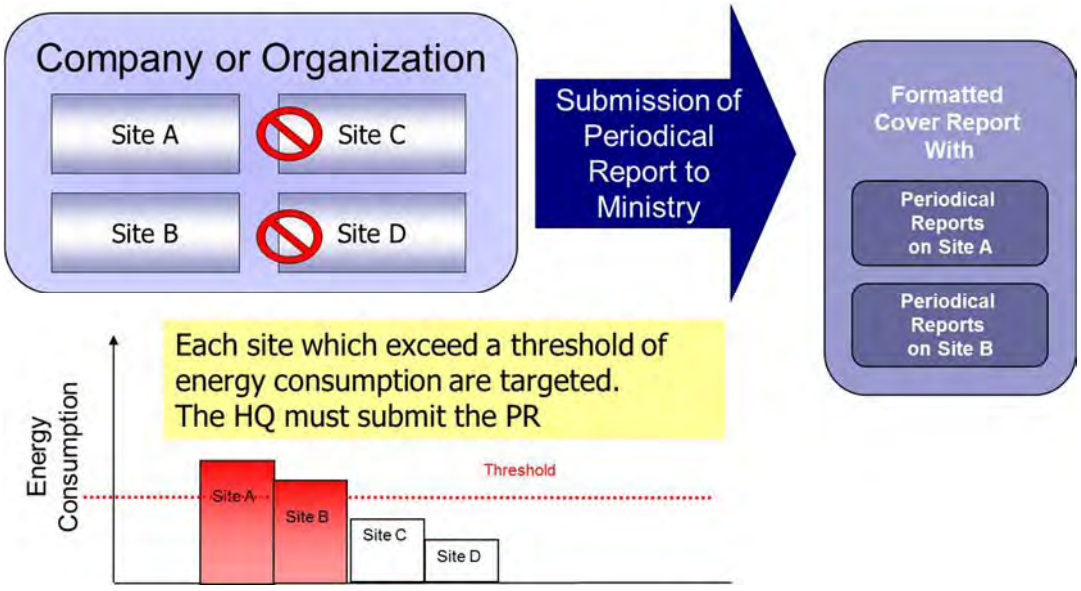


Figure 2- 3 Submission of PR of Category A

A PR for Category B is submitted, compiling the targeted facilities' reports, with a cover letter from headquarters, to MOME.

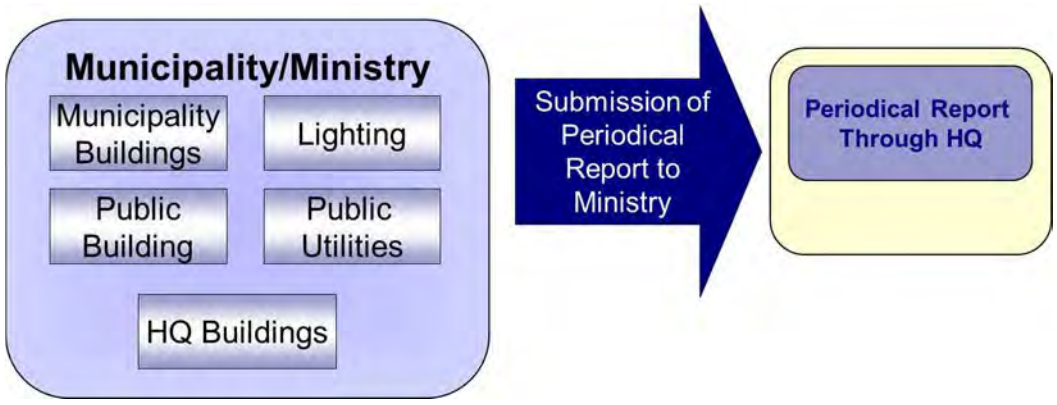


Figure 2- 4 Submission of PR of Category B

(6) Training Organization (TO)

The TO's tasks are defined by the documents from the Public Call undertaken by MOME. Expected tasks are shown below. The Mechanical Faculty of Belgrade University (MFBU) has been the officially appointed TO since November 2015.

a) Undertaking Training Programs for EM and EA
- Announcement and receipt of application
- Checking the conditions for applicants and sending invitation letters
- Proposal and explanation of price of training fees to MOME
- Collection of training fees from applicants

b) Training
- Conducting training with necessary stationary and equipment
- Providing training using training facilities and equipment
- Mentoring for trainees as a part of training
- Issue of completion certificate for training of EM and EA
- Preparation of questions of examination

Figure 2- 5 Tasks of TO

(7) Energy Auditor (EA)

As of December 2017, draft rulebooks regarding EA have been created. An EA license is obtained by an EM license holder through EA training and examination. There is only one type of EA license and any EM license holder can take the same training and examination for EA.

A DO in Category A must conduct an energy audit once every 5 years and a DO in Category B must do so once every 10 years. The Energy Audit Report (EAR) is submitted to the DO, and prescribed data (summary report) to MOME. The audit is made via a contract between DO and EA.

The energy audit is basically conducted by a team consisting of two energy auditors, over one month. The work includes sending a questionnaire, performing a site survey and end with the creation of a report.

2.2.2 Qualification of Energy Manager's License

As described in Rulebook 9.1 and 10.1, an EM license is obtained when he/she passes an examination undertaken by TO, which is commissioned by MOME, and submits the necessary evidence to MOME.

There are 3 steps in the procedure for obtaining an EM license, namely taking the training program, taking the examination program and applying for the license with the necessary evidences. MSc degree holders in mechanical engineering, electrical engineering or technology can skip the 1st step (training program). BSc holders must take the training program for his/her 1st trial and BSc holders who already have the completion certificate for the training program can skip the 1st step.

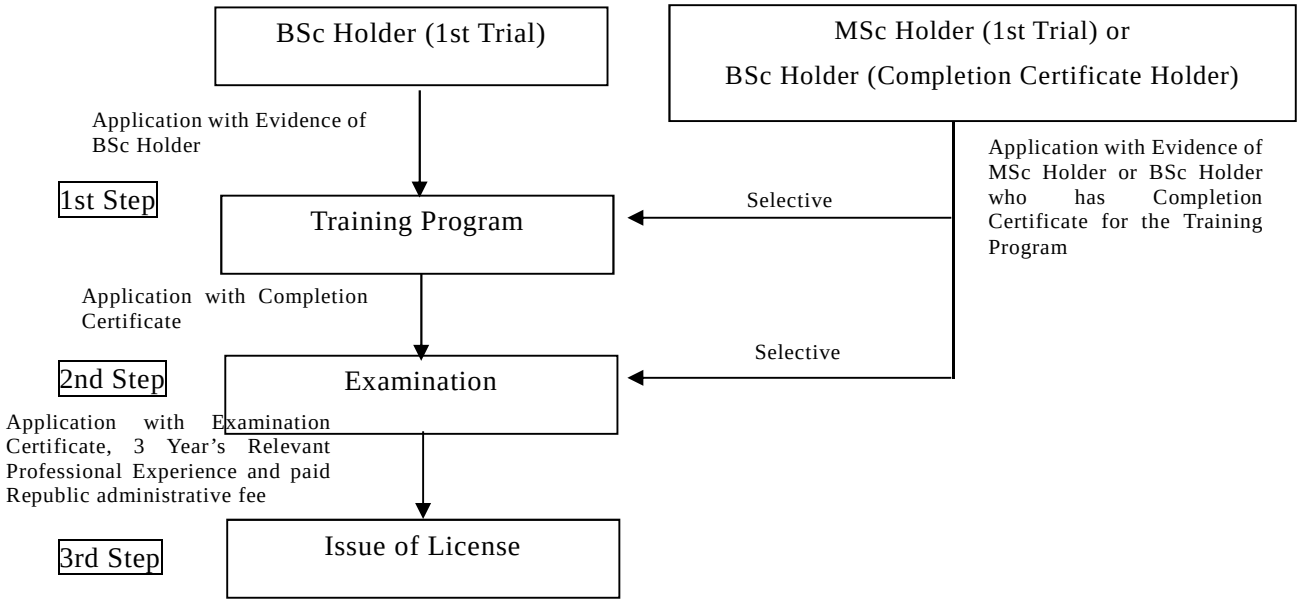


Figure 2- 6 License Acquisition Flowchart of Energy Manager

The 1st step (training program) is conducted by TO, who issue the completion certificate to successful applicants. An applicant applies for the training program with evidence that they are holders of a BSc or MSc.

The 2nd step (examination) is made by application to TO, and the Ministry in cooperation with TO then conducts the examination and issues the examination certificate to successful applicants. An applicant, who has an MSc in mechanical engineering, electrical engineering or technology, or BSc with the completion certificate for the training program, can directly select the examination.

The 3rd step (issue of license) is managed by the Ministry. An applicant, who has the examination certificate, prepares an application form for the license, evidence of 3 year's relevant professional experience, evidence of paid Republic administrative fee and submits it to the Ministry.

2.2.3 Qualification of Energy Auditor's License

There are 3 steps in the procedure to obtain an EA license, namely taking the training program, taking the examination program and applying for license with necessary evidence like acquisition of EM's license.

The pre-conditions for application for the training and examination for EA are limited to only:

- Any type of EM license holder
- MSc holders, and
- 3 year's relevant professional experience in energy auditing

A holder of training completion certificate does not require to take the training again for the second trial.

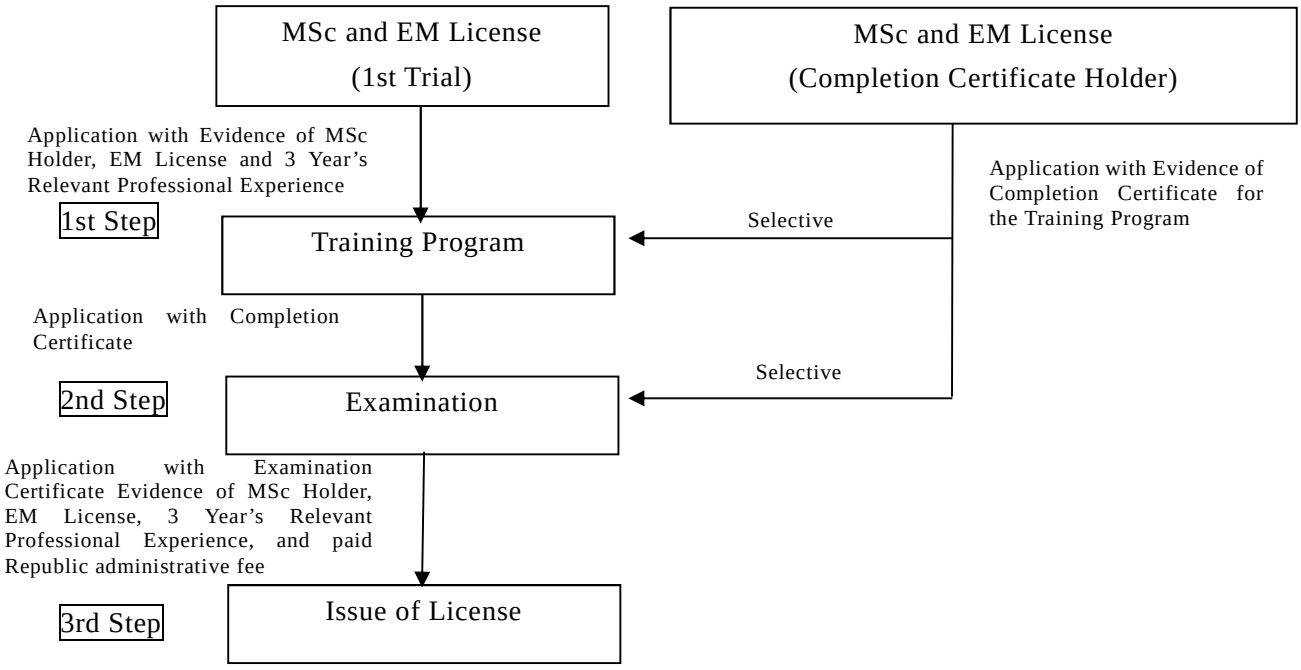


Figure 2- 7 License Acquisition Flowchart of Energy Auditor

The 1st step (training program) is conducted by TO, who issues the completion certificate to successful applicants. An applicant applies for the training program with evidence of MSc, EM license and 3 year's relevant professional experience in energy auditing.

The 2nd step (examination) is conducted by TO and the Ministry issues the examination certificate to successful applicants. An applicant, who has the completion certificate for the training program can take the examination.

The 3rd step (issue of license) is managed by the Ministry. An applicant who has the examination certificate, prepares an application form for the license and evidence of MSc, EM license, 3 year's relevant professional experience and paid Republic administrative fee, and submits it to the Ministry. The license is issued by the Ministry after they run a check.

2.2.4 Assistance for Conducting Survey on Energy Consumption to Identify DO

(1) Preparation of the Survey

PT proposed the format for the energy consumption survey. A survey format is utilized to identify DO and the calculation sheet for PR submitted by DOs.

(2) Assistance for the Survey through Seminar

Decree 2, which is the legal basis for the survey, was issued in March 2016. Two seminars were held in Belgrade to disseminate the beginning of implementation of the EMS and explain how to fill in the calculation sheet for the survey, in April 2016.

Seminar for Municipality
(April 11, 2016)

Seminar for Industry and Building
(April 26, 2016)

Figure 2- 8 Seminars in Belgrade

2.2.5 Assistance for Creation of Guidebook

MOME, together with PT, created the Guidebook for dissemination of the EMS scheme. The Guidebook, which consists of an introduction to the scheme, samples of energy saving methods, etc., was distributed to training applicants, seminar participants, etc. (over 130 books) through training and seminars.

It is recommended that additional copies of the Guidebook are printed if necessary for further opportunities.

Figure 2- 9 Guidebook

2.2.6 Assistance for Creation of the Database for EMS

(1) Assistance for Creation of Technical Specification of Database

MOME undertakes to establish a database via which it can access basic information about DOs, PRs and audit reports, and analyze the energy consumption and energy saving data of DOs. The main budget for procurement has been injected by a Norwegian fund. MOME has asked JICA to assist in supervising the procurement for the Project.

PT proposed the technical specifications, as shown in Appendix 1, for the database to be procured by MOME.

(2) Process of Database Development

The public procurement for the database development was held in June 2015. As a result, the IT company “Quiddita” was selected. Since then, EMS-DB development has been rapidly promoted by cooperative work involving MOME and Quiddita. The following table shows the progress of the database development.

Table 2- 5 Schedule of Database Development

Term	Contents
2015/8 - 2016/3	By the cooperation works of MOME and Quiddita, The formats of annual report, EA report and Code table were reviewed and revised, and the more detail TOR is established in this period.
2016/3 - 2016/7	Database is developed in line with TOR by MOME and IT expert. During the term, the database system is transferred to MOME computer.
2016/7 - 2016/8	MOME has to test the DB functions, and the results have to be informed to IT expert. IT expert will revise the system.
2016/8	IT expert has to make the training to MOME staffs to be able to maintain the DB.
2016/9 - 2017/8	In the warranty term with one year, IT expert has to make technical transfer in order that MOME staffs can implement the system maintenance by themselves.

(3) Source Reports to the Database

The source reports and information for the DB are shown in the following table.

Table 2- 6 Source Reports to the Database

NO	Reports	Targeted Entities	Operation by
1	Annual report	Manufacturing & Commercial sector Governmental Buildings	Energy Manager
2	EA report	Report audited by EA	Energy Auditor
3	TO report	Trainee career trained by TO	TO
4	Analytical documents	Analytical reports of annual reports and EA reports	MOME

(4) Maintenance of the Database

Data input and maintenance are implemented by MOME staff, DO managers, Energy Auditors and TO staff related to EMS. All kinds of data are processed in the MOME computer system. This includes code updates, data rearrangement, data recalculation and statistical analysis. The following figure shows the data flow from data input to data storage and the DB system configuration.

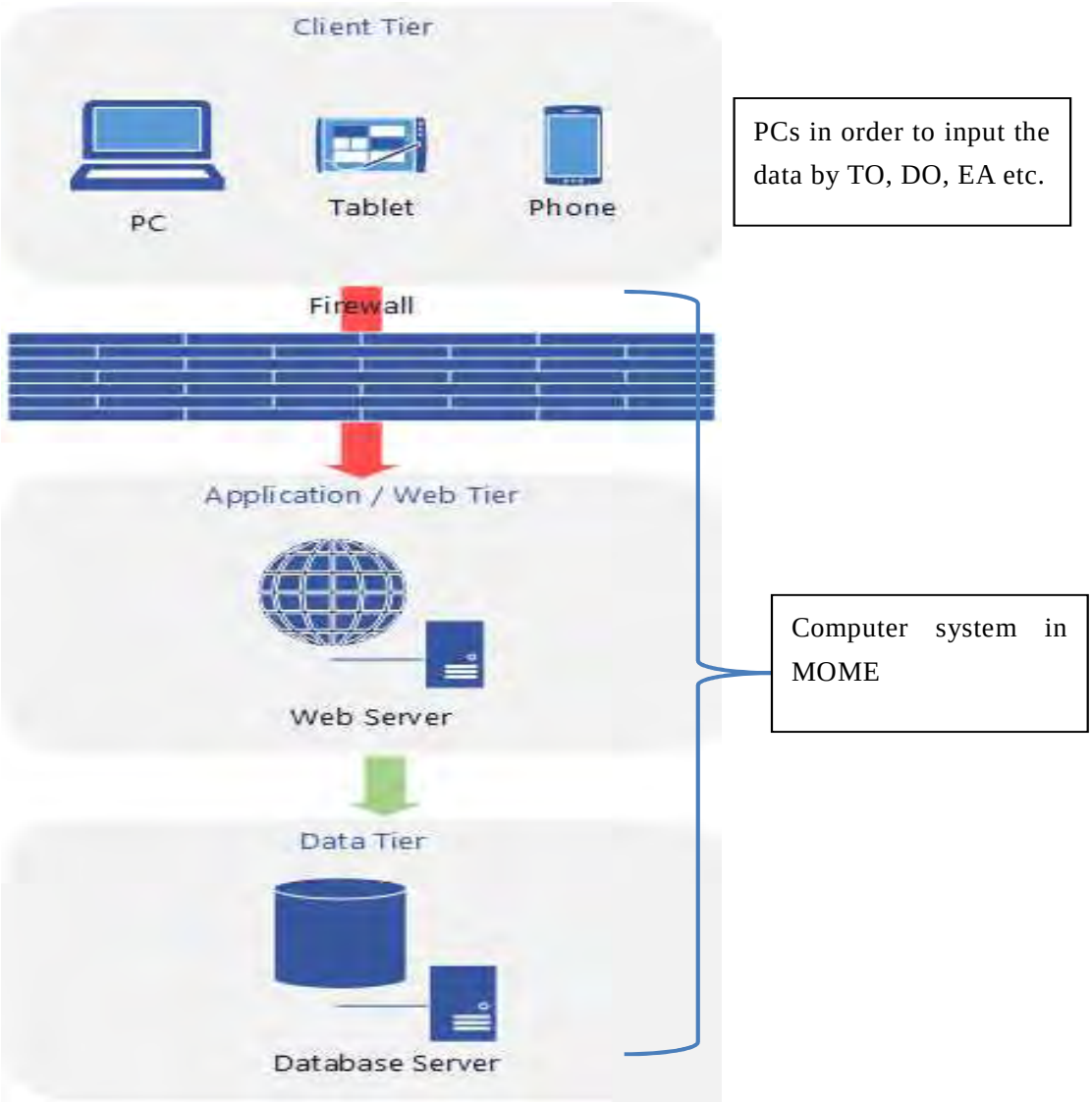


Figure 2- 10 Database Configuration

2.3 Classroom Training Program for EMs and EAs (Output 2)

2.3.1 Assistance for Preparation of Textbooks and Subtexts of Classroom Training for EMs

(1) Principle of Establishment of Classroom Training for EM

3 types of EM license are prepared for municipalities, factories and buildings respectively. Thus, the training content for each differs.

(2) Contents of Classroom Training Program

The contents of classroom training programs, including practical program, are shown below.

Table 2- 7 Training Program for Municipaluty EM

		Monday	Tuesday	Wednesday	Thursday	Friday	Saterday	Monday
		1 day	2 day	3 day	4 day	5 day	6 day	7 day (the same as 6 day)
9-10	1 class	Lecture General about Energy policy and EE policy in Serbia Prof. PhD Milos Banjac	Lecture Electricity Public lighting Prof. PhD Petar Lukic	Lecture Water supply and Drainage Assistant prof. PhD Dejan Ilic/ Assistant prof. PhD Dejan Cantrak	Lecture Planning in energetics Meng Dejan Djukanovic	Lecture ISEM MEng Maja Matejic/PhD Dragan Urosevic	Calculation exercises Plan and program of EE	Calculation exercises Plan and program of EE
10-11	2 class	Lecture EMS in Serbia Prof. PhD Milos Banjac	Lecture Electricity Public lighting Prof. PhD Petar Lukic+D11	Lecture Water supply and Drainage Assistant prof. PhD Dejan Ilic/ Assistant prof. PhD Dejan Cantrak+E4	Lecture Preparation of EE projects Prof. PhD Branko Vasic/ MEng Nada Stanojevic	Lecture ISEM MEng Maja Matejic/PhD Dragan Urosevic	Calculation exercises Plan and program of EE	Calculation exercises Plan and program of EE
11-12	3 class	Lecture SRPS EN ISO 50001 Prof. PhD Branko Vasic/MEng Nada Stanojevic	Lecture Electricity Public lighting Prof. PhD Petar Lukic	Lecture Public transport Assistant prof. Slaven Tica	Lecture Finance engineering Prof. PhD Nikola Dondur	Calculation exercises ISEM MEng Maja Matejic/PhD Dragan Urosevic	Knowledge test ISEM	Knowledge test ISEM
12-13	4 class	Lectrure Energy infrastructure of Municipality MEng Dejan Djukanovic	Lecture Buildings PhD Maja Todorovic, Associate prof./ Radoslav Galic	Lecture Public transport Assistant prof. Slaven Tica	Lecture Prof. PhD Nikola Dondur	Calculation exercises ISEM MEng Maja Matejic/PhD Dragan Urosevic	Knowledge test ISEM	Knowledge test ISEM
Пауза								
14-15	5 class	Lecture Municipality Energy balance MEng Dejan Djukanovic	Lecture Buildings PhD Maja Todorovic Associate prof./ Radoslav Galic	Lecture The renewable sources of energy PhD Milan Gojak, Associate prof.	Lecture Energy services PhD Maja Matejic	Lecture Gas supply PhD Maja Todorovic Associate prof./ Radoslav Galic	Knowledge test ISEM	Knowledge test ISEM
15-16	6 class	Lecture Municipality Energy balance and periodical report MEng Dejan Djukanovic	Lecture District heating PhD Maja Todorovic Associate prof./ Radoslav Galic	Lecture The renewable sources of energy PhD Milan Gojak, Associate prof.	Lecture EE in public procurements Prof. PhD Branko Vasic/MEng Nada Stanojevic	Lecture Plan and program of energy efficiency Prof. PhD Milos Banjac	Knowledge test ISEM	

Table 2- 8 Training Program for Factory EM Training

		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Saturday
		1st day	2nd day	3th day	4th day	5th day	6th day	6th day
9-10	1.	Energy and EE policy of Serbia	Periodical reports	Electricity (1) Introduction - production, distribution, consumption of electricity (electric motors and lighting)	Compressors and distribution of compressed air (1)	Energy efficiency inindustrial ventilation and air conditioning systems (1)	Practical training Boiler and systems for the steam distribution and return of the condensate I group	
10-11	2.	EMS in Serbia	International standard ISO 50001 Energy Management	Electricity (2) Tariff system and analysis of bills and contracting electricity	Compressors and distribution of compressed air (2)	Energy efficiency inindustrial ventilation and air conditioning systems (2)	Practical training Boiler and systems for the steam distribution and return of the condensate II group	Practical training Pumps and transport of liquid III group
11-12	3.	Thermodynamic balances and processes of heat transfer	Combustion processes (1)	Electricity (3) Consumption efficiency - load management, reactive power compensation	Measurements of flow rate, pressure and temperature and other process parameters	Financial engineering (1)	Practical training Boiler and systems for the steam distribution and return of the condensate III group	Practical training Compressors and distribution of compressed air I group
12-13	4.	Thermodynamic balances and processes of heat transfer	Combustion processes (2)	Electricity (4) Practical classes	Measurements of flow rate, pressure and temperature and other process parameters	Financial engineering (2)	Practical training Pumps and transport of liquid I group	Practical training Compressors and distribution of compressed air II group
Пауза								
14-15	5.	Data collection and preparation of the energy balance	Boiler and systems for the steam distribution and return of the condensate (1)	Pumps and transport of liquid (1)	Energy efficiency in cooling systemsm (1)	Financial engineering (3)	Practical training Pumps and transport of liquid II group	Practical training Compressors and distribution of compressed air III group
15-16	6.	Analysis of collected data (ways of presenting of energy consumption)	Boiler and systems for the steam distribution and return of the condensate (2)	Pumps and transport of liquid (2).	Energy efficiency in cooling systems (2)	The plan and program of energy efficiency	Data processing from practical training	Data processing from practical training

Table 2- 9 Training Program for Building EM Training

		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Saturday
		1st day	2nd day	3th day	4th day	5th day	6th day	6th day
9-10	1. час	**Introductory lecture** SEM in Serbia	**Lecture** Energy efficiency measures on heating systems	**Lecture** Rational use of water	**Lecture** Energy audit of the building	**Lecture** Energy efficiency in HVAC systems	**Practice** Energy Management Information System	**Practice** Measuring by infrared camera, blower door, district heating substation
10-11	2. час	**Lecture** ISO 50001 - Energy management	**Lecture** Energy efficiency measures on heating systems	**Lecture** Rational use of water	**Lecture** Energy audit of the building	**Lecture** Energy efficiency in HVAC systems	**Practice** Energy Management Information System	**Practice** Measuring by infrared camera, blower door, district heating substation
11-12	3. час	**Lecture** Thermodynamic balances and processes of heat transfer	**Lecture** Systems for the use of renewable energy in buildings	**Lecture** Systems of automatic control and management of buildings	**Lecture** Financial engineering	**Lecture** Energy efficiency in HVAC systems	**Practice** Energy Management Information System	**Practice** Energy Management System
12-13	4. час	**Lecture** Thermodynamic balances and processes of heat transfer	**Lecture** Systems for the use of renewable energy in buildings	**Lecture** Systems of automatic control and management of buildings	**Lecture** Financial engineering	**Lecture** Energy Management Information System	**Practice** Energy Management Information System	**Practice** Energy Management System
Пауза								
14-15	6. час	**Lecture** Certification and EE measures on the building envelope	**Lecture** Electricity	Lecture Energy Management Information System	**Lecture** Annual report of designated organization	Lecture Energy Management Information System	**Practice** Measuring by infrared camera, blower door, district heating substation	**Practice** Energy Management System
15-16	6. час	**Lecture** Certification and EE measures on the building envelope	**Lecture** Electricity	Lecture Energy Management Information System	**Preparation for laboratory** Measuring by infrared camera	Lecture EE program	**Practice** Measuring by infrared camera, blower door, district heating substation	**Practice** Energy Management System

(3) Mentoring

As a program in the EM training, mentoring is introduced for trial creation of PR before taking an examination. Trainees make a trial PR for their organization's facilities with the assistance of training

lecturers, who give timely advice to the trainees.

2.3.2 Preparation of Curriculum for EA Classroom Training

(1) Principle of Establishment of Classroom Training for EA

EM license holders can take the classroom training for EA. The EA training does not overlap with the EM training and focuses on strengthening audit capability.

(2) Contents of Classroom Training Program

The contents of the classroom training program, including practical training, are shown below.

Table 2- 10 Training Program for EA

	1st Day	2nd Day	3rd Day
AM	• Introduction and Orientation (1 hour) • Energy Audit Standard (1 hour) • How to Create Energy Audit Report (1 hour)	• Case Study for Each Energy Consumption Equipment (3 hours)	• Group Practice for Audit and Presentation (6 hours) • Explanation for Mentoring and Examination (1 hour)
PM	• Case Study for Each Energy Consumption Equipment (4 hours)	• Measurement Equipment with Training Facilities (4 hours)	

(3) Mentoring

To obtain the license for EA, trainees are required to conduct a trial auditing through mentoring, after completion of the classroom and practical training. The trial auditing is made in a factory site or building site designated by TO. The trial auditing team consisting of 3-5 trainees and is planned to be conducted with a mentor (nominated from TO).

TO decides the candidate sites for the trial auditing from among government buildings, university buildings or public plants, beforehand. Trainees can select the site considering their career and skills.

2.3.3 Preparation of Textbooks and Subtexts of Classroom Training for EAs

(1) Site Survey

An Energy Auditor (EA) conducts a mandatory energy audit ordered by DOs periodically and creates an energy audit report. The reporting format for the energy audit is to be created considering the Serbian manner of designing and operating facilities. For this purpose, PT conducted site surveys at the following 3 sites (factory, hotel and office building).

The audit process is reflected in the curriculum for the EA training program.

Table 2- 11 Sites for Energy Audit

Name of Site	Site Description
Soko Nada Stark A.D	Food factory located in Belgrade
Hyatt Regency Belgrade Hotel	Large-scale hotel located in Belgrade
Government Building SIV-3	Middle-scale office building located in Belgrade

(2) Reporting Format for Energy Audit

Through the site survey, PT created the reporting format for the energy audit as shown in Appendix 2. The format was basically confirmed by MOME and attached in the related secondary legislation.

(3) Textbook and Subtext Book

The energy audit is conducted based on the reporting format proposed in the above Textbook and subtexts are prepared to conduct the energy audit properly. The table of contents for the textbook is proposed as shown in Appendix 3.

2.3.4 Instruction of Trainers How to Perform the Training Program for EMs

The training program for EM was implemented for trainers who were designated by TO. PT advised that TO conduct the training paying attention to the following points.

- The sub-text is distributed to trainees in advance, and the trainees should study the contents before the training.
- At the lectures, the sub-text (Power Point, etc.) is utilized effectively and trainers should conduct the lectures focusing on the important points in order to spend their time efficiently.
- As for the classroom training, dozens of trainees taking part is possible. However, at the practical training, an approach where all the attendees take the training divided into small groups should be considered.

2.3.5 Implementation of Training for Trainers for EAs

(1) Contents

The training for trainers for EA was carried out from June 23 (Tuesday) to June 30 (Sunday) in 2016.

11 persons, who belong to MFBU, participated in this training, and they were divided into 2 groups - Factory Group (Group A, 8 persons) and Building Group (Group B, 3 persons). The classroom lectures and practical training for EA at actual sites were carried out in accordance with the following schedule.

Table 2- 12 Training Schedule for Trainers for EA

Date	Training Contents	Attendees

6/23 (Tue) 10:00 ~ 16:00	Classroom-1: Orientation, methodology of energy audit and audit report format	11 trainees (Group A & Group B)
6/24 (Wed) 10:00 ~ 16:00	Classroom-2: Case studies and measurement equipment	
6/27 (Mon) 10:00 ~ PM	Practical training for energy audit at sites Group A: SOKO Food Factory Group B: Hyatt Hotel	Group A: (8 trainees) Group B: (3 trainees)
6/28 (Tue) & 6/29 (Thu) 9:30 ~ PM	Timely consultation	Group A & Group B
6/30 (Wed) 9:00 ~ 12:00	・Presentations of energy audit results ・Comments on the presentations ・Completion ceremony	Group A: (8 trainees/4 groups) Group B: (3 trainees/1 group)

(2) Results of Training

The results of the training are shown below.

[Classroom]

- PT lectured on the following contents using the text book and sub-text book:
  - EMS scheme
  - Standard method of energy audit
  - Format and contents of energy audit report
  - Case studies of energy conservation measures
  - Handling methods for measuring instruments
- Trainees understood almost all the contents of the lectures

[Site Training for Energy Audit]

- Site training for energy audit was implemented at two sites (SOKO Factory - 8 persons, Hyatt Hotel - 3 persons).
- PT gave some exercises relating to the above two sites, and asked trainees to make presentations about the contents on the final day of the training.

[Timely Consultation]

- PT consulted with trainees in order to prepare energy audit reports for each group (Group A: 3 times, Group B: twice).

[Presentation and Completion Ceremony]

- 4 teams from Group A and 1 team from Group B made presentations about the energy audit results. PT confirmed that every team had enough basic knowledge for an energy audit.
- As for the contents of the energy audit reports and the presentation skills, PT confirmed that they were at a sufficient level. In addition, PT recommended that when the team explains the energy audit results to the site, the matters in which the site is interested should be explained first (i.e. summary table of energy audit results: content of energy conservation measures, and

their cost saving effects and priority).

- Some trainees remarked that they did not have enough experience to calculate the energy saving amount and cost at actual sites. Therefore, they wanted to have the chance to perform additional energy audits with PT.

Classroom

Meeting at the Site

Practice of Energy Audit at the Site

Timely Consultation

Final Presentation

Completion Certificate

Figure 2- 11 Status of Training for Trainers for EA

(3) Real Energy Audit in Training for Trainers

At the time of the training for trainers, conducted in June 2016, there was a request from the

participants to learn practical skills on a real energy audit. Considering this request, further energy audit training was conducted at Polimark Food Factory and Ušće tower office building in October 2016 with the PT. 11 participants took part in a real energy audit.

During the 2 week stay of the PT, the following training was carried out. Questionnaires were sent beforehand to the sites and answers were prepared before the walk-through survey.

- Walk-through energy audit at sites
- Presentation of the draft report

The trainees submitted the final reports 2 weeks after the draft reporting.

Table 2- 13 Training Schedule for Real Energy Audit

Date	Training Contents	Attendees
10/3 (Tue) 10:00 ~ 16:00	Classroom-1: Orientation, methodology of energy audit and audit report format Classroom-2: Case studies and measurement equipment	11 trainees (Group A & Group B)
10/4 (Wed) 10:00 ~ PM	Site training for energy audit Group A: Polimark food factory Group B: Ušće tower	Group A (8 trainees) Group B (3 trainees)
10/5 (Thu) and 10/6 (Thu)	Timely consultation	Group A & Group B
10/7 (Fri) 9:30 ~ PM	Revisit of audited site (reporting the outline of energy audit results and rechecking of site, etc.) Group A: Polimark Food Factory Group B: Ušće Tower	Group A (5 trainees) Group B (3 trainees)
10/12 (Thu) 9:00 ~ 12:00	・Presentations of energy audit results ・Comments on the presentations ・Completion ceremony	Group A (8 trainees/4 groups) Group B (3 trainees/1 group)

PT gave comments to the trainees for the presentation of the draft report, as follows.

(Comments to the Building Team)

- Site persons who heard the presentation of energy audit results did not seem to be experts, because they were persons in charge of accounting/procurement and a manager. Explanation and material should be simple and understandable.
- Standard walk-through audit requires 2 days. 1 day should be allotted to confirm facility content and acquire necessary information via interviews, to comprehend the energy audit points.
- If the preconditions for the energy audit are difficult to fix, it is better to honestly consult with the site persons.

(Comments to the Factory Team)

- It is important that related photographs, drawings, and so on, are used in the report for easy

understanding of the targeted points and their status.

- Regarding the proposed measures for energy conservation, they should be sufficiently considered to avoid the occurrence of problems and complicated operations by executing such measures.

2.3.6 Assistance for Implementation of Classroom Training for EMs

Classroom training for EMs is mainly implemented by TO. At the time of implementation, there were no special requests from TO to PT.

However, the PT prepared some materials such as “Energy situation in Serbia”, “Explanation material for Energy Conservation Law”, “Format of Periodic Reports”, etc. These materials are utilized for the classroom training.

2.3.7 Assistance for Implementation of Classroom Training for EAs

(1) Trial of Energy Auditor Training

The rulebooks regarding EA training and qualification will be made after December 2017. Thus, official EA training was not conducted during the Project period (December 2017).

Instead, trial training under the same conditions as the official training was undertaken and conducted on 3 days (December 8, 9 and 11, 2017).

The trainers were assigned from lecturers whom the PT had instructed and trainees were invited from outside businesses to create the same circumstances as the official training. The official training is planned to be held in April 2018.

(2) Results of the Trial Training

The trial training was implemented with the following schedule and content. 23 applicants, including 8 business persons, participated in the training.

Table 2- 14 Training Schedule for Trial Energy Auditor Training

FRIDAY, 08.12.2017. r., ROOM No 513		
Time	**Lecture**	**Lecturer**
8.30 – 9.00	Registration of participants	
9.00 – 10.30	Energy Policy in Serbia Energy Management System in Serbia	Prof.dr. Miloš Banjac
10.30 -12.00	Energy Audit of Buildings	Prof. dr. Maja Todorović
12.00 – 13.00	Break	
13.00 – 14.30	Energy Audit - basic concepts, methodology of implementation, reporting, presentation of results	Doc. dr. Mirjana Stamenić
14.30 – 16.00	Energy audit of system for production and distribution	Doc. dr. Mirjana Stamenić

	of steam / hot /; condensate recovery system, measures for energy efficiency improvement	Dr. Nikola Tanasić
16.00-16.30	Discussion	
SATURDAY, 09.12.2017. r., ROOM No 513		
9.00 – 10.30	Energy audit of pumping systems and ventilation systems, measures for energy efficiency impovement	Doc. dr. Đorđe Čantrak
10.30 -12.00	Energy Audit of compressed air systems, measures for energy efficiency improvement	Dejan Đukanović
12.00 – 13.00	Break	
13.00 – 14.30	Measurement instruments in use	Dr. Nikola Tanasić Doc. dr Dejan Ilić
14.30 – 15.30	Setting of independently task, explanation, template for preparation of final report and presentation.	Doc. dr. Mirjana Stamenić Doc. dr. Đorđe Čantrak Doc. dr Dejan Ilić Assistent Tamara Bajc Dr. Nikola Tanasić Dejan Đukanović
15.00 – 15.30	Discussion	
MONDAY, 11.12.2017.r., ROOM No 513		
Time	**Lecture**	**Lecturer**
9.00 – 14.00	Group discussion for energy audit	Doc. dr. Mirjana Stamenić Doc. dr. Đorđe Čantrak Doc. dr Dejan Ilić Assistent Tamara Bajc Dr. Nikola Tanasić Dejan Đukanović
14.00 – 16.00	Presentation of results of energy audit	Doc. dr. Mirjana StamenićДоц. Doc. dr. Đorđe Čantrak Doc. dr Dejan Ilić Assistent Tamara Bajc Dr. Nikola Tanasić Dejan Đukanović
16.00 – 16.30	Delivery of the certificate for successful training	

Figure 2- 12 Status of the Trial Training

2.4 Practical Training Program for EMs and EAs (Output 3)

2.4.1 Detailed Design of Training Facilities

(1) Layout of Training Facilities

The training facilities are installed in a room at MFBU based on the agreement between MOME and MFBU (concluded in December 2014). The layout of the training facilities is shown below.

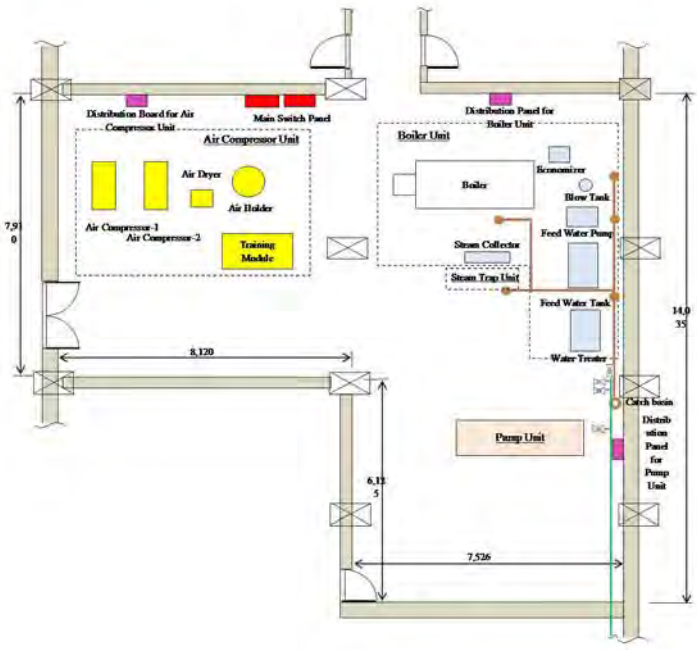


Figure 2- 13 Layout of Training Facilities

(2) Detailed Design of Training Facilities

The detailed design for the Boiler, steam trap, air compressor and pump was conducted by PT. The design contents are reflected in the TECHNICAL SPECIFICATIONS (Appendix 4) in the bid documents.

2.4.2 Assistance for Site Preparation

The original plan for the task allocation of the training facilities was determined among JICA, MOME and MFBU based on the principle of a joint project.

However, it was found that the settlement of training facilities and utility supply work to be prepared by MOME should be merged into the main work to be conducted by a Contractor in terms of efficiency and quality.

In this context, the task allocation was changed and some MOME work shifted to a contract made by JICA's work as agreed in the 1st JCC meeting in May 2015.

Table 2- 15 Task Allocation (Final)

JICA (Installation of Training Plant)	Serbian Side (Appurtenant Work and Preparation)	
	MOME	MFBU
1. Plant installation work 1) Equipment installation work 2) Steel structural work 3) Piping work 4) Duct and stack work at boiler stack 5) Instrument work 6) Electrical work 7) Others 2. Remodeling of training room 1) Making openings on the wall and window for pipe lines and stack 2) Installation of floor plate on open trench 3. Plant installation work 1) Installation of fuel Propane supply system 2) Foundation & tiling work for equipment of training plant 4. Utility, drainage and ventilation	No any work	1. Dismantling of unused existing facilities 2. Refurbishment of training room (lighting, etc.) 3. Preparation of lecture room and related facilities 4. Preparation of desks, chairs, etc. in training room 5. Three PCs for measurement of training facilities.

2.4.3 Procurement of Training Facilities

(1) Outline of Procurement of Training Facilities

PT assists in JICA's procurement of training facilities as summarized below.

(Assistance for Bidding)

- Assistance for Creation of Bid Documents
- Recommendation for Designated Bidders
- Site Orientation for Bidders
- Technical Evaluation of Proposals
- Assistance for Contract Negotiation, etc.

(Assistance for Procurement)

- Technical Evaluation for Request for Approval in Design (submitted from the Contractor)
- Inspection for Main Equipment at Factory
- Quality Check of Equipment and Construction
- Creation of Check Sheet for Commissioning Test and Evaluation of the Report for Commissioning Test
- Confirmation of Completion, etc.

(2) Assistance for Implementation of Procurement

(a) Assistance for Creation of Bid Documents

As previously mentioned, PT prepared the TECHNICAL SPECIFICATIONS as part of the bid documents.

(b) Selection of Designated Bidders

Four designated bidders were recommended by PT from the viewpoints of accessibility to Belgrade, enough skilled engineers, financial soundness to achieve the procurement, and willingness to participate in the procurement.

- Energoprojekt Operma a.d.
- TERMO TIM d.o.o.
- Soko Inžinjering d.o.o.
- Termo Inzenjering d.o.o.

(c) Site Orientation for Bidders

Site orientation was held in Room 518 of MFBU on April 15, 2015, and the above 4 bidders attended.

(d) Bid Opening

The three bidders shown below, out of the 4 designated bidders, participated in the bid opening that took place on May 13, 2015.

- TERMO TIM d.o.o.
- Soko Inžinjering d.o.o.
- Termo Inzenjering d.o.o.

(e) Result of the Bidding

As a result of the bidding, Soko Inžinjering d.o.o. was awarded for the main contract.

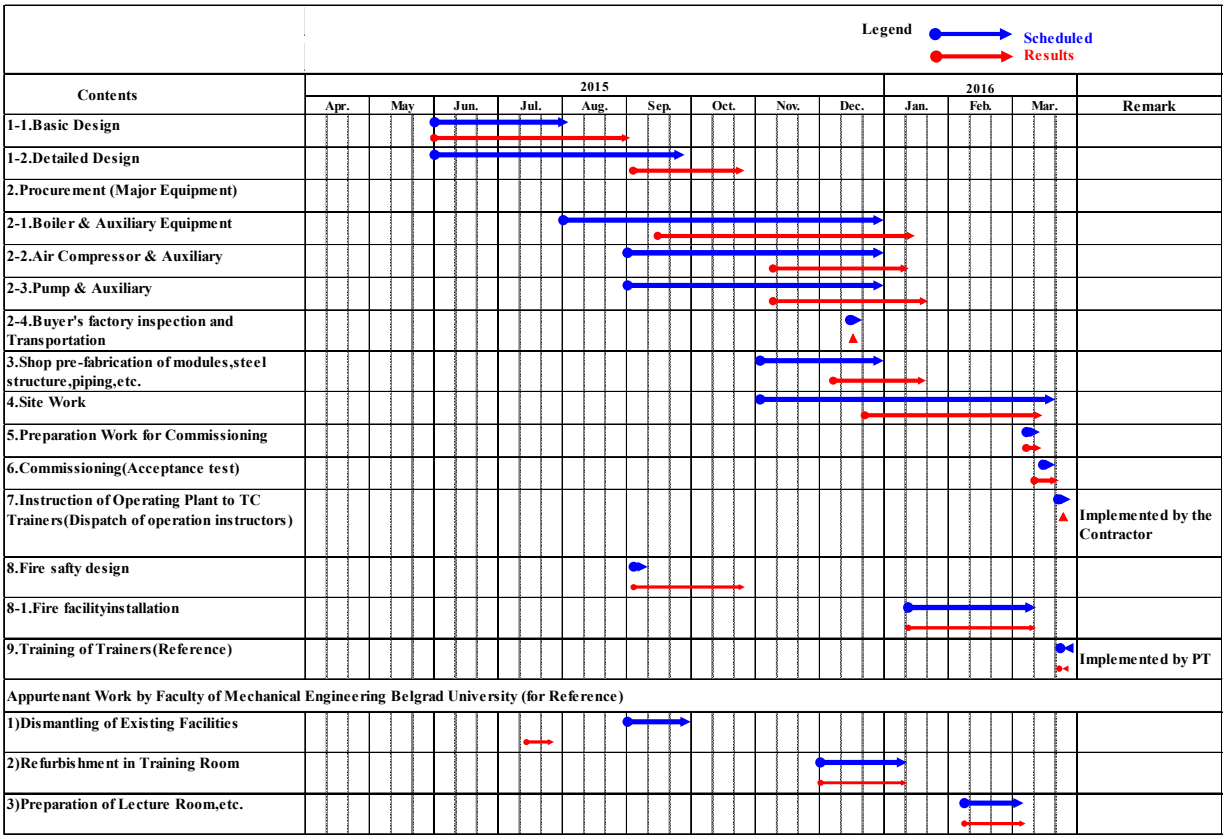
(3) Outline of Training Facilities Installation

(a) Progress Result of Installation Work

The basic design for a series of installation work was started at the beginning of June in 2015. The commissioning and instructions were carried out by the Contractor on the original schedule. PT inspected the facilities and then JICA officially transferred them to MOME.

The progress results are shown in the following chart, comparing them to the original schedule.

Table 2- 16 Progress Result of Installation Work



The pre-commissioning (preparation work for commissioning) was carried out after the mechanical completion, and then the commissioning (Test run) was carried out based on the commissioning manual which was prepared by PT..

In addition, the commissioning was carried out from March 10 (Thursday) to March 22 (Tuesday), and at that time some problems to be found out were taken measures during the commissioning period.

By the commissioning, the performance and all of the functions of each unit had been confirmed.

(b) Status of Facilities Installation

The status of the facility installation is shown in the following pictures.

General View of the Training Facilities

Propane House

Boiler Unit

Steam Trap Unit

Air Compressor Unit

Pump Unit

Figure 2- 14 Status of Facilities Installation

(c) Delivery of Training Facilities

Since the performance and functions were confirmed by the commissioning, PT issued the completion certificate on March 25, 2016 and the training facilities were delivered to MOME on the same day.

(4) Procurement of Instruments

The instruments for energy auditing which are shown in the following table were procured in Japan, and delivered to MOME on the same day as the training facilities were delivered to them.

Table 2- 17 Detail of Delivered Instruments

[Instruments]

No.	Name	Maker	Model	Quantity	Remarks
1	Portable Data Logger	GRAFTEC Co. Ltd.	(1) midi-LOGGER 240 and (2) midi-LOGGER 840	4 1	
2	Current Sensor	U_RD Corporation	(1) CTT-10 CLS-CV10 (2) CTT-24-CLS-CV100 (3) CTT-36-CLS-CV500	10 10 10	
3	(1) Pressure Sensor (2) Power Unit	NAGANO Keiki Co., Ltd.	(1) KM31 (2) KR-85	4 2	
4	k-Thermo Couple	OMRON Co., Ltd.	E52 CA10AE-N 2M	3	
5	Infrared Thermo Camera	NIPPON AVIONICS Co. Ltd.	F30W-CO1GR2	2	
6	Infrared Thermometer	HIOKI E.E. Corporation	Infrared Thermo HiTester 3700	2	
7	Clamp Tester	HIOKI E.E. Corporation	Clamp-on AC/DC HiTester 3280-10	2	
8	Portable Power Meter	FUJIDENKI INC.	Portaflow-C	2	
9	Ultra-Sonic Leak Detector	I&T Corporation	Sonic Catcher ITC-00A	2	
10	Portable Ultrasonic Flow Meter	FUJIDENKI INC.	Porta-Flow C	1	
11	Exhaust Gas Analyzer	testo A.G	testo 310	2	
12	Steam Trap Checker	MIYAWAKI Co.	Dr. TRAP Jr. PM11	2	
13	Acoustic Rod	VESSEL Co., Inc.	Micro Driver 9900 P.O-150	2	Donated by PT
14	Multi-Function CO2 / Temp. / Humidity Logger	T&D Corporation	TR-76Ui	2	
15	Multi-Function Lux Meter / Anemometer / Thermometer	Mother Tool	LM-8000	1	

[Accessories of Data Logger]

No.	Name	Maker	Model	Quantity	Remarks
1	Fixed Resister	Dale	Ultraprecision Fixed Metal Film Resistor 1/4W 250Ω 0.1%	20	
2	USB Cable	YOKO Co. Ltd.	3 m	3	
3	USB Memory	Transcend Japan Co. Ltd.	JetFlash 350 4GB	10	

[Tools]

No.	Name	Maker	Model	Quantity	Remarks
1	Adjustable Wrench-1	KOHNAN SHOJI Co. Ltd. OEM	200 mm	2	
2	Adjustable Wrench-2	KOHNAN SHOJI Co. Ltd. OEM	150 mm	2	
3	Pipe Wrench-1	Arm Industry Co. Ltd.	PW200	2	
4	Pipe Wrench-2	FUJIWARA Industry Co. Ltd.	ESM-160	2	
5	Nipper	LIXIL Corporation OEM	150 mm	2	
6	Driver	ECHO Metal Co. Ltd.	Multi-Driver 6P	2	
7	Cutter	MAKOTO Co. Ltd.	Small 2 (2 pieces)	1	
8	Aluminum Case-1	IRIS OOYAMA Co. Ltd.	AM-15 (415L*150H*290W)	3	
9	Aluminum Case-2	IRIS OOYAMA Co. Ltd.	AM-10 (415L*100H*290W)	7	

[Fittings]

No.	Name	Maker	Model	Quantity	Remarks
1	Bushing 1) Rc 1/4×Rc3/8 2) Rc 1/4×Rc1/2 3) Rc 3/8×Rc1/2	MonoraRO OEM	1) Rc 1/4×Rc3/8 2) Rc 1/4×Rc1/2 3) Rc 3/8×Rc1/2	2 4 2	
2	Socket 1) Rc 1/4 2) Rc 3/8 3) Rc ½	MonoraRO OEM	1) Rc 1/4 2) Rc 3/8 3) Rc ½	2 2 2	
3	Nipple 1) Rc 1/4 2) Rc 3/8 3) Rc 1/2	MonoraRO OEM	1) Rc 1/4 2) Rc 3/8 3) Rc ½	2 2 2	
4	One Touch Connector for Plastic Tube	MonoraRO OEM	Half Union MPC8-02	6	

2.4.4 Preparation of Curriculum for Practical Training Program

PT prepared a curriculum for the practical training as shown in the following tables. In addition, the following points were considered to enable every trainee to understand the content of the training sufficiently.

- Maximum number of trainees in 1 group is within 10 persons and maximum group number is 2.
- If the number of trainees is more than 10, the trainees are divided into 2 groups, and each group is trained based on the following curricula for Group-1 and Group-2.
- If the number of trainees is less than 10, the trainees are trained based on the following Group-1 curriculum.

Table 2- 18 Curriculum of Practical Training

Group-1

Day-1	Day-2	Day-3
9:30 ~ 12:00 Lecture	9:30 ~ 10:45 Boiler Unit	9:30 ~ 12:00 Pump Unit
1. Orientation 2. Lecture of the followings: 1) Outline of training plant 2) Contents of training 3) Structure and operation of 4) Check point of energy audit 5) Instrument for energy audit 3. Grouping of trainees	1. Observation of measurement of effectiveness of insulation on non-insulated valve 2. Use of instruments for energy audit 11:00 ~ 12:00 Steam Trap Unit 1. Study of various types (5 types) of steam traps and action 2. Study of steam trap checking method and importance of periodical maintenance 3. Observation of rain fall effect and the measures 4. Use of instruments for energy audit	1. Study of centrifugal pump and operation 2. Measurement and making pump performance curve 3. Measurement and calculation on effectiveness of inverter pump 4. Measuring and Calculation of Inverter Loss 5. Measurement and calculation of pipe line pressure drop 6. Use of instruments for energy audit
13:00~ 15:30 Boiler Unit	13:00~ 15:30 Air Compressor Unit	13:00~ 14:30
1. Study of boiler facilities and operation 2. Measurement and calculation of boiler efficiency 1) Comparing boiler efficiencies in cases of proper air ratio and excessive one 2) Comparing boiler efficiencies in cases of economizer use and disuse	1. Study of air compressor facilities and operation 2. Measurement and calculation on effectiveness of inverter compressor 3. Measurement and Calculation of pipe line pressure drop 4. Measurement and calculation of air leaking volume from small holes 5. Study of effectiveness on high efficient air blow nozzle 6. Use of instruments for energy audit	1. Presentation of two training results by each group 2. Issuing certification of participation of this training

Group-2

Day-1	Day-2	Day-3
9:30 ~ 12:00 Lecture	9:300~ 12:00 Air Compressor Unit	9:30 ~ 10:45 Boiler Unit
1. Orientation 2. Lecture of the followings: 1) Outline of training plant 2) Contents of training 3) Structure and operation of 4) Check point of energy audit 5) Instrument for energy audit 3. Grouping of trainees	1. Study of air compressor facilities and operation 2. Measurement and calculation on effectiveness of inverter compressor 3. Measurement and Calculation of pipe line pressure drop 4. Measurement and calculation of air leaking volume from small holes 5. Study of effectiveness on high efficient air blow nozzle 6. Use of instruments for energy audit	1. Observation of measurement of effectiveness of insulation on non-insulated valve 2. Use of instruments for energy audit 11:00 ~ 12:00 Steam Trap Unit 1. Study of various types (5 types) of steam traps and action 2. Study of steam trap checking method and importance of periodical maintenance 3. Observation of rain fall effect and the measures 4. Use of instruments for energy audit
13:00 ~ 15:30 Pump Unit	13:00~ 15:30 Boiler Unit	13:00~ 14:30
1. Study of centrifugal pump and operation 2. Measurement and making pump performance curve 3. Measurement and calculation on effectiveness of inverter pump 4. Measuring and Calculation of Inverter Loss 5. Measurement and calculation of pipe line pressure drop 6. Use of instruments for energy audit	1. Study of boiler facilities and operation 2. Measurement and calculation of boiler efficiency 1) Comparing boiler efficiencies in cases of proper air ratio and excessive one 2) Comparing boiler efficiencies in cases of economizer use and disuse	1. Presentation of two training results by each group 2. Issuing certification of participation this training

2.4.5 Preparation of Textbook and Subtext Book for Practical Training

PT prepared a textbook and a sub-textbook for trainers for the practical training (Appendix 5).

- Practical Training Text
- Practical Training Subtext Book

In addition, the contents of these textbooks are tentative. Therefore, PT proposed that it was necessary to timely review and revise the contents by TO.

2.4.6 Implementation of Practical Training for Trainers

(1) Outline of Training of Trainers

PT implemented the practical training for trainers from March 28 to March 30, 2016. The same training program is used for trainers for both EM training and EA training.

The following trainees attended. In addition, after the training, certificates of attendance were issued to every participant.

- MFBU (TO): 14 participants
- MOME: 1 participant (Observer)

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(2) Schedule of Training of Trainers for Practical Training

The following table shows the practical training schedule.

Table 2- 19 Schedule of Practical Training for Trainers

Date	Hour	Contents	Room Number	Remarks
3/28(Mon)	9:00～12:00	1. Lecture about the followings	#518 room	
		1) Schedule of training of trainers	↓	
		2) Outline of energy conservation law and	↓	
		back ground of EMS introduction	↓	
		in Serbia	↓	
		3) Outline of the training plant	↓	15 minutes coffee break
		4) Check points of energy saving	↓	
		5) Introduction of instruments for	↓	
		energy audit	↓	
	12:00～13:00	Lunch time		
	13:00～16:00	2. TOT of Air Compressor Unit	#24 Room	
		1) Outline of air compressor unit	↓	
		2) Operation of air compressor unit	↓	15 minutes coffee break
		3) Training contents of air compressor unit	↓	
		4) Use of instruments for energy audit	↓	
3/29(Tue)	9:00～9:15	Confirmation of schedule for day ⇒Move to training room	#518 room	
	9:15～12:00	3. TOT of Boiler Unit and Steam Trap Unit	#24 Room	
		1) Outline of boiler unit and steam trap unit	↓	15 minutes coffee break
		2) Operation of boiler unit and steam trap	↓	
		unit		
	12:00～13:00	Lunch time		
	13:00～14:30	3) Training contents of boiler unit and	#23 Room	
		steam trap unit	↓	
		4) Use of instruments for energy audit	↓	15 minutes coffee break
	14:45～16:00	2. TOT of Pump Unit	#24 Room	
		1) Outline of pump unit	↓	
		2) Operation of pump unit	↓	
3/30(Wed)	9:00～9:15	Confirmation of schedule for day	#518 room	
		⇒Move to training room		
	9:15～10:30	2. TOT of Pump Unit (Continued)	#24 Room	
		3) Training contents of pump unit	↓	
		4) Use of instruments for energy audit	↓	
		⇒Move to #518 room and coffee break		
	11:00～12:00	Wrap-up	#518 room	
		1) Hearing the comments about the TOT		
		contents		
		2) Issuing certificate of the completion		
		of training		

(3) Status of Practical Training

PT implemented the practical training using the textbooks for practical training at a lecture room (lecture) and training room (practical training).

The following pictures show the practical training.

Lecture in Lecture Room

Participants of TOT

Practical Training of Boiler

Practical Training of Air Compressor

Practical Training of Pump

Explanation of Propane Handling (Boiler Fuel)

Figure 2- 15 Status of Practical Training for Trainers

(4) Implementation of Supplementary Training

Supplementary training on the practical training facilities for the trainers for EAs was implemented over 3 days from June 20 (Monday) to June 22, 2016 (Wednesday). This practical training was implemented upon a request from TO, because some trainees felt that they did not become sufficiently skilled in the content of the training in the previous March. 13 trainees from MFBU

participated in the below training.

(Operation Training for Training Facilities)
Group A (Factory): June 20 (Monday) 10:00 ~ 16:00
Group B (Building): June 21 (Tuesday) 10:00 ~ 16:00
(Training on Handling of Measuring Equipment)
Group A and Group: June 22 (Wednesday) 10:00 ~ 16:00

(5) Results of the Supplementary Training

- All the trainees actually operated pumps and air compressors themselves. Thus, it was confirmed that they were able to understand the operation methods for pumps and air compressors, including the auxiliary equipment.
- As for boiler units, operation is complicated, so it will take time until they are able to operate a boiler unit by themselves. In particular, support from Bosch is necessary for the change of exhaust gas oxygen content and for boiler operation itself. Therefore, the PT asked TO to sign a service agreement with Bosch as soon as possible.
- Trainees handled the measurement equipment (data logger, exhaust gas analyzer, thermocamera, infrared thermometer, air leak detector, acoustic rod, etc.) themselves, and it was confirmed that they sufficiently understood the handling methods for such measurement equipment.

2.4.7 Assistance for Implementation of Practical Training for EMs and EAs

(1) Assistance for Implementation of Practical Training for EM

The first practical training for Factory EM was implemented over 6 days from November 14 (Monday) to November 19, 2016 (Saturday) as per the following schedule. About 100 applicants applied for the training, out of which 32 participated. The other applicants took the training in the next round.

Table 2- 20 Training Schedule for Factory EM

Time	Nov.14	15	16	17	18	19	
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
9-10	Energy and EE policy of Serbia	Periodical reports	Electricity (1) Introduction - production, distribution, consumption of electricity (electric motors and lighting)	Compressors and distribution of compressed air (1)	Energy efficiency inindustrial ventilation and air conditioning systems (1)	Practical training Boiler and systems for the steam distribution and return of the condensate I group	
10-11	EMS in Serbia	International standard ISO 50001 Energy Management	Electricity (2) Tariff system and analysis of bills and contracting electricity	Compressors and distribution of compressed air (2)	Energy efficiency inindustrial ventilation and air conditioning systems (2)	Practical training Boiler and systems for the steam distribution and return of the condensate II group	Practical training Pumps and transport of liquid III group
11-12	Thermodynamic balances and processes of heat transfer	Combustion processes (1)	Electricity (3) Consumption efficiency - load management, reactive power compensation	Measurements of flow rate, pressure and temperature and other process parameters	Financial engineering (1)	Practical training Boiler and systems for the steam distribution and return of the condensate III group	Practical training Compressors and distribution of compressed air I group
12-13	Thermodynamic balances and processes of heat transfer	Combustion processes (2)	Electricity (4) Practical classes	Measurements of flow rate, pressure and temperature and other process parameters	Financial engineering (2)	Practical training Pumps and transport of liquid I group	Practical training Compressors and distribution of compressed air II group
Lunch Break							
14-15	Data collection and preparation of the energy balance	Boiler and systems for the steam distribution and return of the condensate (1)	Pumps and transport of liquid (1)	Energy efficiency in cooling systemsm (1)	Financial engineering (3)	Practical training Pumps and transport of liquid II group	Practical training Compressors and distribution of compressed air III group
15-16	Analysis of collected data (ways of presenting of energy consumption)	Boiler and systems for the steam distribution and return of the condensate (2)	Pumps and transport of liquid (2).	Energy efficiency in cooling systems (2)	The plan and program of energy efficiency	Data processing from practical training	Data processing from practical training

PT was present at the practical training on November 19 and the lectures about data analyses. After the training, the PT gave advice to the TO on how to improve the practical training in the future.

[Advice on the Training Schedule]

- The practical training was allocated only one day, and the training time for each unit was only one hour. Therefore, it might be difficult for the participants to understand the required energy conservation technologies concerning each facility sufficiently.
- The PT suggested that 2 days would be required for the practical training, including data analyses, and so on.
- So as to keep the two days of practical training, the PT recommended the following cases.
  ① 5 day Lecture + 2 day Practical training (Total 7 days)
  ② 4 day Lecture + 2 day Practical training (Total 6 days)
  ③ 4 day Lecture + 2 day Practical training + 1 day make-up lecture (Total 7 days)

- For promoting energy conservation in various fields, it is expected that EMs will take positive action, being key persons. Therefore, it is necessary to improve the training content and have trainees gather data and confirm the operation conditions of the training facilities, and so on as much as possible.
- There was a problem in this practical training, which was implemented within one day. Furthermore, it is necessary to consider break times and lunch time.

[Advice on the Facilities]

- At the boiler unit, the oxygen content in the exhaust gas was set rather high at approximately 7.5 %. It is necessary to change the set value of the air ratio during operation. Therefore, a contract must be signed with Bosch as soon as possible.
- At an open funnel on a drainage pipe line, the boiler sometimes blows down water leaks onto the training room floor. Therefore, it is necessary to consult SOKO Factory on measures for this.
- In the case of cold weather, there would be a possibility of a shortage of fuel propane supply to the boiler unit. In such case, it is necessary to warm up the propane shed inside (supply hot air from building inside).

[Other]

- Recently, there have appeared many kinds of calculation software for energy conservation. Therefore, it is better to introduce these and utilize them for data analyses after the practical training.

Pictures of the training are shown below.

Practical Training for Boiler

Practical Training for Air-Compressor

Practical Training for Pump

Classroom after the Practice

Figure 2- 16 Status of Practical Training for Foacoty EMs

2.5 Qualification and Examination System of EMs and EAs (Output 4)

2.5.1 Assistance for Preparation of Examination of EAs

(1) Principle of Examination Method

As of December 2017, the examination method for EA is still being reviewed. A 2 step evaluation, (i) a paper test with mark sheet style and (ii) creation of exercise energy audit report (including presentation), is expected to be adopted.

(2) Preparation of Examination Test

The TO prepares and conducts the examination. The PT assisted in the creation of the paper test and the exercise by showing Japanese samples.

2.6 Capacity of MOME to Implement Energy Management and Audit System (Output 5)

2.6.1 Assistance for Planning Dissemination and Awareness Seminars for DOs and EMs

(1) Dissemination Activities

PT assisted in planning mascot characters and promotional goods as one of the dissemination activities.

(2) Seminar and Ceremony

PT assisted in planning various dissemination seminars and the ceremony, etc.

2.6.2 Assistance for Implementation of Dissemination and Awareness Seminars for DOs and EMs

(1) Dissemination Activities

(a) Content of Activities

PT conducted the following activities.

- Creation of mascot characters
- Creation of goods using the characters
- Introduction of other promotional goods

(b) Creation of Mascot Characters

PT created original mascot characters to promote energy saving. It is expected that the characters will be used for presentation materials and promotional goods.

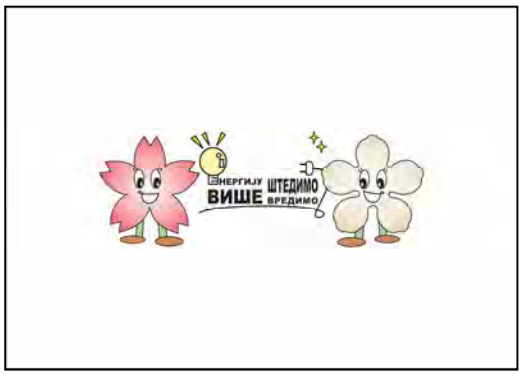


Figure 2- 17 Mascot Characters (Sakura Chan and Plum Chan)

(c) Promotional Goods Using the Mascot Characters

PT created promotional goods (eco bag, notebook, etc.) using the original mascot characters. These goods were given to participants in ceremonies and seminars and positive feedback was received from many participants.

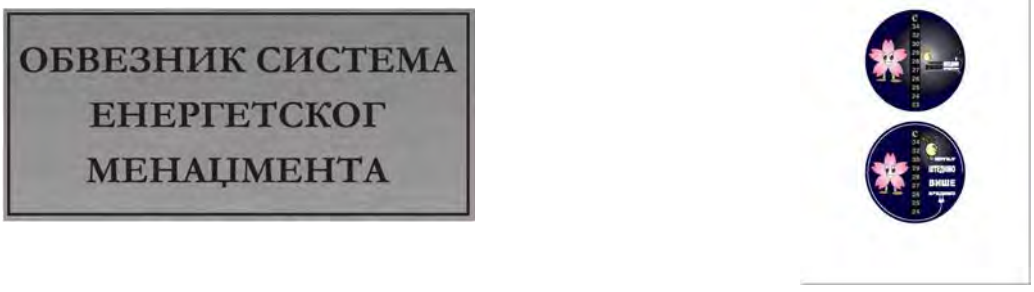
Eco Bag Notebook

Figure 2- 18 Samples for Promotion Goods using the Mascot Character

(d) Introduction of Other Promotional Goods

PT designed promotional goods and distributed some goods to participants of seminars and workshops.

Calendar Drop Curtain Sticker



Nameplate Magnet Thermometer

Figure 2- 19 Samples of Promotion Goods

(2) Opening Ceremony for Serbian Energy Efficiency Center (SEEC)

"Serbian Energy Efficiency Center (SEEC)" was given as the official name for TO and the opening ceremony was held in MFBU on October 11, 2016. This opening ceremony was made expecting to announce the effect of SEEC's establishment and the promotion of nationwide energy saving.

The Minister of Mining and Energy (Aleksandar Antić), Dean of MFBU (Radivoje Mitrovic), JICA, MOME-related persons, MFBU-related persons, PT members, etc. attended the opening ceremony and it was successfully conducted in the presence of the media.

Figure 2- 20 Opening Ceremony of SEEC

(3) Seminars

(a) Seminar for Introduction of EMS

As mentioned in the previous section, seminars for the introduction of EMS were held twice at COC in Belgrade in April 2016. Another seminar was held in December 2017 to provide feedback on the first year's experience of EMS.

(b) Seminar for V4 (Višegrad 4) Countries

The V4 seminar was held at COC on October 11, 2016, with representatives from Serbian officials, JICA, and V4 countries (Poland, Czech Republic, Bulgaria and Slovakia) to exchange views on their experiences in energy policy execution. 6 members from V4 countries participated in this. There were an active discussion regarding energy policy in Japan

Table 2- 21 Agenda for V4 Seminar

	Agenda	Presenter	Venue
9:00	・Opening Remark	MOME/ EOJ	COC
9:10	・Introduction of the Energy Management System in Serbia	MOME	
9:30	・V4 country presentation 1		
10:00	・V4 country presentation 2		
10:30	・V4 country presentation 3		
11:00	・V4 country presentation 4		
11:30	・Energy Conservation Law of Japan and Japanese Technology in Energy Efficiency	PT	
12:00	・Q&A		

2.6.3 Assistance for Monitoring DOs

(1) Proposal of Monitoring Method

Monitoring of DOs is conducted by submission of Periodic Reports (PRs). PT recommended that MOME clarify the contents of PRs through a telephone call or e-mail after their submission.

PT confirmed that MOME practiced this recommendation and communicated properly with DOs which submitted their PRs.

(2) Actual Recording of Submission of PRs

As of December 2017, PRs have been submitted as shown below. PRs from the Industry DOs were able to be collected to some extent. However, it is assumed that potential DOs may still exist. It is necessary for MOME to continue to make efforts in dissemination to raise the collection rates.

On the other hand, even though the number of Municipality DOs was identified beforehand, the actual number of submissions was limited (14 DOs). It is assumed that there are difficulties for municipalities in dealing with a lot of facilities during the first year. Data collection methods are to be established as early as possible.

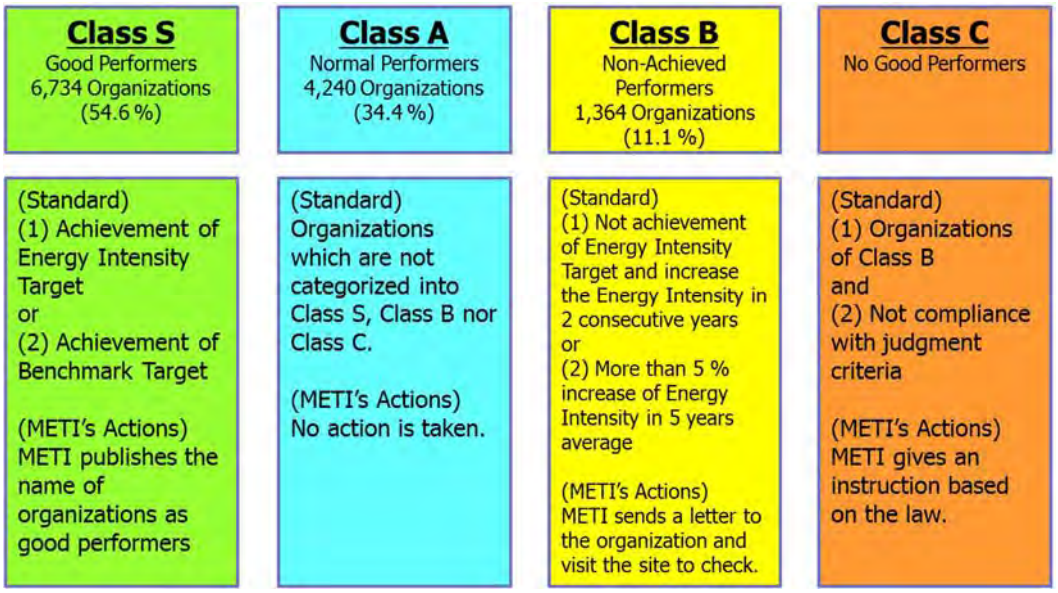
Table 2- 22 Actual Records for Submission of PRs in 2017

Industry		
The total number of DO that submitted the application for primary energy consumption	Number of DO that submitted Periodical Report	%
72 DO (83 locations)	41 (66 locations) – 37 nominated EM	56.9 (79.5)
Municipalities		
The total number of municipalities	Number of municipalities that submitted Periodical Report	%
79	14 (all have nominated EM)	17.7
Buildings		
The total number of DO that submitted the application for primary energy consumption	Number of DO that submitted Periodical Report	%
8 (12 locations)	0	0

(3) Proposal of Rating Method for DOs

(a) Rating Sample in Japan

Japan's Ministry of Economy, Trade and Industry (METI) introduced a rating system for the Japanese EMS and has disclosed the results of the rating since 2016 (the names of Class S organizations are available to the public). If an organization is categorized into Class B, it will be a target for a site check conducted by METI.



(Source: METI website)

Figure 2- 21 Sample of Rating in Japan for 2013

(b) Proposal on Rating Method for Serbia

PT recommends a similar rating system in Serbia using the past few years' records to raise the motivation of good performing DOs via awards or publications, etc.

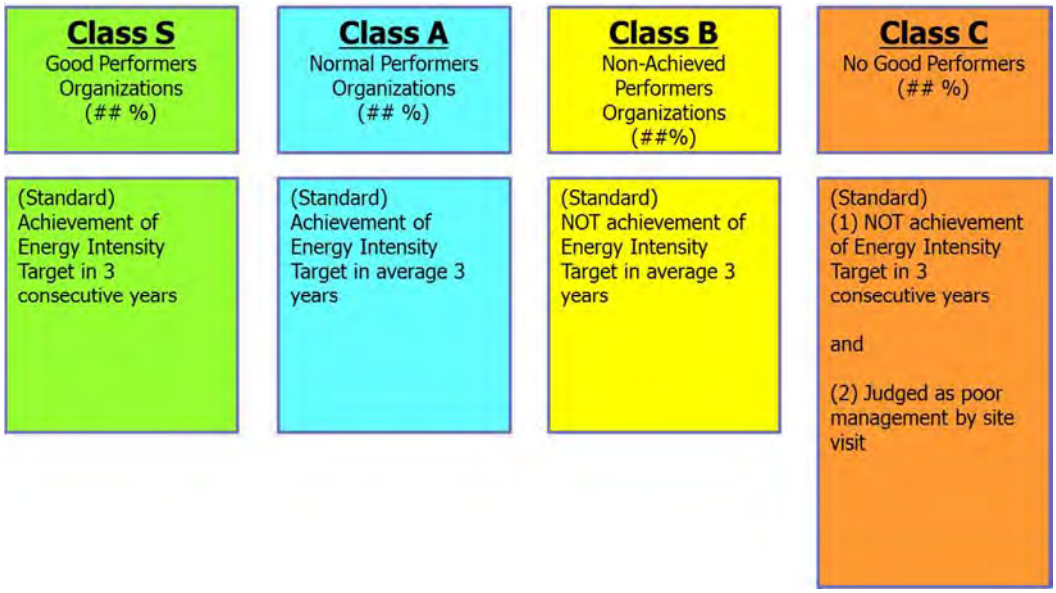


Figure 2- 22 Recommended Rating System for Serbia

Regarding Class C organizations, which are poor performers, it is recommended that their performance is checked via site visit. The following figure shows a sample of how to deal with poor performing DOs (Class C).

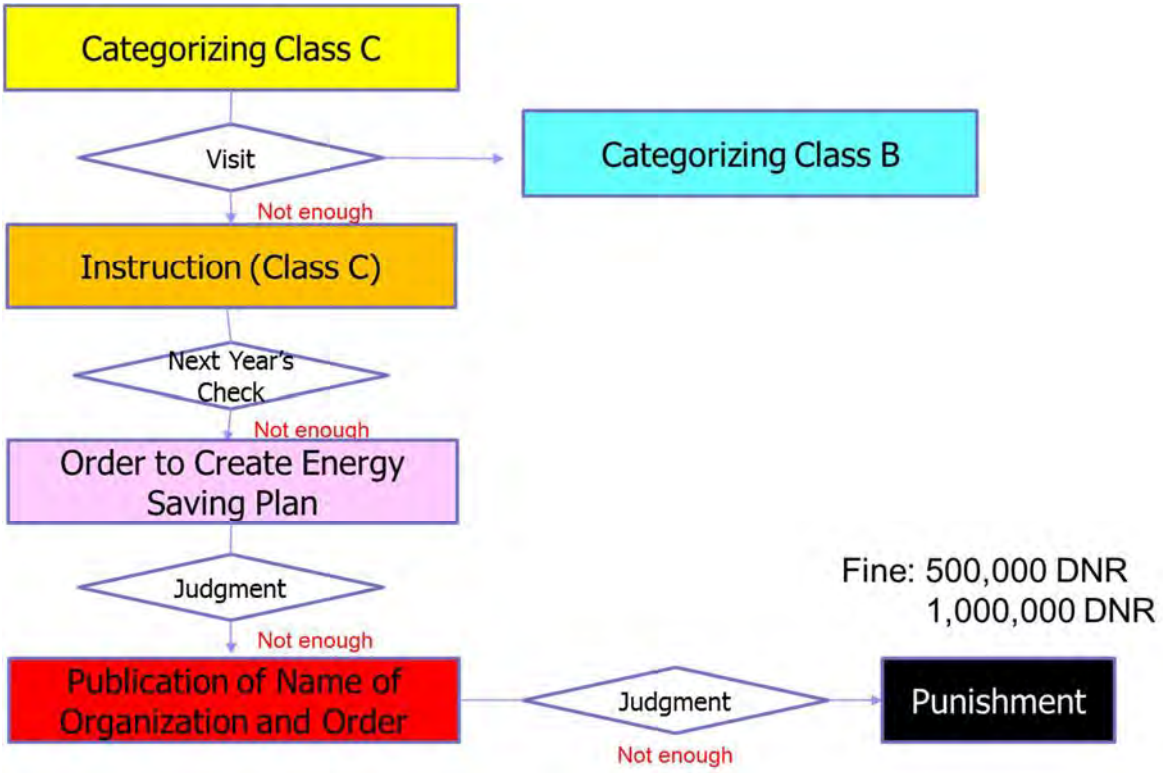


Figure 2- 23 Sample of Process for Poor Performing DOs

2.6.4 Performance Check for EAs

(1) Confirmation Method for Performance of EAs

During the Project period, official EA training had not been conducted as previously mentioned. Thus, the performance level of EA candidates was surmised based on the results of the trial EA training conducted in December 2017.

(2) Performance Level Surmised via the Trial EA Training

Based on the results of the trial EA training, the following observations could be made.

- Participants almost understand the theory for energy saving methods. This is because almost all participants graduated with a master's degree from a university.
- Participants could understand the format of the Energy Audit Report (EAR) and have the capacity to make proposals based on the format.
- In the exercises for energy auditing, participants had the skills to provide answers if information and problems were given.
- To gain the capacity for answering questionnaires sent beforehand, collecting

information/issues at a site, and presenting effectively to the site, it may be necessary to accumulate greater real business experience. The creation of opportunities for real energy auditing is crucially important.

(3) Suggestions for Tips on Energy Auditing from PT

At the end of the training, PT suggested tips accumulated by long business experience in Japan to the participants (Appendix 6).

2.6.5 Assistance for Review of Implementation of EMS

(1) Necessity of Review of the EMS Implementation

The EMS scheme has just started (since 2017) and it has not been found that drastic changes are necessary. However, the collection rate of PRs in Municipality DOs was not very high and there is a possibility that potential Industry DOs still exist.

Building DOs will also start to submit their PRs from 2018. It is a challenge to improve the collection rate.

To raise the collection rate, it is crucially important that the following actions are be taken as countermeasures.

- Utilizing various opportunities to disseminate information (Workshops undertaken by MOME, education by MFBU, etc.)
- Dissemination of the procedure for authorization of DO (MOME Website)
- Award system for good practices

(2) Necessity of Review of Training and Qualification System

(a) Training System for EM

Regarding the EM training system, the following items are expected to be revised.

- There were opinions from some participants that they were notified of the schedule at short notice and it was difficult to arrange their own schedule. It may be better to announce the fixed schedule beforehand.
- In order to make the minimum number for training low, cost sharing between the official training and MFBU's education program is desired. For example, when MFBU implements an education program for students, it is recommended that the O&M costs are shared by utilization time.
- To raise the utilization rate, other training programs such as one day training or training for third countries are undertaken.
- There were opinions from some participants that the allocated time for practical training was not enough. When many participants are concentrated in the allocated time, the practical training can be split into another day for the participants who live in Belgrade.

(b) Qualification

Even after passing the qualification test, some applicants forget to issue their licenses. It is recommended that MOME reminds them to implement the procedure to issue the license as early as possible.

2.6.6 Assistance for Making Necessary Revisions on EMS

(1) Final Seminar

On December 13, 2017, the final seminar for dissemination was held to report the first year's results and the next year's activity plan to DOs. 90 participants joined the seminar in Belgrade. The seminar also announced the start of official energy audit in 2018.

Figure 2- 24 Agenda of the Seminar and Status of the Seminar Room

(2) Proposal of Implementation Structure for MOME

PT proposed the implementation structure for MOME from the next year. It suggested 3 permanent staff for implementation of EMS and other assistant staff for legal matters, IT assistance and inspections, etc.

In the near future, the number of PRs submitted from DOs will increase and a heavy work load during a certain period may result. Short term support staff only for the heavy load period is also considered.

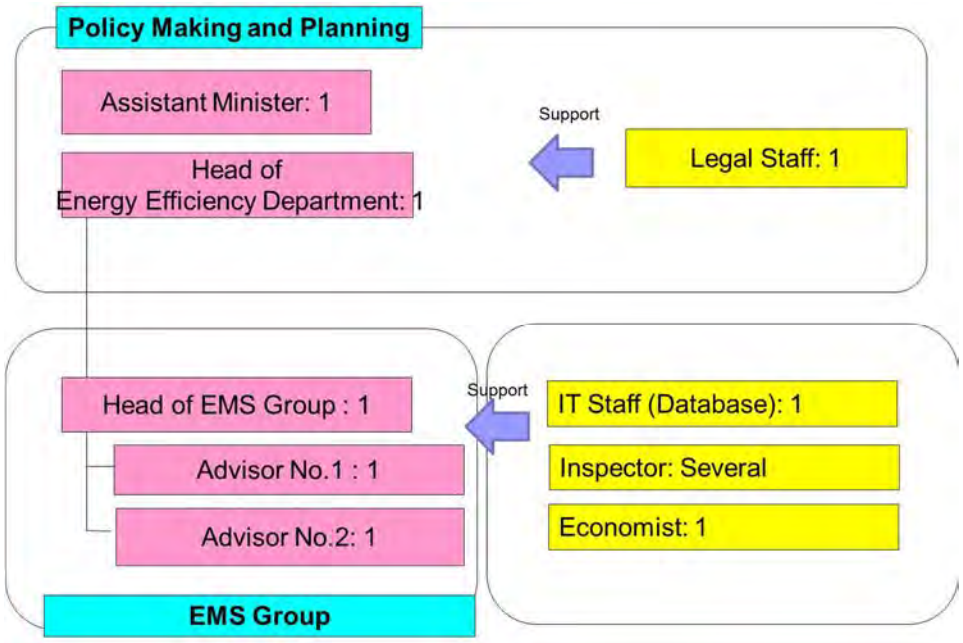


Figure 2- 25 Expected Implementation Structure of MOME

(3) Proposal of Activity Plan in 2018

PT proposed the following schedule for 2018. It fixes the schedule for the EM training with a prior announcement.

Table 2- 23 Implementation Plan in 2018

	2017				2018											
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Seminar and Ceremony														▲ International Energy Fair		
Training for Municipality EM								Training								
Training for Industry EM								Training						Training		
Training for Building EM			Training											Training		
Training for EA								Training								
Submission of PR							▲									
Business and Annual Report TO					▲											▲
Adoption of EA RBs							▲									

2.6.7 Assistance for Preparation of SEEC Business Plan and SEEC Annual Action Plan

(1) Preparation of Annual Report

PT suggested to TO that the annual report should include the annual activities done, balance of revenue and expenditure, and future action plan. Corresponding to the PT's suggestion, MFBU as TO submitted the Annual Report for 2016 in 2017 as shown below. The Annual Report for 2017 will be submitted in early 2018.

TRAINING ORGANISATION FOR ENERGY MANAGERS AND ENERGY ADVISORS
UNIVERSITY OF BELGRADE, FACULTY OF MECHANICAL ENGINEERING, Street Kraljice Marije 16, 11 120 Belgrade 35

THE REPORT ON ACTIVITIES OF TRAINING ORGANIZATION FOR ENERGY MANAGERS AND ENERGY ADVISORS FOR 2016 AND WORKING PLAN FOR 2017

BELGRADE, MARCH 2017.

The Report on Activities of Training Organization

CONTENTS

Figure 2- 26 Annual Report of 2016 Submitred from MFBU (TO)

(2) Suggestions on Improvement of Monetary Balance and Utilization Rate

TO is operated based on the revenue paid by applicants for EMs and EAs. However, the number of applicants may decrease year by year as the number of qualified persons increases. To avoid a drop in revenue and improve the utilization rate of training facilities, the following measures are suggested.

- Gather participants for one day training from private sector (PT has already created a one day training package).
- Gather participants from third countries (donor's assistance may be necessary).

- Promote the effectiveness of training through seminars, workshops, etc.
- Consider practical training as a university education program.

2.6.8 Implementation of Training in Japan

(1) Objective

Efforts are undertaken to learn the know-how, knowledge and experience for management in EMS accumulated in Japan from the management side and designated organization side.

(2) Schedule

The training schedule is shown below.

Table 2- 24 Training Schedule

Day		AM	PM	Stay
2017/7/4	Tue	Arrival		Tokyo
2017/7/5	Wed	9:00-11:00 Orientation at JICA HQ	13:30-14:00 Explanation of the Training Schedule 14:00-15:00 TEPCO Company Overview 15:00-16:00 Visit of Central Load Dispatching Office	Tokyo
2017/7/6	Thu	10:00-12:00 Visit of METI Local Office (EMS Operation)	14:30-16:30 Visit of Harumi District Coolling	Tokyo
2017/7/7	Fri	9:00-12:00 Move to Hirono Coal P/S	13:00-16:00 Visit of Hirono Coal P/S	Tokyo
2017/7/8	Sat			Tokyo
2017/7/9	Sun			Nikko
2017/7/10	Mon	10:00-11:30 Visit of Nikko Hydro Power Station (Furukawa Electric)	13:15-15:30 Visit of Power Cable Factory (Furukawa Electric)	Tokyo
2017/7/11	Tue	10:00-12:00 Overview of ECCJ (Activities of ECCJ, Training, Examination, Role of ECCJ in EMS)	14:00-16:00 Kaizen Activities in Factory (Furukawa Electric)	Tokyo
2017/7/12	Wed	AM EE equipment, EE activity (Hitachi at Akihabara)	PM Smart City (at Kashiwanoha)	Tokyo
2017/7/13	Thu	9:00-10:30 Smart Meter Installation and Operation Office 10:30-11:30 Energy Saving in TEPCO's HQ Buildiing	14:00-16:30 Visit of TEPCO R&D Center Laboratory Tour of R&D Center Visit of Electricity Museum of TEPCO	Tokyo
2017/7/14	Fri	9:00-10:30 Exchange of Opinions at TEPCO 11:00-12:00 Wrap-up Meeting at JICA	13:00-15:00 Visit of Energy Efficiency Shopping Store	Tokyo
2017/7/15	Sat	Departure		

(3) Participants of the Training

The following participants joined the training (total of 11 members including a member of JICA's Balkan Office).

Table 2- 25 Participants of the Training

	Name & Title	Division, Ministry /Agency
1	Mr. Miloš Banjac Assistant minister	MoME(Ministry of Mining and Energy)
2	Ms. Vesna Rodić Head of group for EE	MoME(Ministry of Mining and Energy)
3	Mr. Slobodan Stojanović Inspector for equipment under pressure	MoME(Ministry of Mining and Energy)
4	Ms. Dragana Jović Engaged for energy efficiency financing mechanisms	MoME(Ministry of Mining and Energy)
5	Mr. Dejan Djukanović Assistant	MFBU(Faculty for Mechanical Engineering, Belgrade University)
6	Mr. Srđan Otović Assistant	MFBU(Faculty for Mechanical Engineering, Belgrade University)
7	Mr. Petar Vasiljević Deputy production of energy director	Public Utility Company "Beogradske elektrane"
8	Ms. Deana Vlasak Chief for investments, reconstruction and adaptation of facilities	Administration for Joint Services of the Republic Bodies
9	Mr. Ljubomir Stojanović Director of Branch Hydro-electric power plant Pirot	JP EPS
10	Mr. Srđan Poledica Leading engineer for steaming systems GP2, Sector for Energetics, Block for Refining of oil	NIS AD Block for Refining of oil
11	Ms. Irena Popovic Officer	JICA Balkan Office

(4) Status of the Training

Some sites in the training are shown below.

District Heating Plant (July 6)
(Harumi Toriton Square)

Coal Power Station (July 7)
(Hirono Thermal Power Plant)

Figure 2- 27 Status of the Training in Japan

Site of Hydro Power (July 10)
(Furukawa Nikko Hydro Power Plant)

Site of Cable Factory (July 10)
(Furukawa Electric Company)

Smart City (July 12)
(Kasiwano-Ha Smart City)

Electricity Historical Museum (July 13)
(TEPCO)

Figure 2- 28 Status of the Training in Japan

Chapter 3 Achievements of the Project

3.1 Achievements of the Project and Future Targets

3.1.1 Progress after the Terminal Evaluation

(1) Overview of the Terminal Evaluation

The Terminal Evaluation for the Project was conducted in October 2016. Reflecting the results of the evaluation, it was decided to extend the period of the Project to December 2017 from April 2017.

At the time of the evaluation, because some outputs described in the Project Design Matrix (PDM) had not been completed as shown in Appendix 7, JICA decided to extend the period to make certain of the project's effects. Thus, PT was able to assist MOME until the first submission of PRs and follow the monitoring work of MOME.

(2) Setting Conditions for Extension of Project Period

JICA set the following conditions for extension of the period

- Security of MOME's Implementation Structure: Strengthening Staff for Training Evaluation and Monitoring of PRs.

  To strengthen MOME's capability for training evaluation and monitoring work, 3 staff members, including the head of Group of Energy Management System, have to be assigned from 2018 and later.
- Creation of Business Plan for SEEC: Strengthening TO for Proper Operation

  To strengthen the TO's sustainable capability to enable proper operation in terms of technical and financial aspects, the TO has to create an annual business plan report and discuss the contents with MOME. MOME and TO review the future business plan for the TO annually.

(3) Clearance of the Conditions for Project Extension

MOME made efforts to secure the budget for the necessary staffing in order to clear the said conditions. As a result, MOME secured the necessary staff for 2018.

In addition, TO submitted the SEEC's business plan annual report and the report was authorized by MOME, JICA and PT at the JCC meeting.

(4) Effects of Project Extension

After the Terminal Evaluation, the Project was accelerated and the following progress could be achieved by December 2017.

(a) Start of Submission of PRs and Review

DOs in the Municipality and Industry Sector started the submission of PRs in accordance with the secondary legislation in June 2017. MOME collected PRs and then completed reviews of the contents

by December 2017.

PT confirmed that MOME used telephone or e-mail for clarification of PRs. However, there is still a problem in collecting PRs from municipalities because it is difficult to establish a system to collect so much information for the whole organization.

(b) Acceleration of Official EM Training

The following table shows the actual results of EM training and examinations. Municipality EM training started from June 2016 and Factory (Industry) EM training started from November 2016. These training sessions have been accelerated, triggered by the Terminal Evaluation.

Because the EMS scheme and the necessity of EM licenses have become known through continuous efforts by MOME, many applicants take the training every time.

Table 3- 1 Actual Results of EM Training and Examinations

Training (Start of Training)	Training		Examination		License
	Applicants	Passed	Applicants	Passed	
Municipality 1st (2016 June)	34	34	34	31	64
Municipality 2nd (2016 Oct)	41	40	36	31	
Municipality 3rd (2017 June)	-	-	15	10	
Industry 1st (2016 Nov)	32	32	51	50	62
Industry 2nd (2016 Dec)	30	30			
Industry 3rd (2017 Jan)	34	34	39	34	
Industry 4th (2017 Jun)	35	35	55	26	
Building 1st (2017 Feb)	39	39	29	21	33
Building 2nd (2017 Oct)	27	27	16	12	

(c) Other Effects

It is thought that a rise in awareness has occurred in MOME and MFBU because the Terminal Evaluation clearly pointed out the Project period. Thus, the following points have been well understood.

- Necessity of strengthening dissemination through website information and various workshops
- Necessity of energy efficiency goods for dissemination
- Effective improvement of SEEC's business plan, etc.

3.1.2 Results of the Expected Output Shown in the PDM

The results of the expected output in the main activities shown in the PDM are summarized below (details are attached in Appendix 7). The item of 100 DOs submitting PRs could not been completed as of December 2017 because 2017 was the first year of submitting PRs. The number of submissions is expected to gradually increase with penetration of the EMS scheme.

Table 3- 2 Results for the Main Activities of the Project

Target	Expected Output	Verification Method	Achievement (as of December 2017)
DO	100 DOs analyze current situation on energy consumption.	Energy Consumption Survey	- 72 Industries - 79 Municipalities - 8 Buildings (Total 159 DOs)
DO	100 DOs prepare the plan to enhance energy efficiency in their periodical report.	Submission of Periodical Reports	- 41 Industries (66 Sites) - 14 Municipalities (Total 55 DOs)
Trainer	At least 4 trainers for EMs and EAs complete the practical training course.	Activities Report of MFBU	- 14 Trainers for Municipality EM - 14 Trainers for Industry EM - 8 Trainers for EA
EM	At least 100 DOs hold qualified Energy Managers. .	Records of Official Training	- 64 Qualified EM in Municipality - 62 Qualified EM in Industry - 33 Qualified EM in Building (Total 159 Qualified EM)
Training Program	Textbook and Sub-textbook for EM Training and EA Training Programs, and Training Facilities and Instruction Manual	-	- Establishment of Training Program for EM - Establishment of Training Program for EA - Installation of Training Facilities - Establishment of Instruction Manual for Training Facilities

Regarding the items in completion of all the secondary legislation and 15 authorizations of EA, they were not fully completed during the Project period. However, MOME wishes to complete them by the first half of 2018.

3.1.3 Overall Goals of the Project in the PDM

In the PDM of the Project, the overall goals are described below. Both goals are targeting 5 years after the start of submission of PRs (2022). Thus, it is too early to evaluate achievement of the overall goals. It is recommended that JICA monitors the achievement of the overall goals annually even after the Project.

Table 3- 3 Overall Goals of the Project

Target	Overall Goal	Verification Method
DO	Five years after the introduction of EMS, on the average of total DOs for five years, the percentage of total energy consumption reduction will be 1 % for a year.	Periodical Reports
DO	Five years after the introduction of EMS, energy audit must be conducted for all DOs in industry sector.	Energy Audit Reports

3.2 Proposal of Future Activity Plan

3.2.1 Short Term Plan for Sustainable Operation

(1) Identified Issues

The following issues have been identified through the implementation of the Project.

- EA will play a key role in improving the quality of periodic reports and performance of DOs. However, the role of EA requires sufficient experience to draw cooperative reactions from DOs and find critical points for energy loss through a one-time walk-through survey. Even though trainees take the EA training program and mentoring, proper manners and know-how can be accumulated by real business experience.
- Quality of the official energy audit is also one of the issues if an EA does not conduct it in the proper way. MOME wishes to create some mechanism to check and secure the accuracy of energy audit reports (site visit at random by MOME's Inspectors, simple check methodology during the site visit by the Inspectors, improvement in the capability of the Inspectors, etc.).
- The energy production sector, such as thermal power and district heating, consumes a lot of energy. It is supposed that this sector has the potential for energy saving through proper management of operation and maintenance.
- To evaluate the performance of DOs among the similar business DOs in the industrial sector,

a benchmarking system should be considered in the creation process for periodic reports as far as possible.

- Collection rate of Periodic Reports is not very high at this moment. It is expected to be raised via information dissemination or continuous support for EMs.

(2) Countermeasures

To tackle the above issues, the following items are proposed as countermeasures.

- Capacity building for EA by enhancing opportunities for energy auditing and providing OJT with professional experts.
- Capacity building for Inspectors via creation of mechanism to check and secure accuracy of energy audits conducted by EAs.
- Creation of energy management methodology in the energy production sector from the viewpoints of operation and maintenance.
- Creation of benchmarking in the industrial sector via development of comparison methodology.
- Further dissemination program to enhance the EMS to the whole country.

3.2.2 Middle Term Vision

PT proposed the middle term targets for 5 years after the Project (towards 2022) as shown below. These targets are drafted under conditions that match the overall goals for the PDM of the Project with reasonable progress level.

Table 3- 4 Middle Term Vision (Draft)

Target 1: Primary Energy Consumption of DO (1% reduction /year)

Reduction of Primary Energy Consumption of DO	2017	2018	2019	2020	2021	2022
	Baseline	Forecasted				
Industry	-	1%	1%	1%	1%	1%
Insdustry	-	1%	1%	1%	1%	1%
Municipality	-	1%	1%	1%	1%	1%
Building	-	1%	1%	1%	1%	1%
Ministry	-	1%	1%	1%	1%	1%
Average	-	1%	1%	1%	1%	1%

Target 2: Number of DO Identified (Assumed Maximum Number: Industry 100, Municipality 79, Building 20, Ministry 10)

Number of DO Identified	2017	2018	2019	2020	2021	2022
	Baseline	Forecasted				
Insdustry	72	86	95	100	100	100
Municipality	79	79	79	79	79	79
Building	8	16	20	20	20	20
Ministry	0	10	10	10	10	10
Total	159	191	204	209	209	209

Target 3: Number of Submitted DO (Assumed Maximum Number: Industry 100, Municipality 79, Building 20, Ministry 10)

Numer of Submitted DO	2017	2018	2019	2020	2021	2022
	Baseline	Forecasted				
Insdustry	41	72	86	95	100	100
	57%	83%	90%	95%	100%	100%
Municipality	14	42	70	79	79	79
	18%	53%	89%	100%	100%	100%
Building	0	8	16	20	20	20
	0%	50%	80%	100%	100%	100%
Ministry	0	5	10	10	10	10
	0%	50%	100%	100%	100%	100%
Total	55	127	182	204	209	209

Target 4: Number of Energy Audit Conducted (All the Industrial DO within 5 years)

Number of Energy Audit Conducted (Accumulated Number)	2017	2018	2019	2020	2021	2022
	Baseline	Forecasted				
Insdustry	0	10	30	60	80	100
Municipality	0	5	10	20	40	79
Building	0	5	10	15	20	20
Ministry	0	0	10	10	10	10
Total	0	20	60	105	150	209
(Annual Number Conducted)	0	20	40	45	45	59

3.3 Summary of the Project

3.3.1 Lessons Learned from the Project

The lessons learned from the Project are summarized as follows.

(1) Good Point: Good Relationship between MOME and MFBU for Preparation of Training Program

MFBU was assigned as the Training Organization (TO) through the Public Call. After that, training

facilities and training of trainers were prepared on schedule. Textbooks and sub-textbooks for EM and EA were prepared together with PT under the supervision of MOME.

To create a textbook regarding energy efficiency, multiple authors cover wide areas and must avoid overlapping. In order to foster good communications with each other, all the parties participate in important meetings and discuss directions, task allocation and schedules.

In the meeting, PT shows a sample of a textbook in Japan and MOME and MFBU can make a version of the textbook for EM and EA effectively.

(2) Point for Reflection: Expansion of Project Period

The period of the Project was extended twice due to the delay in establishment of secondary legislation (Original schedule: 25 months, Revised schedule: 45 months).

There were 14 rulebooks (secondary legislation) to be established and it took more time than in the original plan. Because the details affect all the stakeholders, the Government must create this with careful consideration and coordinate among other related government organizations.

Even though a primary law has been established, creation of secondary legislation may take a great deal of time considering the time needed for authorization by related organizations.

3.3.2 Recommendation to JICA

The Project took more time due to preparation of secondary laws before starting the scheme, because the Government must create the scheme with careful consideration and coordinate among other related government organizations, which has a big impact.

However, the Municipality and Factory DOs started the submission of PRs in 2017 and the Building DO will also start from 2018. The number of EM, which are the people responsible for energy management in an organization, has steadily increased to meet the increase in DO.

MFBU, which is an implementing organization as TO, has accumulated enough experience and skills for the creation of a training program for EMs and EAs including the practical training. However, the number of applicants may decrease year by year as the number of qualified persons increases. To avoid a drop in revenue and improve the utilization rate of training facilities, various countermeasures such as on-demand training from private sector, utilization in a university education program, etc. are suggested.

Through this Project, JICA and PT have assisted in the creation of a nationwide mechanism for energy management as one of the required conditions for EU participation by Serbia. The full-scale implementation, including Building DOs, will finally start from 2018. However, there are still two challenges, which are (i) security of staffing for energy management and (ii) sustainable operation for the official training under circumstances in which applicants for training may gradually decrease. MOME’s continuous efforts to tackle these challenges are crucial.

Energy Auditor (EA) is a higher level position than Energy Manager (EM) because EAs instruct EMs and MOME can monitor their performance through the submission of summary report. Official EA training will start from 2018 and mandatory energy auditing will be conducted by an authorized

EA.

Thus, even after the Project period, it is recommended that JICA periodically monitors proper operation of the EMS scheme including strengthening MFBU's capability and EA's activities.

Appendix

Table of Contents of Appendix

2. Technical Specification of EMS-DB

2.1 Outline of the Database

2.1.1 The purposes of the database

The database concepts are as the following items. The main purposes of the EMS-DB has to be useful an information system for MOME who maintains it and the designated organization (herein after DO) and the sites who use the data. Additionally it is necessary that the system security has to be kept, as the EMS-DB system is accessed through public network by DOs & sites.

- The EMS-DB has to be useful for the DOs & the sites.
- The EMS-DB has to analyze the EMS activities of the DOs & the sites.
- The EMS-DB has to make reports for the related authorities.
- The EMS-DB has to supply the suitable data to the academic persons interested in energy efficiency.

2.1.2 The functions of EMS-DB

The required functions of EMS-DB are as follows;

- EMS-DB has to be built for the targets to be able to analyze the periodical report (herein after P-report) and energy audit summary report (herein after EA-report).
- The contents of the P-report consist of energy consumption data, activities of energy conservation, middle and long term plan, and the contents of the EA-report consist of energy audit date, name of energy auditors, basic information of auditors and energy audit results EMS-DB can manage such kinds of the data and information.
- By the above data in EMS-DB, MOME can make the maintenance of P- reports and EA-reports easily, at the same time, MOME can analyze for time series data of the reports. For realizing the above activities, MOME will maintain and manage the software and hardware for EMS-DB and the related computer systems.
- EMS-DB has two kinds of data files (it called as “Table” in relational database system), one is “Master files” and another is “Transaction files. The master files basically are maintained by MOME, and the transaction files are updated and stockpiled with the annual P- reports by DOs and EA-reports by energy auditors.
- MOME judge the stockpiling years on the past P- reports and EA-reports, the recent computer system has enough capacity to be able to stock the data so many years. (Saying P-report base, it is more than ten years)

2.1.3 System structure

The system connection between DOs & sites and EMS-DB system is as the following figure.

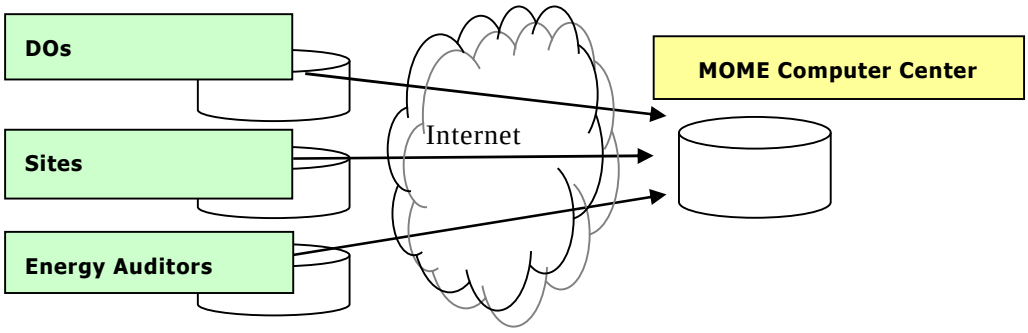


Figure 2.1-1 System connection between users and EMS-DB

- DOs & sites have to enter their P- reports to EMS-DB through internet system by themselves. However as it is afraid that the beginning of EMS or new coming DOs are not familiar to use EMS-DB, such DOs & sites can send their P- reports to MOME by postal mail, e-mail and other electrical devices. In this case, MOME has to enter the P- reports to EMS-DB by their staffs.

- DOs & sites can see their P-reports and EA-reports through internet system, however they cannot see the P- reports and EA-reports of other DOs & sites. And MOME can prepare the some kinds of analytical reports such as distribution maps by the business sectors and energy efficiency positions of DOs & sites from the bench marks and the targets.

- MOME will prepare the following hardware systems for establishing EMS-DB in MOME office.

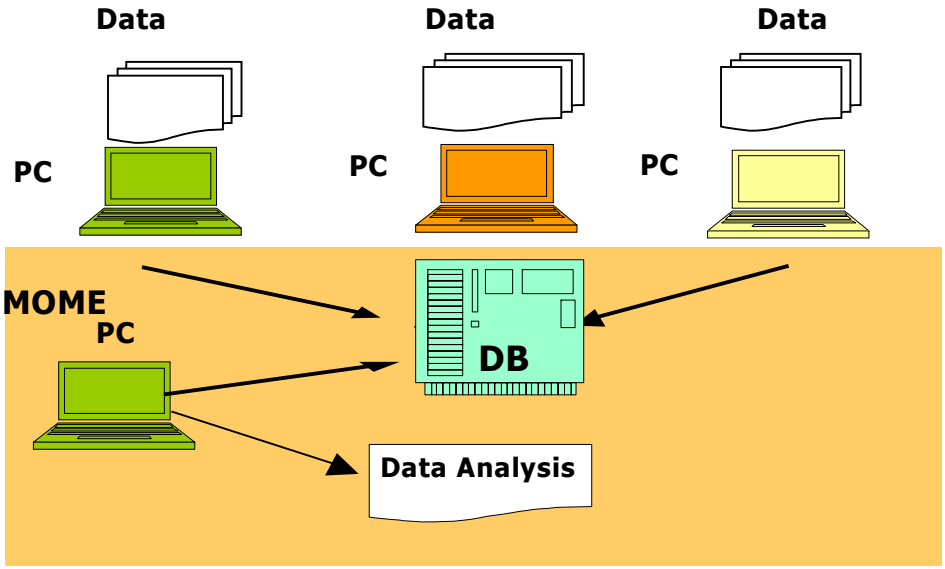


Figure 2.1-2 Hardware System for establishing EMS-DB

2.1.4 Flow of DB development

The contents of the DB development are as follows;

- For building and maintenance of the DB system, Input data (P-reports and EA-reports), EMS analysis items (Data analysis methods), Output formats (Information service) and DB maintenance manual (DB operation standards) should be prepared.
- The contents of DB maintenance rules should be prepared by MOME and the contractor at the time of developing the DB system.
- As EMS-DB is designed under P-reports and EA-reports, the table formats in EMS-DB have to be designed with including data items of the two reports.
- Regarding information service contents, data analytical contents and DB maintenance standards, those have to be designed at the time of detail design at the time of DB development by contractor of the DB system.
- In the TOR, the output formats of the only minimum necessary information contents are designed by MOME and the contractor.
- Regarding the DB maintenance and operation system of MOME, it should be considered at the time of the DB development between MOME and IT experts of the contractor.

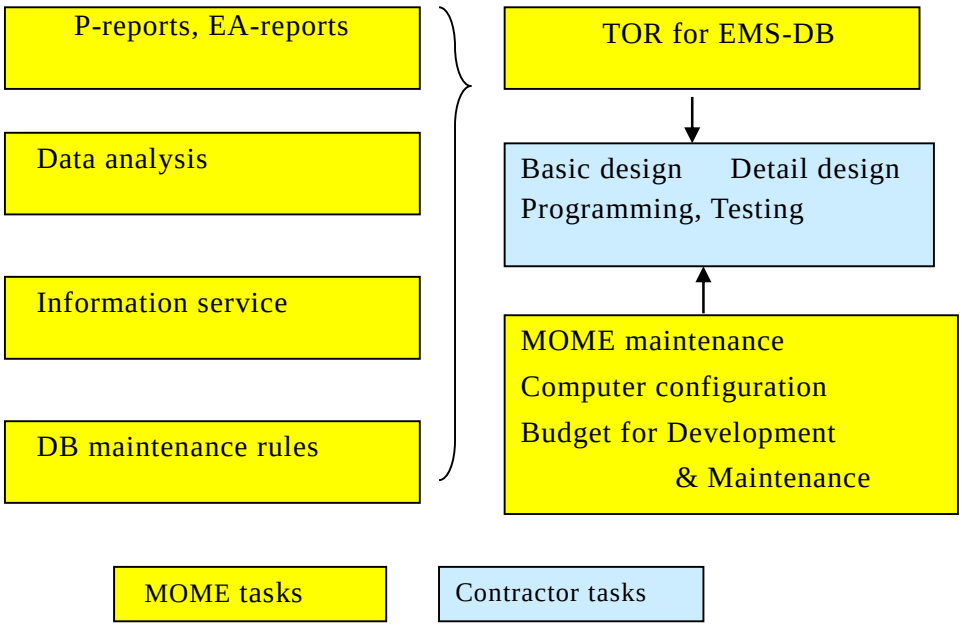


Figure2.1-3 Flow of the DB development

- The system connection overview between the DB and the users is as the following figure. In the figure, there is two phases. The first phase is post mail method for collecting P-reports and EA-reports and the second phase is internet method for collecting the reports. The functions of the phases have to be prepared in the DB system.

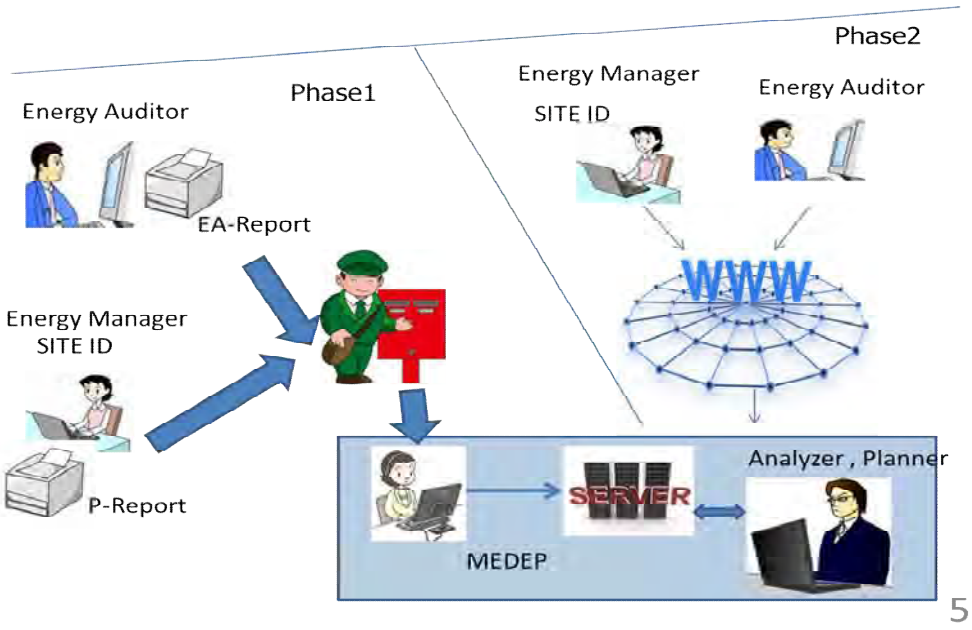


Figure 2.1-4 System Overview for the DB and the users

In phase 1, the papers of P-reports and EA-reports are collected by post mail. The data in the papers are entered to the DB in MOME office.

In phase 2, the data of P-reports and EA-reports are entered through internet system from DO office to the DB in MOME office. As input system for P-report and EA-report, the following procedures can be considered.

	DO and Energy auditor works	MOME works
Phase 1	(1)DOs make the papers of P-report (2) EAs make the paper of EA-report (3)The papers are sent by post mail	(1) The data on paper are entered to Excel sheets in MOME office (2) The Excel sheets are entered to the DB by mapping method.
Phase 2	(1)DOs and EAs make the paper (2)The data on paper are entered to the DB though internet (3) The PDF file converted from the paper are sent to MOME by E-mail	(1) MOME gets the data on PDF by e-mail (2) MOME checks between the data in DB and the data on PDF by e-mail

2.2.1 Inputs and outputs

The following figure shows input data to EMS-DB and outputs from the DB. P-reports are fulfilled by the DOs & sites and EA-reports are made by energy auditors. The reports have to be made by site (factory and building).

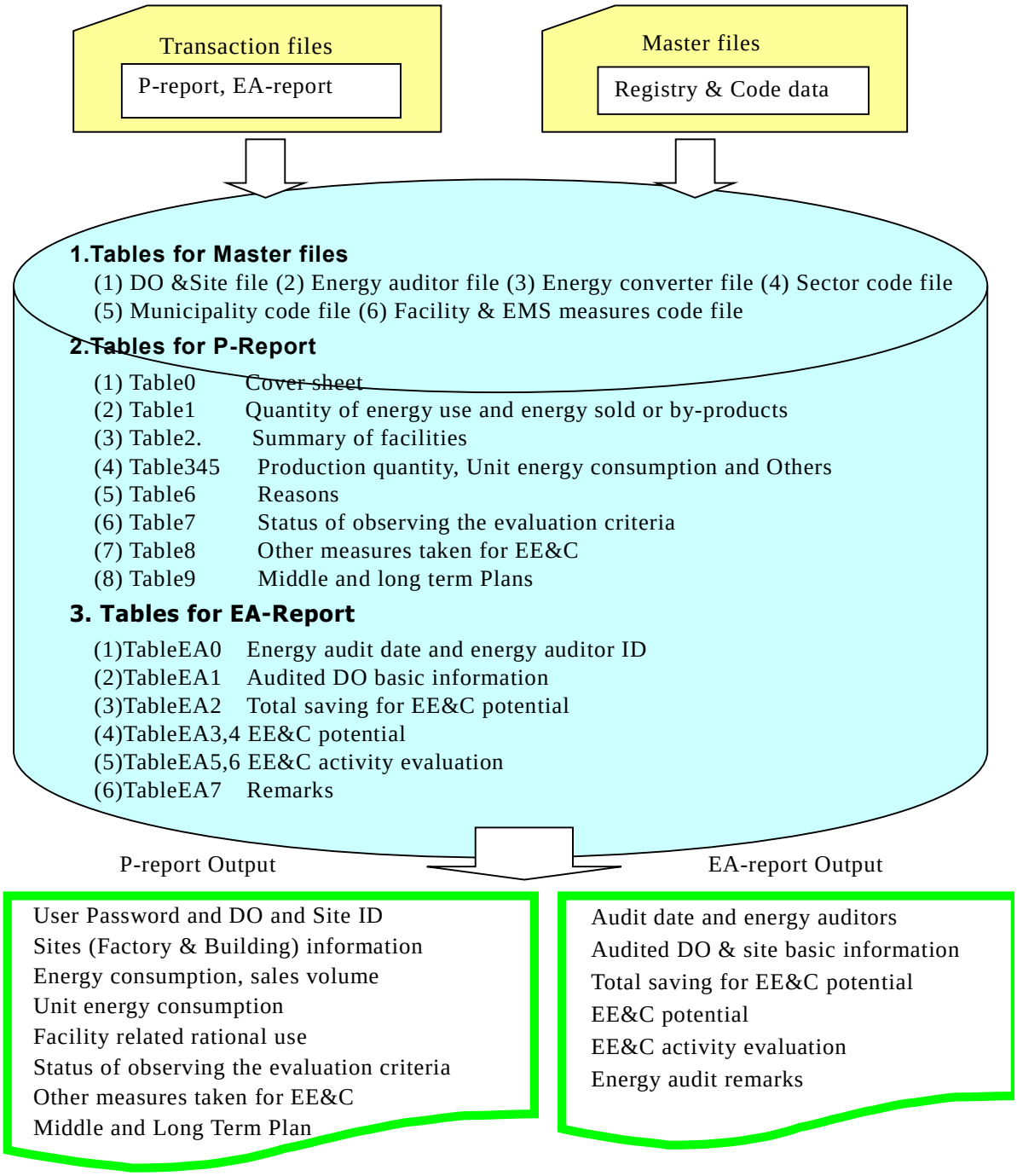


Figure 2.2-1 Input data to EMS-DB and Outputs from the DB

2.2.2 Data collection and maintenance of Master files

The following are the terms for data collection and maintenance of the master files.

- There are six master files for EMS-DB. The master files are (1)DO & Site master file, (2)Auditor master file, (3)Energy conversion master file, (4)Sector code master file, (5) Municipality code master file and (6)Facility & EMS measurement code master files.

- The data for the master files of the above (3), (4), (5), (6) are collected by MOME and the master files are created and maintained by MOME.

- MOME manages "(1) DO & Site master file" and "(2) Auditor master file" when the changes of the existing data are requested from DOs, and new DOs, new Sites and new auditors would like to register to the master files.

- MOME announces to DOs & sites when the energy conversion and sector master files are revised, it can be considered that the announcement has to be done by MOME homepage, and special comments in P- report and EA-report.

2.2.3 DO & Site master file

The DO & Site master file is created and maintained under the following terms.

- The DO-ID and Site-ID are managed by MOME exclusively, and the registration and update of new coming DOs, sites (new factory and new building), municipality and facilities are implemented by MOME.

- MOME announces DO and site IDs and initial Passwords to the DOs & sits. By DOs and sites using the ID and password, they can see their data in EMS-DB through internet system.

- After MOME registers DO & Site ID and other required data in the master files in EMS-DB, the DOs & sites can use EMS-DB. It means that the required formats and data of the designated site in EMS-DB are prepared by MOME.

- As one designated site has one P- report, when a DO has two sites, the P-report has to be created for the two sites. However, in the P- reports, one is the P-report for the whole DO and other two are P-reports of the two sites, those should be submitted from the DOs to MOME.

Table 2.2-1 DO & Site master file

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Year										Year																																										
DO & Site Code										DO-ID																																									
										Site-ID																																											
Registerd Date										Registerd Date																																									
Revised Date										Revised Date																																								
DO administration										DO name																																									
										Municipal Code																																										
										Postal code																																										
										Address																																										
										Phone Number																																										
										FAX Number																																										
										E-mail Address																																										
Enager manager										Energy manager name																																										
										Liecence number																																										
										Department																																										
										Private phone																																										
										Private Fax																																										
										Private E-mail																																										
										Password																																										
Site										Site name																																									
										Municipal code																																										
										Postal code																																										
										Address																																										
										Phone number																																										
										Fax number																																										
										E-mail address																																										
Enager manager										Energy manager name																																										
										Liecence number																																										
										Department																																										
										Private phone																																										
										Private Fax																																										
										Private E-mail																																										
										Password																																										
Business type										Sector-code																																									
										Sub-sector name																																										

Note: The length of DO & Site master file is 70 columns. Only 50 columns of DO & Site master file are shown in the above table. Full format of DO & Site master file should be referred to “DO & Site ” sheet in Master file layout of EXCEL book.

2.2.4 Energy auditor master file

The energy auditor master file is created and maintained under the following terms.

- The Energy Auditor IDs (Accredited ID code, Password) are managed by MOME exclusively, and the registration and update of new auditors are implemented by MOME.

- MOME announces energy auditor ID to the auditors. By energy auditors using the ID and password, they can see their data in EMS-DB through internet system.

- After MOME registers auditor ID and other required data in the master files in EMS-DB, the auditors can use EMS-DB. It means that the required formats of the EA-report in EMS-DB are prepared by MOME.

Table 2.2-2 Auditor master file

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Energy Auditor-ID	Accredited ID code																																																
	Password																																																
	EA name																																															
Company information	Company name																																															
	Address code																																															
	Address																																															
	Phone																																															
	Fax																																															
	E-mail																																															
Private information	Private address code																																															
	Private address																																															
	Phone																																															
	Fax																																															
	E-mail																																															
Update Information	Initial registration y y y y																																															
	m m																																															
	d d																																															
	Latest update y y y y																																															
	m m																																															
	d d																																															

Note: The length of Auditor master file is 70 columns. Only 50 columns of auditor master file are shown in the above table. Full format of Auditor master file should be referred to “Auditor master” sheet in Master file layout of EXCEL book.

2.2.5 Energy conversion master file

The energy conversion master file is created and maintained under the following terms.

- As the data of energy conversion master file, heat values are described in columns of Final energy (toe/unit), Final energy (kWh/unit), Final energy (MJ/unit) and Primary energy (toe/unit) of energy conversion master file, it is used for unit conversion when P- report and EA-report are created.
- The targeted energies managed by P- report and EA-report are Steam & Water, Coal, Oil, Gas, Renewable energies and Electricity.
- Energy codes have to be arranged for each energy and utility in the master file, the energy and utility are handled with the codes in EMS-DB. The contents of the conversion master file should be referred to the following table.

Table 2.2-3 Energy conversion master file

Type of energy	Type code	Codes	Energies	Unit	Density	Final energy (toe/unit)	Final Energy (kWh/unit)	Final Energy (M joule/unit)	Primary energy (toe/unit)	Serbia CO2 factor kgCO2/ kWh	to Carbon Dioxide (CO2kg/ unit)	to Carbon Dioxide (CO2kg/ toe)
						A	B=A*10000*1000/860	C=B*3.6	D=A/Efficiency	E	F=E*B	G=F/A
Fuel & Heat	1	10010	Lignite raw	ton	1.35ton/m3	0.3095	3,599	12,958	0.3095	0.35	1,260	4,070
	1	10020	Lignite dried	ton	1.35ton/m3	0.3869	4,499	16,197	0.3869	0.35	1,575	4,070
	1	10030	Brown Coal	ton	1.55ton/m3	0.4299	4,999	17,997	0.4299	0.35	1,750	4,070
	1	10040	Hard coal	ton	1.35ton/m3	0.5159	5,999	21,596	0.5159	0.35	2,100	4,070
	1	10050	Coke	ton	0.50ton/m3	0.6019	6,999	25,195	0.6019	0.35	2,450	4,070
	1	10060	Coke gas	1000m3		0.4800	5,581	20,093	0.4800	0.20	1,116	2,326
	1	10070	Refinery Gas	1000m3		0.9400	10,930	39,349	0.9400	0.20	2,186	2,326
	1	10080	Gasoline	KL	0.75ton/KL	0.6203	7,212	25,964	0.6203	0.25	1,803	2,907
	1	10090	Kerosene	KL	0.80ton/KL	0.7567	8,798	31,674	0.7567	0.25	2,200	2,907
	1	10100	Diesel	KL	0.85ton/KL	0.7735	8,994	32,379	0.7735	0.25	2,249	2,907
	1	10110	Light fuel oil	KL	0.95ton/KL	0.8985	10,448	37,613	0.8985	0.28	2,925	3,256
		10120	Heavy fuel oil	KL	0.95ton/KL	0.9793	11,388	40,995	0.9793	0.25	2,847	2,907
	1	10130	Oil coke & Heavy end	ton	0.95ton/KL	0.8500	9,884	35,581	0.8500	0.30	2,965	3,488
	1	10140	LPG(Propane-Butane)	ton	0.60ton/m3	0.5675	6,599	23,756	0.5675	0.24	1,584	2,791
	1	10150	Natural gas	1000m3	0.65NG/Air	0.7960	9,256	33,321	0.7960	0.20	1,851	2,326
	1	10160	Wood	1000m3	0.40ton/m3	0.1680	1,953	7,033	0.1680	0.30	586	3,488
	1	10170	Wood waste	ton		0.4500	5,233	18,837	0.4500	0.30	1,570	3,488
	1	10180	Charcoal	ton	0.63ton/m3	0.5233	6,085	21,906	0.5233	0.30	1,825	3,488
	1	10190	Biogas	1000m3		0.9260	10,767	38,763	0.9260	0.20	2,153	2,326
	1	10200	Biomass 1	ton	0.60ton/m3	0.3009	3,499	12,598	0.3009	0.30	1,050	3,488
	1	10210	Biomass 2	ton								
	1	10220	Biomass 3	ton								
	1	10230	Other 1									
	1	10240	Other 2									
	1	10250	Other 3									
	1	10260	Steam	1000kWh		0.0860	1,000	3,600	0.0860	0.40	400	4,651
	1	10270	Hot water	1000kWh		0.0860	1,000	3,600	0.0860	0.40	400	4,651
	1	10280	Geothermal water	1000kWh		0.0860	1,000	3,600	0.0860	0.00	0	0
Electricity	2	20010	From EPS	1000kWh		0.0860	1,000	3,600	0.2606	0.80	800	9,302
	2	20020	From Private producer	1000kWh		0.0860	1,000	3,600	0.2150	0.80	800	9,302
	2	20030	From Solar energy	1000kWh		0.0860	1,000	3,600	0.0860	0.00	0	0
	2	20040	From Geothermal	1000kWh		0.0860	1,000	3,600	0.0860	0.00	0	0
	2	20050	From Wind Energy	1000kWh		0.0860	1,000	3,600	0.0860	0.00	0	0
	2	20060	Other 1									
	2	20070	Other 2									
Water	3	30010	Portable water	1000m3								
	3	30020	Industrial water	1000m3								

Note: Full format of energy conversion master file should be referred to “Convertor” sheet in Master file layout of EXCEL book.

2.2.6 Sector code master file

The sector code master file is created and maintained under the following terms.

- Basically factories and buildings are targeted in the first stage of EMS, mainly, manufacturing sectors have factories and commercial and service sector have large scale buildings.
- The sector and subsector classification names have to be registered in the master file, as example, sector classification names in manufacturing sector are selected from the energy consumption report published by SEEA in 2002 and commercial and service sector classification names are quoted from large electricity consumers of EPS.

Table 2.2-4 Sector code master files

Site Class	Site Class Code	Sector	Code	Subsector	Subsector Code
Factory	1	Non-Ferrous Metals	101	Black Metallurgy	1011
Factory	1	Non-Ferrous Metals	101	Ores and products of Non-	1012
Factory	1	Building Materials	103	Stone, Gravel and Sand	1031
Factory	1	Building Materials	103	Building Materials	1032
Factory	1	Chemical	104	Basic Chemical Products	1041
Factory	1	Chemical	104	Naphtha Derivates	1042
Factory	1	Non-Metals	105	Non-Metallic Minerals	1051
Factory	1	Textile	106	Textile Materials	1061
Factory	1	Textile	106	Final Textile Products	1062
Factory	1	Textile	106	Leather Shoes and Fur	1063
Factory	1	Wood Industry	107	Wood Timber / Lumber	1071
Factory	1	Wood Industry	107	Final Wood Products	1072
Factory	1	Food Industry	108	Food and Tobacco Products	1081
Factory	1	Food Industry	108	Animal Food	1082
Factory	1	Food Industry	108	Beverages and Gum	1083
Factory	1	Metal Industry	109	Plants / Machines	1091
Factory	1	Metal Industry	109	Traffic Vehicles	1092
Factory	1	Metal Industry	109	Metals	1093
Factory	1	Metal Industry	109	Electrical Machines and	1094
Factory	1	Pulp and Paper	110	Production and Paper	1101
Factory	1	Energy	111	Coal and Coal products	1111
Factory	1	Energy	111	Oil Refinery and Oil	1112
Factory	1	Energy	111	Natural gas and supply	1113
Factory	1	Energy	111	District heating supply	1114
Factory	1	Energy	111	Power generation and	1115
Factory	1	Other Industry	112	Building of Ships	1121
Factory	1	Other Industry	112	Graphical/Printing Services	1122
Factory	1	Other Industry	112	Recycling of Raw Materials	1123
Factory	1	Other Industry	112	Various Products	1124

Site Class	Site Class Code	Sector	Code	Subsector	Subsector Code
Building	2	Governm	201	Central Government	2011
Building	2	Governm	201	Municipal	2012
Building	2	Governm	202	Education	2021
Building	2	Governm	202	Institute	2022
Building	2	Public	203	Water Supply	2031
Building	2	Public	203	Gas network	2032
Building	2	Public	203	District Heating	2033
Building	2	Public	203	Public Transport	2034
Building	2	Public	203	Municipal Waste	2035
Building	2	Public	203	Public Transportation	2036
Building	2	Public	203	Public Greenery	2037
Building	2	Public	203	Road Maintenance	2038
Building	2	Public	203	Multifunction P.U.C.	2039
Building	2	Commerc	204	Trade	2041
Building	2	Commerc	204	Whole sales	2042
Building	2	Commerc	204	Detail sales	2043
Building	2	Services	205	Finance and Banks	2051
Building	2	Services	205	Media & IT	2052
Building	2	Services	205	Consulting	2053
Building	2	Services	205	Real estates	2054
Building	2	Services	205	Health and Hospitals	2055

Note: Full format of sector name master file should be referred to “Sector” sheet in Master file layout of EXCEL book.

2.2.7 Municipality code Master File

As EMS is implemented national wide, district names and municipality names are described in the P- report and EA-report. The municipality master file is registration file for including the municipality names and the codes. The following table is a part of the municipality names and code.

Table 2.2-5 Municipality code master file

District	Municipality	District code	Municipal code
Grad Beograd	Barajevo	10	1001
Grad Beograd	Čukarica	10	1002
Grad Beograd	Grocka	10	1003
Grad Beograd	Lazarevac	10	1004
Grad Beograd	Mladenovac	10	1005
Grad Beograd	Novi Beograd	10	1006
Grad Beograd	Obrenovac	10	1007
Grad Beograd	Palilula	10	1008
Grad Beograd	Rakovica	10	1009
Grad Beograd	Savski Venac	10	1010
Grad Beograd	Sopot	10	1011
Grad Beograd	Stari Grad	10	1012
Grad Beograd	Surčin	10	1013
Grad Beograd	Voždovac	10	1014
Grad Beograd	Vračar	10	1015
Grad Beograd	Zemun	10	1016
Grad Beograd	Zvezdara	10	1017
Borski Okrug	Bor	11	1101
Borski Okrug	Kladovo	11	1102
Borski Okrug	Majdanpek	11	1103
Borski Okrug	Negotin	11	1104
Branicevski	Veliko Gradište	12	1201
Branicevski	Požarevac	12	1202
Branicevski	Golubac	12	1203
Branicevski	Malo Crniće	12	1204
Branicevski	Žabari	12	1205
Branicevski	Petrovac	12	1206
Branicevski	Kučevo	12	1207
Branicevski	Žagubica	12	1208
Jablanicki okrug	Leskovac	13	1301
Jablanicki okrug	Bojnik	13	1302
Jablanicki okrug	Lebane	13	1303
Jablanicki okrug	Medveđa	13	1304
Jablanicki okrug	Vlasotince	13	1305
Jablanicki okrug	Crna Trava	13	1306
Kolubarski okrug	Osečina	14	1401
Kolubarski okrug	Ub	14	1402
Kolubarski okrug	Lajkovac	14	1403
Kolubarski okrug	^Valjevo	14	1404
Kolubarski okrug	Mionica	14	1405
Kolubarski okrug	Ljig	14	1406
Mačvanski okrug	Bogatić	15	1501
Mačvanski okrug	Šabac	15	1502
Mačvanski okrug	Loznica	15	1503
Mačvanski okrug	Vladimirci	15	1504
Mačvanski okrug	Koceljeva	15	1505
Mačvanski okrug	Mali Zvornik	15	1506
Mačvanski okrug	Krupanj	15	1507
Mačvanski okrug	Ljubovija	15	1508
Moravički okrug	Gornji Milanovac	16	1601
Moravički okrug	Čačak	16	1602
Moravički okrug	Lučani	16	1603
Moravički okrug	Ivanjica	16	1604
Nišavski okrug	Aleksinac	17	1701
Nišavski okrug	Svrljig	17	1702
Nišavski okrug	Merošina	17	1703
Nišavski okrug	Ražanj	17	1704
Nišavski okrug	Doljevac	17	1705
Nišavski okrug	Gadžin Han	17	1706
Nišavski okrug	Medijana	17	1707
Nišavski okrug	Niška Banja	17	1708
Nišavski okrug	Palilula	17	1709
Nišavski okrug	Pantelej	17	1710
Nišavski okrug	Crveni Krst	17	1711
Pčinjski okrug	Vladičin Han	18	1801
Pčinjski okrug	Surdulica	18	1802
Pčinjski okrug	Bosilegrad	18	1803
Pčinjski okrug	Trgovište	18	1804
Pčinjski okrug	Vranje	18	1805
Pčinjski okrug	Bujanovac	18	1806
Pčinjski okrug	Preševo	18	1807
Pirotski okru	Bela Palanka	19	1901
Pirotski okru	Pirot	19	1902
Pirotski okru	Babušnica	19	1903
Pirotski okru	Dimitrovgrad	19	1904
Podunavski okrug	Smederevo	20	2001
Podunavski okrug	Smederevska	20	2002
Podunavski okrug	Velika Plana	20	2003

Note: Full format of Municipality code master file should be referred to “Municipality” sheet in Master file layout of EXCEL book.

2.2.8 Facility & EMS measurement code master files

P-report and EA-report use facility group names and EMS measurement names. The facility & EMS measurement master tables with the codes are as follows;

Table 2.2-6 Facility & EMS measurement code master files

Facility classification	Code
Combustion facility	10
Heating: equipment & others	20
Heating: air conditioning,water supply	21
Waste heat recovery facility	30
Power generation facility: gas turbine of power generation &others	40
Power generation facility: boiler of cogeneration & others	41
Heat loss prevention facility by radiation, conduction, resistance and others	50
Electricity loss prevention facility by radiation, conduction, resistance and	51
Electricity utilizing facility: converting to power and heat and others	60
Electricity utilizing facility: converting to lighting facility	61
Others	70

Measurements classification	Code
Establishing management standards	1
Observing measurement/record	2
Observing maintenance/inspection	3
Measures to be taken on new installation	4
Others	5

2.2.9 Creating and Maintenance for master files by MOME

For creating and maintenance of the master files, the registration and update are required for the master files.

Table 2.2-7 Initialization and Update of the master files

Master file names	Registration	Update
DO & Site	○	○
Auditor	○	○
Energy conversion		○
Sector code		○
Municipality code		○
Facility & EMS measurement		○

MOME maintains the above six master files. It is essential for MOME that the master files are linked to other information systems such as “MOME-Web system”、”MOME-Mail system”、”GIS system” and Other code system defined by other ministries.

2.3 Transaction files

2.3.1 Initialization and Maintenance of P-report as transaction files

The followings are the terms for maintaining P-reports. As reference, the P-report input sheet described by DOs and P-report file format in the DB are shown in Appendix 1.

- P-reports are major data sources as the transaction file of EMS-DB. Maintenance system of the P-reports almost equal to the maintenance of EMS-DB. The P-reports are registered once a year by DOs & sites. Such kind of the P-report is called as transaction file. The transaction files are basically updated at any time except annual maintenance period of P-report by MOME.
- Regarding the data storage years of P-reports in EMS-DB, it is discussed by MOME when developing EMS-DB. The recent computer server has enough capacity for storing the data for more than ten years as P-report size, the storage years of P-reports in EMS-DB can be judged at aspect of the institutes of EMS without the constrains of the computer capacity.
- When DOs & sites would like to change their DO & Site ID, MOME maintains after the information are reached from the DO or site. The contents of DO & Site master file are maintained by MOME.
- The DOs & sites can revise their values and items of the transaction files by themselves through internet system. However, DOs & sites cannot change the DO names, building names, municipality names and sector & subsector names. If the DOs & sites would like to change these items, DOs have to inform it to MOME, the revise works should be done by MOME.
- MOME makes the transaction files backup for security, the backup operation has to be implemented every day basically. And also MOME will back up when the master files are revised and updated.
- When DOs & sites cannot input technically their P-report to the EMS-DB, MOME will support their operations. Concretely, MOME will input the P-reports to the EMS-DB instead of the DOs & sites.
- Before starting EMS, the data entry procedures and technical knowledge are explained by MOME through user's manual and seminars held by MOME in the whole country.
- The following shows the relation between file contents in P-report and table name in EMS-DB. Basically the all kinds of file contents in P-reports are entered to the tables in EMS-DB.

Table 2.3-1 Relational Tables between the P-report and EMS-DB

EMS-DB	P-report contents
Table 0	DO cover sheet and information
	Site ID, Address, Business type
	Energy manager information
	Energy audit information
Table 1	Energy consumption to be consumed
	Renewable energy consumption
	Utilization of water
Table 2	Facilities and equipment
Table 3	Production and Energy consumption trends
Table 4	Unit energy consumption
Table 5	Trends of unit energy consumption
Table 6	Reasons not to be achieved
Table 7	Compliance check with evaluation criteria
Table 8	Other measures for EE&C
Table 9	Middle and long term plan

- Basically the contents of P- report are entered to EMS-DB through terminals of internet system in DOs & sites. Otherwise it is entered through MS-EXCEL sheets to EMS-DB. Apart from the entry methods, the initial data entry to P-report has to be operated by DOs & sites.
- Therefore, the functions of the EMS-DB for initializing and maintaining the transaction files have to be able to enter the data through Web and MS-EXCEL sheets. Additionally it is required that the functions of the DB can maintain the transaction files.

2.3.2 Maintenance of EA-report as transaction files

The followings are the terms for maintaining EA-report. As reference, the EA-report input sheet described by auditor and EA-report file format in the DB are shown in Appendix 2.

- EA- report is major data sources for the transaction file of EMS-DB as well as P-report. The EA-reports are revised by energy auditor. Therefore, EA-report is one of transaction file in EMS-DB.
- Regarding the data storage years of EA-reports in EMS-DB, it is attributed in the same period as the storage years of P-report.
- When energy auditor would like to enter a new DO and a new site, the energy auditor has to register the DO and Site ID before doing the operation, the registration is implemented only by MOME.
- The DOs & sites cannot revise the values and any items of the EA-report files by own operation through internet system. If the DOs & sites would like to change these items, DOs have to inform it to the energy auditor, the revise works of EA-report should be done by the energy auditor and MOME.
- The following shows the relation between file contents in EA-report and table names in EMS-DB. Basically the all kinds of file contents in EA-reports are entered to the tables in EMS-DB.
- Basically the contents of EA-report are entered to EMS-DB through terminals of internet system of energy auditor. Therefore, the functions for initializing and maintaining the EA-reports have to be able to enter the data through Web. Additionally it is required to be able to maintain EA-reports.
- EA-report tables of EMS-DB are relational table formats. The functions for handling the tables are prepared for the following DB tables.

Table 2.3-3 Table functions for initializing and maintaining EA-report files

Table NO	Functions
Table 0	Energy audit date and energy auditors
Table 1	Basic information.
Table 2	Total EE&C saving for EE&C potential
Table 3	Energy saving by Energy for EE&C potential
Table 4	Energy saving by Measure for EE&C potential
Table 5	Total score for Evaluation of EE&C activities
Table 6	Each evaluation for Evaluation of EE&C activities
Table 7	Remarks

2.4 Functions of the Outputs

The followings are output information and the functions for the DB. MOME needs the outputs for maintaining EMS and EMS-DB. The most of the outputs are PC screen, paper and electrical devices, the required outputs are as follows;

- Basically the followings are output contents of P-report and EA-report files of EMS-DB.
- More complicate analysis outputs should be discussed when making the detail design between MOME and contractor.

Table 2.4-1 Output on P-report and EA-report files

Report	Output NO.	Contents of the outputs
P-report	Output 1	DO names, Site names, Site IDs and Pass words
	Output 2	DO information
	Output 3	Site information
	Output 4	Energy consumption
	Output 5	Facility and equipment
	Output 6	Unit energy consumption yearly trends
	Output 7	Reasons not to be EE&C
	Output 8	Compliance and evaluation of EE&C
	Output 9	Other measures
	Output 10	Middle and long term plan
EA-report	Output 11	Energy audit date and energy auditors
	Output 12	DO & Site Basic information
	Output 13	Total saving for EE&C potential
	Output 14	Energy saving by Energy for EE&C potential
	Output 15	Energy saving by Measure for EE&C potential
	Output 16	Total score for Evaluation of EE&C activities
	Output 17	Each evaluation for Evaluation of EE&C activities
	Output 18	Remarks

2.5 Offered documents from MOME

For the database development, MOME prepares the following documents and information to the contractor of the DB development.

- P-report format and EA-report format used for EMS conducted by MOME.
- Computer configuration information such as hardware and software including operating system and package database system prepared by MOME.
- Basic design for the database system prepared by JICA IT expert, however, the basic design just reference for developing the database. The contractor should review it and propose the own basic design to MOME.
- The data required the DB development such as P-reports and EA-reports for testing the DB development are prepared and supplied by MOME.
- The schedule for the DB development basically is shown by MOME, however, it is negotiable between MOME and the contractor.

2.6 Criteria and acceptance of work achievement

For completing and finalizing the DB development, the expected products and documents from the contractor to MOME are as follows;

- Regarding the EMS-DB system

  The DB system has to have and process the functions directed by MOME including the input functions of P-report and EA-report, the data processing functions, the data output functions and the data maintenance functions.

- Verification of the database completeness

  Verification means to be able to handle completely the above functions. For showing the verification, the contractor has to demonstrate the DB operation to the stakeholders including MOME and DOs.

- Making manuals

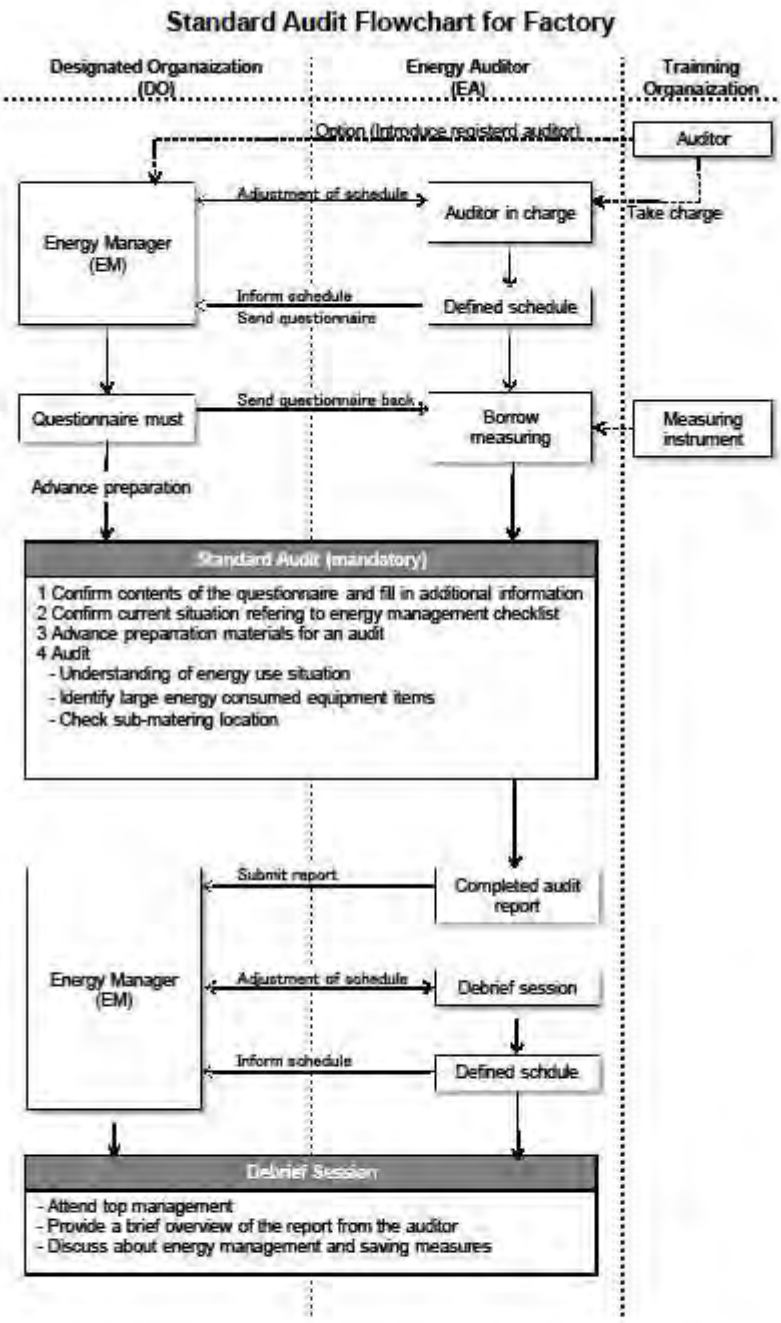
  For users and MOME staffs to implement the operation and the maintenance of the system, the contractor has to make “System manual”, “Operation manual” and “User’s manual”. Especially user’s manual has to be described with deep contact to MOME due that it strongly connects how to use the DB between MOME and DOs.

- Continuity of the DB system updating

  It is predicted that the functions of the database system are very changeable due to enhancing the utilization of the database system. The contractor has to correspond to update the database system. The updating contract for the system should be discussed between MOME and the contractor.

Appendix 2: Report Format of Energy Audit

<Factory>



Questionnaire for Commercial Factory

Input cell	Sellected cell	No input

1 Outline of I Address

Registered Number of DO				
Site -ID				
Name of site				
Site address				
	TEL:		E-mail	
Business type of factory				
Registered license number of Energy Manager				
Date of accredited energy auditor in the latest yyyy/mm/dd				

2 Outline of Building (Need to fill in)

No. of user	Weekday	persons	Weekend	persons
Total floor area		m^2		

3 Outline ot building services (Fill in as far as you can)

EPS	Contract conditions		Voltage	
	Contract demand			

		Name of major equipment	Energy	Capacity	No. of unit	Operation hour
Major equipment	Chillers					
	Air compressors					
	Others					
	Gas operated equipment					

4 Energy Consumption (Need to fill in)

Year	Month	Electricity				Fuel and Heat						Water supply	
		Power demand	EPS	Solar energy	Wind Energy	Natural gas	Lignite raw	Lignite raw	Lignite raw	Hard Coal	Steam	City water	Industrial water
		kW	kWh	kWh	kWh	m3	t	t	t	t	kWh	m^3	m^3
2013	1												
	2												
	3												
	4												
	5												
	6												
	7												
	8												
	9												
	10												
	11												
	12												
Sum		—	0	0	0	0	0	0	0	0	0	0	0
Cost [1000RSD/y]		—											
Unit cost [RSD/unit]		—	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Corresponding value of primary energy		—	0.0001 toe/kWh	0.0001 toe/kWh	0.0001 toe/kWh	0.0008 toe/m3	0.3095 toe/t	0.3095 toe/t	0.3095 toe/t	0.5159 toe/t	0.0001 toe/kWh	-	-
Primary energy consumption		—	0	0.0	0	0	0	0	0	0	0	—	—
Corresponding value of CO2 emission		—	0.00080 tCO2/kWh	0.00000 tCO2/kWh	0.00000 tCO2/kWh	0.00020 tCO2/m3	0.00035 tCO2/t	0.00035 tCO2/t	0.00035 tCO2/t	0.00035 tCO2/t	0.40000 tCO2/kWh	-	-
CO2 emission		—	0	0	0	0	0	0	0	0	0	—	—

5 Value related to energy usage (Select from that of raw material, production, sales total)

Year	Month	Raw material t
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
Sum		0

	Quantity	Unit
Primary energy consumption	0	toe
Energy intensity	#DIV/0!	toe/t

6 Operating time of factory

Days of annual use								
Operating time			~				~	
			~				~	
			~				~	
			~				~	
			~				~	

7 Implemented energy saving measures in past years (Need to fill in)

Item 1		Result	
Item 2		Result	
Item 3		Result	
Item 4		Result	
Item 5		Result	

8 Desired items for Audit (At your descretion)

Items	Specific content and reason etc.

9 Advance Preparation prior to Audit

Materials		Reply	Remarks
Checklist	Energy management situation checklist		
Data on energy usage	Expense sheet related to energy usage		
	Specific data on major equipment		
As built drawing	Layout (Building & Facility)		
	Equipment list		
	Single-line diagram of electrical facility		
	Diagram of steam, air and air conditioning piping		
Administration	Daily and monthly report on power		
	Maintaion records of inspection for access to electricity		
Measuring	Data on interior environment measurement		

10 Energy management situation checklist

	Items	Question	Answer	Score	Sum
Management system	Organisation in place?	Is there a designated person or post with responsibility for energy management		0.00	0
	Announcement of main goals	Any promotion by posters, slogans etc.		0.00	
	Coordination with related posts	Are several members of personnel actively participating?		0.00	
	Record of activities	Are energy management activities recorded?		0.00	
	Systematic training of personnel	Is training provided for personnel working on energy management?		0.00	
Operating management	Operating standard	Are there any operating standards for main systems?		0.00	0.0
	Operation managers	Are there any designated operation managers in accordance with standards?		0.00	
	Peak power management	Is attention paid to peak power using demand meter etc?		0.00	
	Review of standards	Are operating standards revised on an as needed basis?		0.00	
Measurement & Record	Energy consumption	Are there records (paper chits, memos etc.) of energy usage?		0.00	0
	System operation period	Are operating times recorded for main combustion, cooling, lighting systems etc.		0.00	
	Separate energy measurements	Knowledge of energy usage according to different departments or application?		0.00	
	Data on system operation conditions	Are measurements of temperature, illuminance, current etc. taken?		0.00	
	Quality control	Is there any precision management, calibration of main meters?		0.00	
Maintenance	Maintenance and inspection standards	Are there any standards for maintenance and inspection of main systems?		0.00	0.0
	Maintenance and inspection log	Are there any records of maintenance and inspection of main systems?		0.00	
	Drawing maintenance	Are as-builts and system drawings maintained?		0.00	
	Scheduling of repairs and renewals	Are scheduled repairs or renewals planned based on the inspection records?		0.00	
Visualization of energy	Energy graph preparation	Are graphs showing energy data prepared?		0.00	0
	Previous year's data comparison	Is there energy data from the previous year?		0.00	
	Distribution of data	Is there internal distribution of energy usage conditions?		0.00	
	Output unit management	Is there any management of output units?		0.00	
	Data analysis	Is analysis of increases or decreases in energy usage carried out?		0.00	
efforts to energy saving	Target setting	Are there any target settings for energy saving?		0.00	0.0
	Target review	Is there a review of energy saving targets?		0.00	
	System improvement	Is there any implementation or review of system improvements or remedial measures?		0.00	
	Results of improvement	Is there any verification of the efficacy of improvements or remedial measures?		0.00	

2. Overview of building and systems

Outline	Name of site	0			
	Address	0			
	total floor area	0 m^2			
Electricity	Contract condition	0			
	Contract demand	0			
		Name of major equipment	Capacity	No. of unit	Operation hour
Major equipment	Chillers	0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
	Air compressors	0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
	Others	0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
	Gas operated equipr	0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h
		0	0kW	0	0 h

Implemented energy saving measures in past years	Item 1	1900/1/0	Result	0
	Item 2	1900/1/0	Result	0
	Item 3	1900/1/0	Result	0
	Item 4	1900/1/0	Result	0
	Item 5	1900/1/0	Result	0

3. Energy usage conditions

	Energy consumption		Cost	CO2 emission
	[toe/year]	[%]	[1000RSD/year]	[t-CO2/year]
EPS	0	0%	0	0
Solar energy	0	0%	0	0
Wind Energy	0	0%	0	0
Natural gas	0	0%	0	0.000
Lignite raw	0	0%	0	0.000
Lignite raw	0	0%	0	0.000
Lignite raw	0	0%	0	0
Hard Coal	0	0%	0	0
Steam	0	0%	0	0
sub total	0	0%	0	0.0
City water	-	-	0	-
Industrial water	-	-	0	-
Total	0	-	0	0.0

Natural gas 0%

EPS 0%

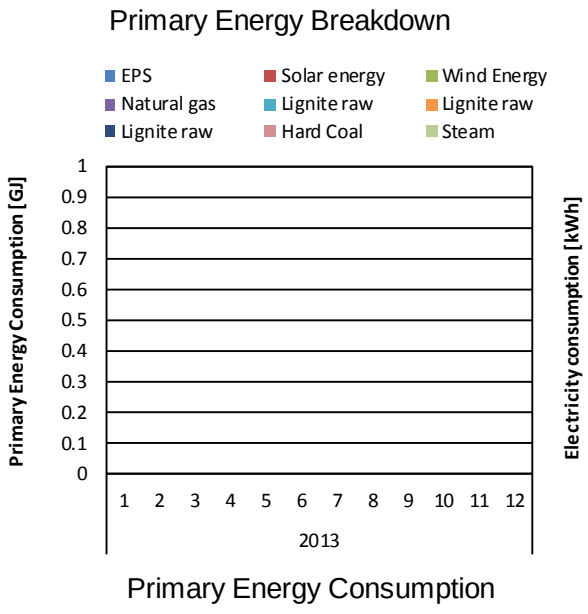
#DIV/0!
toe/t

City water 0%

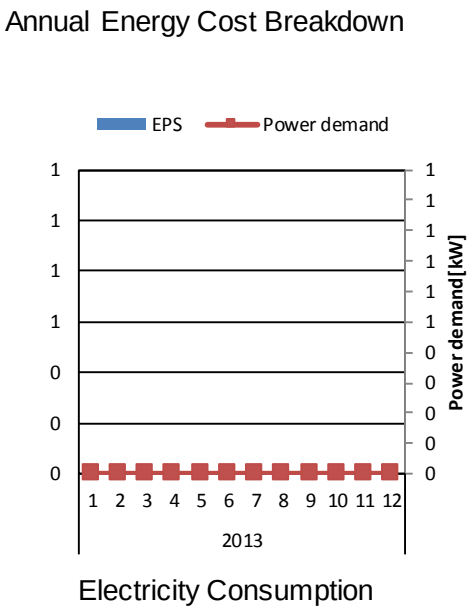
Natural gas 0%

EPS 0%

#DIV/0!
RSD/t

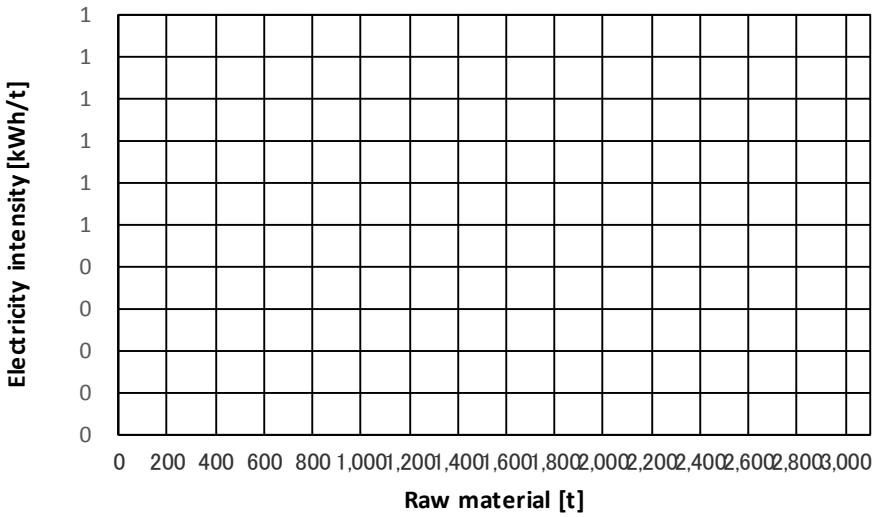


Primary Energy Consumption

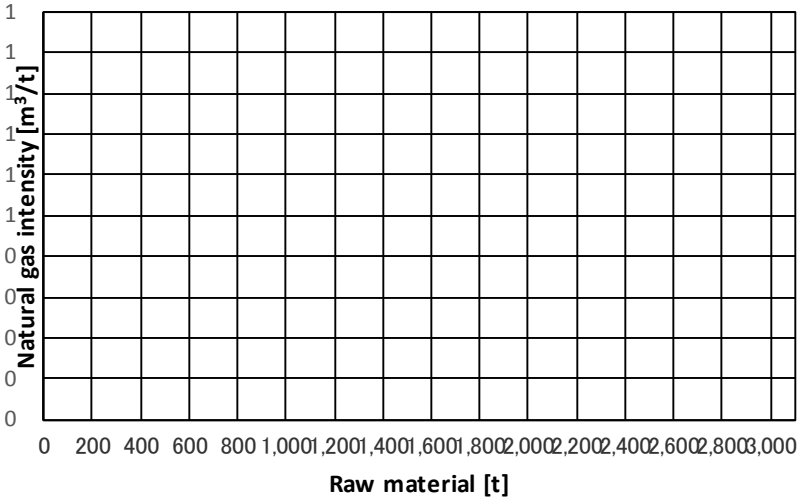


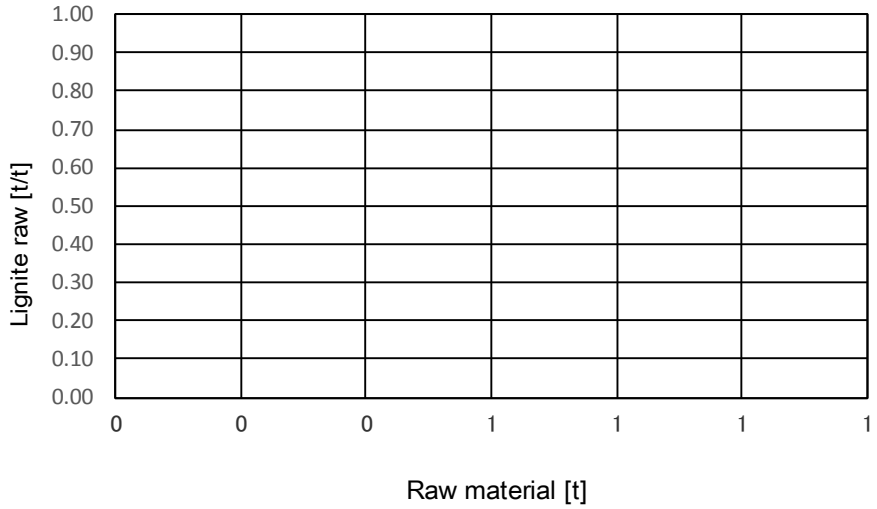
Electricity Consumption

4.Raw material/Production vs. Electricity Consumption

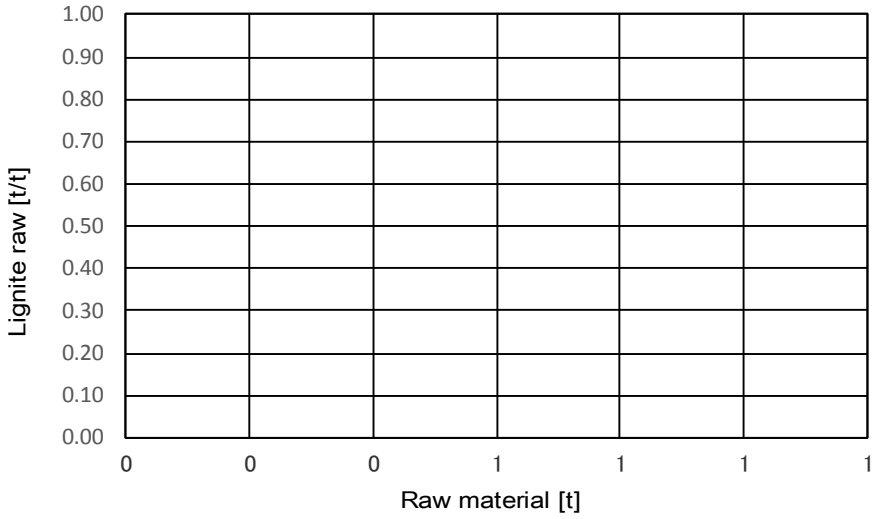


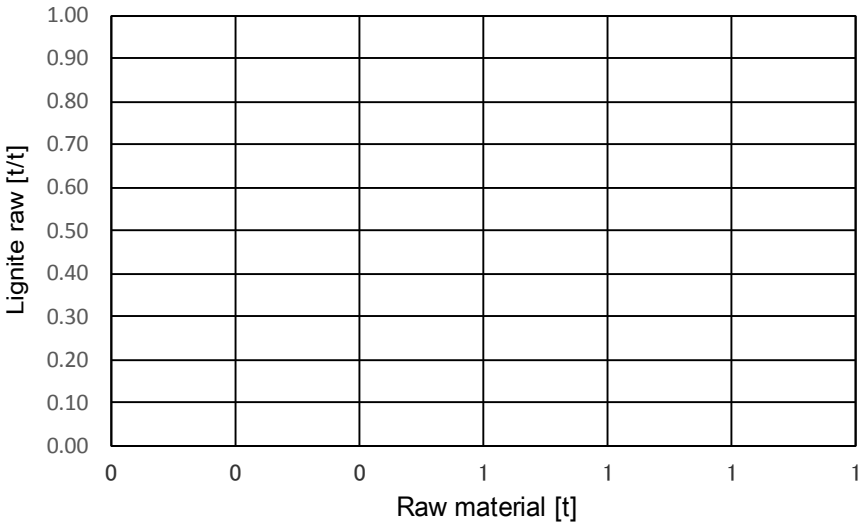
5.Raw material/Production vs. Fuel and Heat Consumption

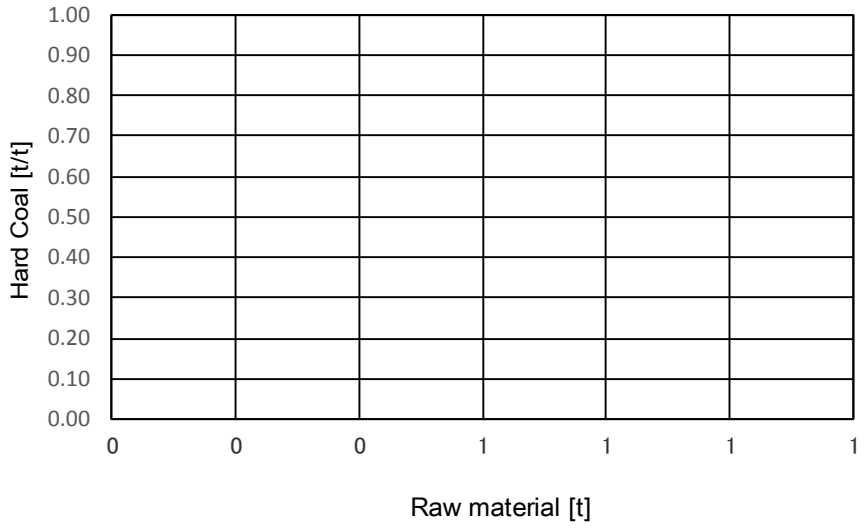




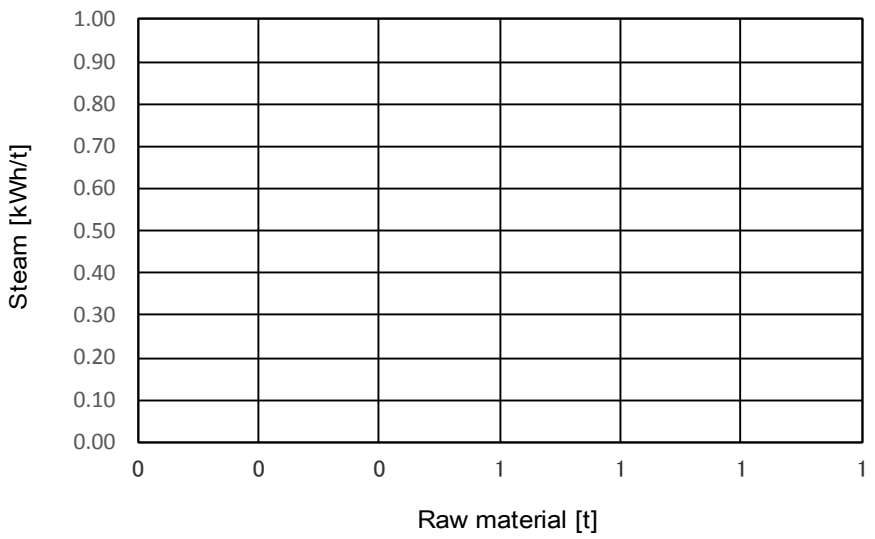
5.Raw material/Production vs. Fuel and Heat Consumption



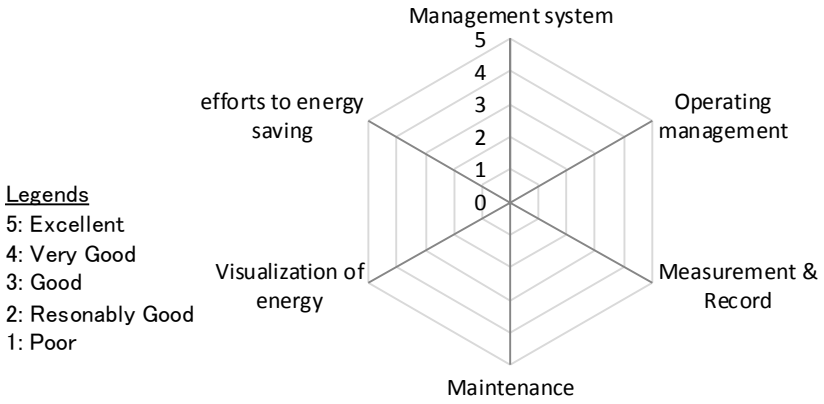




5.Raw material/Production vs. Fuel and Heat Consumption



6. Energt management conditions



6. Proposals for improvements

Input cell	Sellected cell

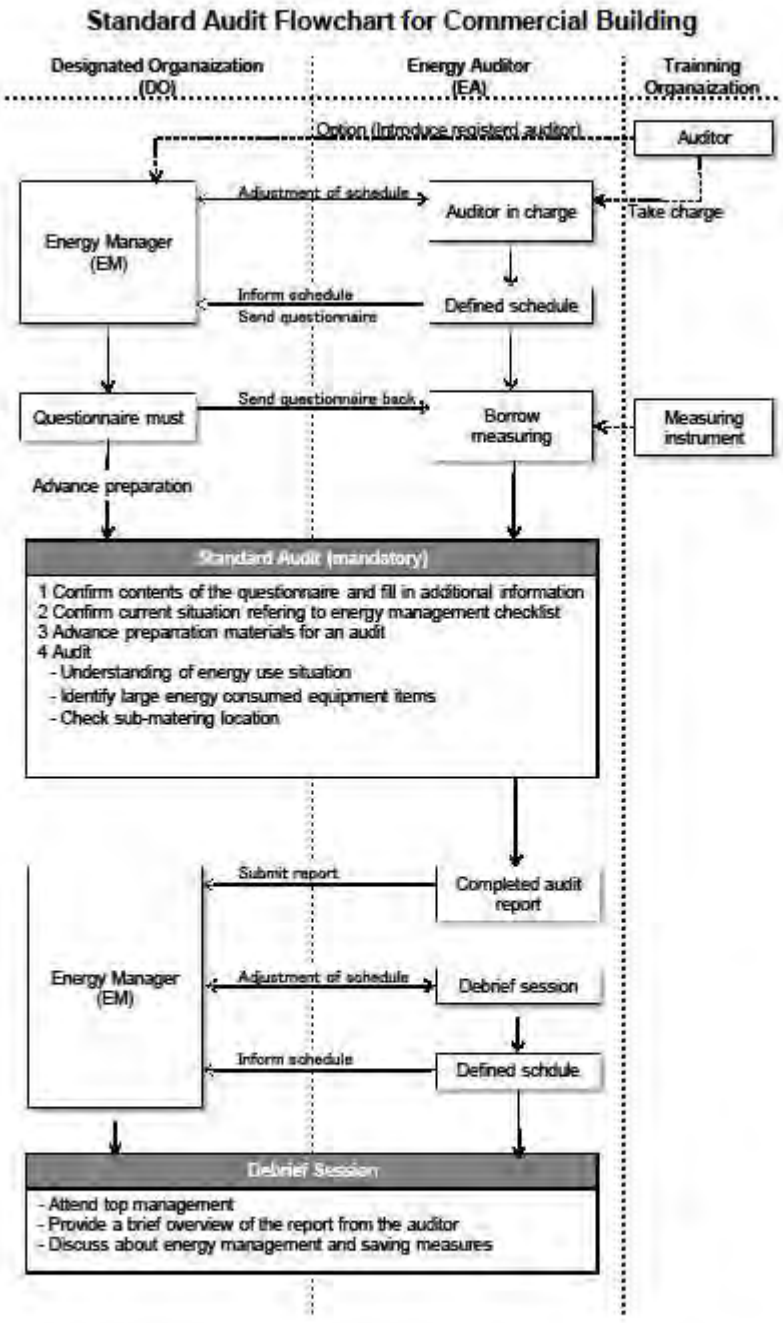
No	Energy saving measures	Energy	Primary energy saving note[1] [elec・gas・water/year]			CO_2 emission [t-CO_2/year]	Saving cost [1000RSD]	Initial cost[2] [1000RSD]	Pay back period [year]
A No Cost Measures (Improvements in usage)									
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
					#N/A				0.0
					#N/A				0.0
					#N/A				0.0
					#N/A				0.0
					#N/A				0.0
					#N/A				0.0
					#N/A				0.0
Sum	Electricity		0	toe/y		0	0	0	
	Fuel and Heat		0	toe/y	-	0	0	0	–
	Water supply		0	m^3/y		0	0	0	
B Low Cost Measures (Remodeling to recover investment capital within 5 years)									
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
Sum	Electricity		0	toe/y		0	0	0	0.0
	Fuel and Heat		0	toe/y	-	0	0	0	0.0
	Water supply		0	m^3/y		0	0	0	
C High Cost Measures (Large scale remodeling)									
					#N/A				0.0
					#N/A				0.0
					#N/A				0.0
					#N/A				0.0
					#N/A				0.0
Sum	Electricity		0	toe/y		0	0	0	
	Fuel and Heat		0	toe/y	–	0	0	0	–
	Water supply		0	m^3/y		0	0	0	

Note1: Values in parentheses indicate energy saving ratio compared to annual consumption.

Note2: Initial cost is approximate estimate and should be considered further prior to the implementation.

Energy Saving Measures (A and B)		
Reduced Energy Consumption		
Electricity	0.0 toe/year	#DIV/0!
Fuel and Heat	0.0 toe/year	#DIV/0!
Primary Energy	0.0 toe/year	#DIV/0!
Water Supply	0 m^3/year	#DIV/0!
Annual Saving Cost	0 RSD	#DIV/0!

<Building>


Standard Audit Flowchart for Commercial Building
Designated Organaization (DO)
Energy Auditor (EA)
Trainning Organaization
Option (Introduce registerd auditor)
Auditor
Adjustment of schedule
Auditor in charge
Take charge
Energy Manager (EM)
Inform schedule
Send questionnaire
Defined schedule
Questionnaire must
Send questionnaire back
Borrow measuring
Measuring instrument
Advance preparation
Standard Audit (mandatory)
1 Confirm contents of the questionnaire and fill in additional information
2 Confirm current situation refering to energy management checklist
3 Advance preparation materials for an audit
4 Audit
- Understanding of energy use situation
- Identify large energy consumed equipment items
- Check sub-matering location
Submit report
Completed audit report
Energy Manager (EM)
Adjustment of schedule
Debrief session
Inform schedule
Defined schdule
Debrief Session
- Attend top management
- Provide a brief overview of the report from the auditor
- Discuss about energy management and saving measures

1/9

Questionnaire for Commercial Bulding

Input cell	Sellected cell	No input

1 Outline of I Address

Registered Number of DO				
Site -ID				
Name of site				
Site address				
	TEL:		E-mail	
Registered license number of Energy Manager				
Date of accredited energy auditor in the latest yyyy/mm/dd				

2 Outline of Building (Need to fill in)

Use			
No. of user	Weekday persons	Weekend persons	
Total floor area	m^2		
Structure			

3 Outline ot building services (Fill in as far as you can)

EPS	Contract conditions		Voltage	
	Contract demand			

			Name of major equipment	Energy	Capacity	No. of unit	Operation hour
Air conditioning	Refrigeration system						
	Heating system						
	Others						
	AC system		No.1				
			No.2				
			No.3				
Plumming	Water supply	System					
		Type					
	Hot water	System					
		Heater					

4 Energy Consumption (Need to fill in)

Year	Month	Electricity				Fuel and Heat						Water supply	
		Power demand	EPS	Solar energy	Wind Energy	Natural gas	Hard Coal	Heavy fuel oil	Kerocine	Biomass	Steam	City water	Industrial water
		kW	kWh	kWh	kWh	m3	t	t	m3	t	kWh	m^3	m^3
2013	1												
	2												
	3												
	4												
	5												
	6												
	7												
	8												
	9												
	10												
	11												
	12												
Sum		—	0	0	0	0	0	0	0	0	0	0	0
Cost [1000RSD/y]		—											
Unit cost [RSD/unit]		—	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Corresponding value of primary energy		—	0.0001 toe/kWh	0.0001 toe/kWh	0.0001 toe/kWh	0.0008 toe/m3	0.5159 toe/t	0.9458 toe/t	0.9458 toe/m3	0.3009 toe/t	0.0001 toe/kWh	-	-
Primary energy consumption		—	0	0.0	0	0	0	0	0	0	0	—	—
Corresponding value of CO2 emission		—	0.00080 tCO2/kWh	0.00000 tCO2/kWh	0.00000 tCO2/kWh	0.00020 tCO2/m3	0.00035 tCO2/t	0.00028 tCO2/t	0.00025 tCO2/m3	0.00030 tCO2/t	0.40000 tCO2/kWh	-	-
CO2 emission		—	0	0	0	0	0	0	0	0	0	—	—

Primary energy consumption	toe/y	0
Energy intensity	$toe/m^2/y$	#DIV/0!

5 Utility Time and Air Conditioning Usage Situation (Fill in as far as you can)

Utility Time	Cooling			Heating		
AC usage period		~			~	
Days of use						
AC operating time		~			~	
Set temp. and humid						

6 Implemented energy saving measures in past years (Need to fill in)

Item 1		Result	
Item 2		Result	
Item 3		Result	
Item 4		Result	
Item 5		Result	
Item 6		Result	

7 Desired items for Audit (At your descretion)

Items	Specific content and reason etc.

8 Advance Preparation prior to Audit

Materials		Reply	Remarks
Checklist	Energy management situation checklist		
Data on energy usage	Expense sheet related to energy usage		
	Specific data on major equipment		
As built drawing	Layout (Building & Facility)		
	Equipment list		
	Single-line diagram of electrical facility		
	Diagram of steam, air and air conditioning piping		
Administration	Daily and monthly report on power		
	Maintaion records of inspection for access to electricity		
Measuring	Data on interior environment measurement		

9 Energy management situation checklist

	Items	Question	Answer	Score	Sum
Management system	Organisation in place?	Is there a designated person or post with responsibility for energy management		0.00	0
	Announcement of main goals	Any promotion by posters, slogans etc.		0.00	
	Coordination with related posts	Are several members of personnel actively participating?		0.00	
	Record of activities	Are energy management activities recorded?		0.00	
	Systematic training of personnel	Is training provided for personnel working on energy management?		0.00	
Operating management	Operating standard	Are there any operating standards for main systems?		0.00	0.0
	Operation managers	Are there any designated operation managers in accordance with standards?		0.00	
	Peak power management	Is attention paid to peak power using demand meter etc?		0.00	
	Review of standards	Are operating standards revised on an as needed basis?		0.00	
Measurement & Record	Energy consumption	Are there records (paper chits, memos etc.) of energy usage?		0.00	0
	System operation period	Are operating times recorded for main combustion, cooling, lighting systems etc.		0.00	
	Separate energy measurements	Knowledge of energy usage according to different departments or application?		0.00	
	Data on system operation conditions	Are measurements of temperature, illuminance, current etc. taken?		0.00	
	Quality control	Is there any precision management, calibration of main meters?		0.00	
Maintenance	Maintenance and inspection standards	Are there any standards for maintenance and inspection of main systems?		0.00	0.0
	Maintenance and inspection log	Are there any records of maintenance and inspection of main systems?		0.00	
	Drawing maintenance	Are as-builts and system drawings maintained?		0.00	
	Scheduling of repairs and renewals	Are scheduled repairs or renewals planned based on the inspection records?		0.00	
Visualization of energy	Energy graph preparation	Are graphs showing energy data prepared?		0.00	0
	Previous year's data comparison	Is there energy data from the previous year?		0.00	
	Distribution of data	Is there internal distribution of energy usage conditions?		0.00	
	Energy intensity management	Is there any management of energy intensity?		0.00	
	Data analysis	Is analysis of increases or decreases in energy usage carried out?		0.00	
Efforts to energy saving	Target setting	Are there any target settings for energy saving?		0.00	0.0
	Target review	Is there a review of energy saving targets?		0.00	
	System improvement	Is there any implementation or review of system improvements or remedial measures?		0.00	
	Results of improvement	Is there any verification of the efficacy of improvements or remedial measures?		0.00	

2. Overview of building and systems

Outline	Bulding name	0				
	Address					
	Principal use	0				
	total floor area	0 m^2				
	Structure					
Electricity	Contract condition	0				
	Contract demand	0				
Air conditioing	Refrigeration system					
	Heating system					
	AC system	Item 1				
		Item 2				
		Item 3				
	AC usage period	Cooling	0月 ～ 0月	Heating	0月 ～ 0月	
	Days of use	Cooling	0	Heating	0	
	Operating time	Cooling	0:00 ～ 0:00	Heating	0:00 ～ 0:00	
Plumming	Water supply	System				
		Type				
	Hot water	System				
		Heater				

Implemented energy saving measures in past years	Item 1		Result	
	Item 2		Result	
	Item 3		Result	
	Item 4		Result	
	Item 5		Result	
	Item 6		Result	

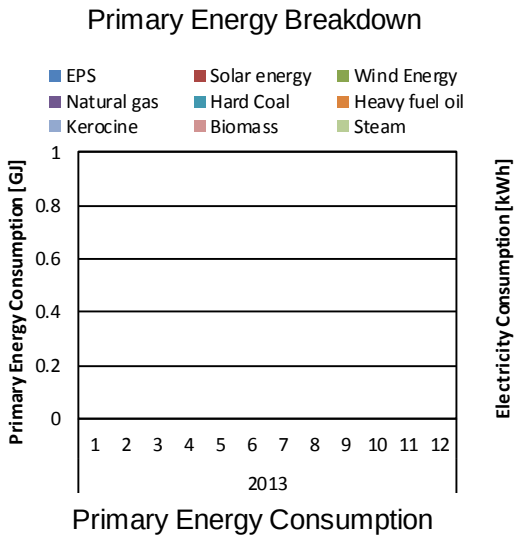
	Energy consumption		Cost	Unit cost	CO2 emission
	[toe/year]	[%]	[1000RSD/year]	[RSD/unit]	[t-CO2/year]
EPS	0	0%	0	0.0	0
Solar energy	0	0%	0	0.0	0
Wind Energy	0	0%	0	0.0	0
Natural gas	0	0%	0	0.0	0
Hard Coal	0	0%	0	0.0	0
Heavy fuel oil	0	0%	0	0.0	0
Kerocine	0	0%	0	0.0	0
Biomass	0	0%	0	0.0	0
Steam	0	0%	0	0.0	0
sub total	0	0%	0		0
City water	-	-	0	0.0	-
Industrial water	-	-	0	0.0	-
Total	0	-	0		0

Natural gas 0% Biomass 0% EPS 0% Steam 0%

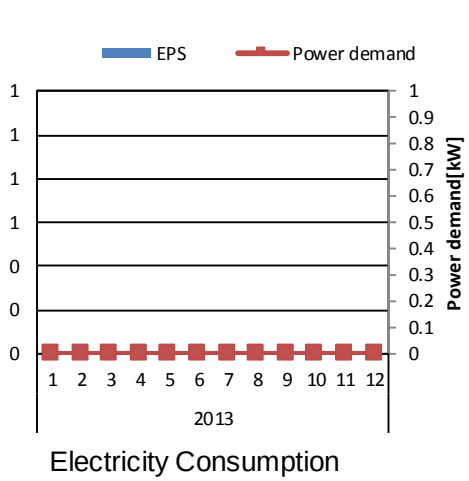
#DIV/0!
toe/m²/y

City water 0% Natural gas 0% EPS 0%

#DIV/0!
RSD/m²/y

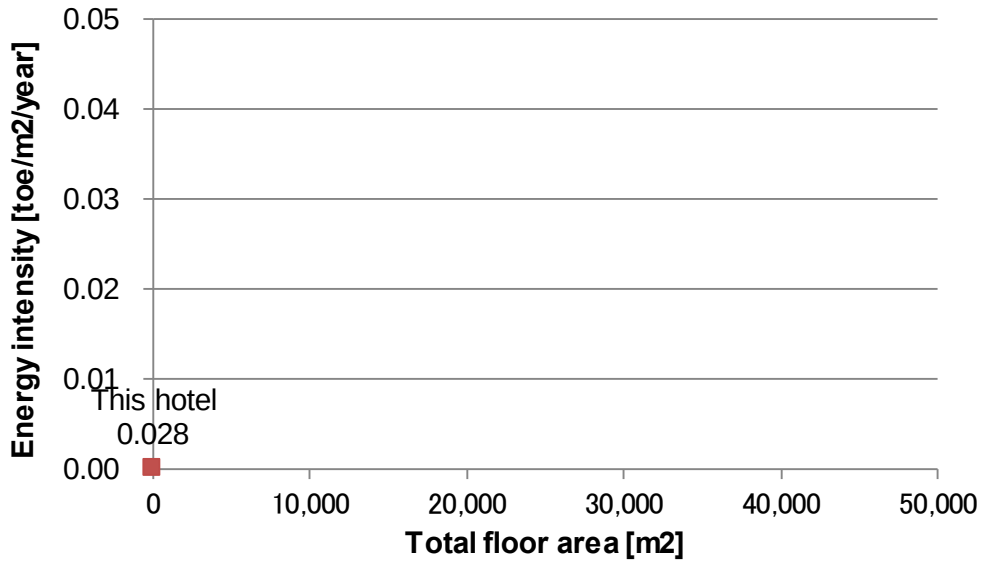


Primary Energy Consumption

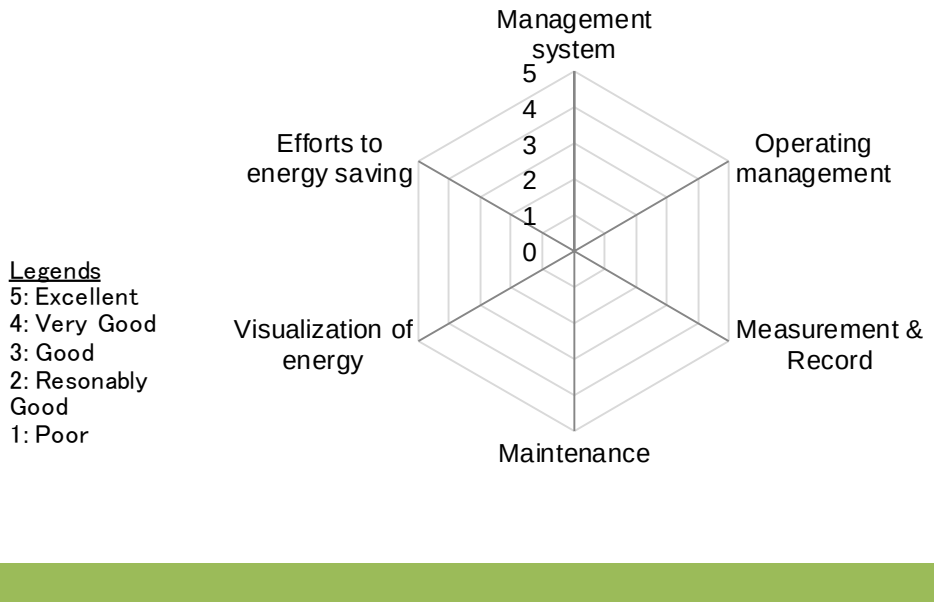


Electricity Consumption

4. Comparison of energy cunsumption



5. Energt management conditions



6. Proposals for improvements

Input cell	Sellected cell

No	Energy saving measures	Energy	Primary energy saving [1] [elec・gas・water/year]			CO_2 emission [t-CO_2/year]	Saving cost [1000RSD]	Initial cost [2] [1000RSD]	Pay back period [year]
A No Cost Measures (Improvements in usage)									
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
Sum	Electricity		0.0	toe/y		0	0	0	
	Fuel and Heat		0.0	toe/y	-	0	0	0	-
	Water supply		0.0	m^3/y		0	0	0	
B Low Cost Measures (Remodeling to recover investment capital within 5 years)									
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
Sum	Electricity		0.0	toe/y		0	0	0	
	Fuel and Heat		0.0	toe/y	-	0	0	0	-
	Water supply		0.0	m^3/y		0	0	0	
C High Cost Measures (Large scale remodeling)									
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
				toe/y	#N/A				0.0
Sum	Electricity		0.0	toe/y		0	0	0	
	Fuel and Heat		0.0	toe/y	-	0	0	0	-
	Water supply		0.0	m^3/y		0	0	0	

Note1: Values in parentheses indicate energy saving ratio compared to annual consumption.

Note2: Initial cost is approximate estimate and should be considered further prior to the implementation.

Energy Saving Measures (A and B)		
Reduced Energy Consumption		
Electricity	0.0 toe/year	#DIV/0!
Fuel and Heat	0.0 toe/year	#DIV/0!
Primary Energy	0.0 toe/year	#DIV/0!
Water Supply	0.0 m^3/year	#DIV/0!
Annual Saving Cost	0 RSD	#DIV/0!

Appendix 3: Table of Contents of Energy Auditor Textbook

.

Table of Contents

PART 2

TECHNICAL SPECIFICATIONS

- 0 -

General Specification

Table of Contents

1. Introduction

This inquiry specification has been prepared by Japan International Cooperation Agency (hereinafter "JICA") to construct an energy conservation training plant under the cooperation of JICA.

The training plant (hereinafter "the Plant") is used for practical training to learn energy conservation technologies.

General conditions of this procurement are as follows:

(1) Location of the Plant: University of Belgrade, Faculty of Mechanical Engineering
(2) Buyer: JICA
(3) Duration of work: 9 months
(4) Schedule: Refer to the Attachment 1-1 " Schedule of EE&C Training Plant Installation (Tentative)"
(5) The units and common utility facilities in the Plant
- Boiler unit
- Steam trap unit
- Compressor unit
- Pump unit
- Common utility facilities (City water supply system, power supply system and Water drainage system)

2. Scope of the work

The following works should be done for installing the Plant.

(1) To design both basic and detail layout
(2) To purchase and deliver the required equipment and materials
(3) To conduct the following works
- Foundation work to install the equipment and tiling work around the equipment
- The following building work
  - To install shed for fuel Propane cylinders at the boiler unit
  - To make openings on the wall or window for duct and pipe lines
  - To cover the opening of existing pipe trench
- Steel structure work
- Equipment installation work
- Piping work
- Duct and stack work
- Drainage work

- Installation work of city water supply system
- Insulation work
- Painting work
- Labeling work of equipment and pipe lines
- Instrument work
- Electrical work
- Common work of utility facilities
- Other required work

(4) To prepare for commissioning work of the Plant after the mechanical completion
(5) To conduct commissioning of the Plant
(6) To dispatch the operation instructors
- Commissioning
- About one week after the commissioning

(7) To submit the required documents
(8) To acquire necessary permission for all the work
(9) To provide fuel Propane cylinders required for the commissioning of boiler unit
(10) To conduct required works based on the fire safety design and instruction by the Fire Police Department as additional works

3. Items out of the scope

The following items are excluded as the items out of scope.

(1) Refurbishment work of the training room (Lighting, etc.)
(2) Procurement of data logger for the boiler unit, air compressor unit and pump unit
(3) Procurement of laptop PC's of the boiler unit, air compressor unit and pump unit
(4) Data transfer from data loggers to laptop PC's
(5) Payment of utilities (Power, City water) cost during site work including preparation work for commissioning and commissioning.

4. Contents of the training

Each unit must have the functions to enable trainers to instruct the following required training contents to trainees.

(1) Boiler unit
a. To understand boiler facilities and operation
b. To measure and calculate boiler efficiency at the following conditions

- Too high and adequate air ratio at full and partial load boiler operation (Understanding the effectiveness of adequate air ratio operation)
- Use and disuse of economizer at full and partial load boiler operation (Understanding the effectiveness of economizer)
- Lowering steam pressure at full and partial load boiler operation and adequate air ratio (Understanding the effectiveness of lowering steam pressure)

c. To understand insulation effect on uninsulated valve

(2) Steam trap unit

a. To understand various kinds of steam traps, the characteristics and selection of proper type steam traps
b. To understand importance of periodical maintenance
c. To observe rain fall influence on steam traps

(3) Air compressor unit

a. To understand air compressor facilities and operation
b. To understand effectiveness of inverter air compressor
c. To measure and calculate pipe line pressure drop
d. To measure leaking air volume from small holes
e. To demonstrate high efficient air blow nozzle

(4) Pump Unit

a. To understand centrifugal pump operation and characteristic
b. To measure and make pump performance curve
c. To measure and calculate inverter pump effectiveness
d. To confirm inverter loss (Comparison of power consumption at the rated rotating speed between inverter operation and direct grid power operation)
e. To measure and calculate pipe line pressure drop

5. Applied laws, regulations and standards

The installation work shall obey the following laws, regulations and standards.

- SRPS standard
- The Rulebook for the steam boiler and pressure vessel
- The Rulebook for low voltage electrical installation
- The Rulebook for protection of low voltage installation and transformer
- The Rulebook for protection from static electricity
- The Rulebook on electric explosive proof installation
- The Rulebook on the construction, installation and testing electric explosive proof appliance

- The Law on planning and construction
- The Rulebook on allowed noise level
- The Law on the health and safety at work
- The Law on the fire safety
- EN standard
- Other related laws, regulations and standards

6. Basic design data

(1) Unit of measurement

a. Temperature: ºC
b. Pressure: Pa, kPa, MPa, mmH2O, psi
c. Flow rate: Nm^3/hour, m^3/hour, L/min, kg/h
d. Velocity: m/sec

(2) Climate condition

a. Ambient temperature: Max. 38 ºC
Min. -15 ºC
b. Wind velocity: Max. 40 m/s
c. Rainfall: Max.: 50 mm/h
d. Snow fall: Max. 300 mm

(3) Utilities conditions

a. Fuel
- Kind of fuel: Propane
- Net heating value: 46,355 kJ/kg (HHV: 55,300 kJ/kg)
- Density: 1.8954 kg/Nm^3
- Temperature: Ambient temperature

b. City water
- Pressure: 0.2 MPaG
- Temperature: Ambient temperature
- Water quality
  - Total Hardness: 238 mg$CaCO_3$/L (13.36 dH)
  - Electric conductivity: 450 mS/m
  - Fe: 0.05 mg/L
  - Manganese : 50 mg/L
  - Silica: 2.5 mg/L
  - Chloride: 200 mg/L
  - Alkalinity: 3.5 mmol/L

c. Electric power:
- High voltage: 380 V, 50 Hz, 3 Phases 4 Lines

- Low voltage: 220 V, 50 Hz, Single phase 3 Lines

7. Basic design requirement

The Plant must satisfy the following requirements:

(1) For effective training, the Plant must satisfy the following requirements:
- The plant has necessary functions for training purposes.
- Trainers are able to educate trainees on energy saving technologies effectively and accurately by using the Plant.
- The plant is designed compactly and neatly in order for trainees to understand the overall operation easily.
- The Plant is configured effectively to enable easy operation and measurement.

(2) Every training unit is designed to operate safely, and they must have required safe guards and interlock systems to avoid any troubles such as fire, electric shock, etc.

(3) The equipment and piping are located compactly because of the limited space.

(4) The following a part of air compressor unit and pump unit is installed in each steel frame.
a. Air compressor unit: A part for studying pressure drop of tube and hose, air leakage from small holes and high efficient blow nozzles
b. Pump unit: All equipment and piping

(5) They must have the configuration to enable to be easily maintained.

8. Common specification

Common specification of each work item is as follows:

(1) Foundation and tiling work
a. Fundamentally the following equipment is set up on channel bases of approximately 100mm in height. The anchor bolts for fixing with the floor shall have enough pull-out strength and required number.
- Boiler and auxiliary equipment at boiler unit
- Air compressor and auxiliary equipment at air compressor unit
- Training module of air compressor unit

b. The existing floor tiles are removed in the minimum area for the places of

newly installed equipment. And after the installation, the floor tiles around newly installed equipment are restored and repaired.

(2) Building work

a. Making required openings in the wall or window of the training room for the following stack and pipe line.
   - Exhaust gas stack of boiler unit
   - Exhaust steam pipe line to atmosphere of boiler unit
   - Vent line of blow tank and boiler feed water tank of boiler unit
   - Outlet pipe line of safety valve on fuel Propane pipe line
   - Others (if required)

b. As for the openings, the following measures are considered.
   - Rain seal of the openings
   - Thermal expansion of the stack and pipe lines

(3) Piping

a. Materials are selected as indicated in the unit specification.
b. Pipe line size and material selected appropriately considering the kind of fluid, pressure, temperature, flow rate (fluid velocity).
c. Suitable pipe supports are installed at necessary places.
d. Thermal expansion of piping is considered.
e. Air tighten tests are implemented under 120% of the working pressure.
f. Flushing at preparation work for commissioning is implemented by water or compressed air.
g. Use of asbestos is not allowed.

(4) Painting

a. Use heat resistant paint
b. Anti-rust: ZnO type anti-rust paint (double coat)
c. Top coat: Alkyl type polymer paint (double coat)
d. When spray painting is applied, follow manufacture’s standard.
e. Color
   - Steam pipe line: Silver/Gray (BS-10A03, RAL-9007)
   - Water and steam condensate pipe line: Green (BS-12D45, RAL-6003)
   - Fuel Propane pipe line: Yellow (BS-08C35, RAL-1007)
   - Compressed air pipe line: Light Blue (BS-20E51, RAL-5024)
   - Steel frame and pipe support: Dark Blue (BS-20D45, RAL-5019)
   - Equipment supplied by supplier: According to suppliers standard

(5) Labelling work of equipment and pipe lines

a. Entry contents on label

- Static equipment and rotating machines: Equipment number and name
- Field mounted instruments: Tag number
- Pipe lines: Fluid name and flow direction on appropriate points
- Language: English

b. Specification of label
- Kind of label: Self-adhesive plastic label
- Color of Label and character: White and black
- Size of letter: Appropriate size for identification

(6) Thermal insulation

a. Insulation material: Rock wool or glass wool
b. Insulation thickness: Min. 20 mm
c. Insulation cover: Steel or aluminum plate
d. Surface temperature of insulation: higher than 80 ºC
e. Personnel protection by insulation on hot parts
- Surface temperature: 60 ~ 80 °C
- Range of insulation: up to 2 m above floor)
- Insulation material and thickness: Glass wool or rock wool, 20 mm (Minimum thickness)
- In case that the insulation is not applied such as air cooler, wire mesh is installed surrounding them.

f. Some parts on steam pipe lines, valves of boiler unit and steam trap unit are not insulated for training purpose, and the uninsulated hot parts shall be surrounded with wire mesh a little apart from the surface for personnel protection.

(7) Power source

a. Machinery power: 380 V, Three phases, 50 Hz
b. Control and general power source: 220 V single phase, 50 Hz

(8) Wiring

a. Cable size must be selected to minimize voltage drop along the line.
b. The interconnections must be gathered and neatly routed.
c. The connections must be safely guarded.

(9) Grounding

a. Grounding for equipment is required.
b. Grounding resistance: lower than 10 Ω

(10) Process flow display panel

The following 3 process flow display panels are prepared in order to explain the

contents of each unit to the trainees. Refer to the unit specification for the details.

- Boiler and steam trap unit
- Air compressor unit
- Pump unit

.

(11) Safety

a. Rotating parts such as rotating shafts and coupling are covered by safety guards.
b. The valves for manual operation can be reachable from safe places.
c. Indicators of local gauges are read clearly from safe places.
d. High temperature parts are covered by thermal insulation or wire mesh for personnel protection.
e. The site installation work is undertaken with the necessary safety measures.

(12) Factory test

a. Factory test of each completed product is conducted in accordance with each manufacturer's standard.
b. As for the following equipment, the factory test results are submitted to Consultant before shipping.
   - Boiler and auxiliary facilities at boiler unit
   - Air compressors and auxiliary facilities at air compressor unit
   - Pump and auxiliary facilities at pump unit
c. As for the boiler and auxiliary facilities, Consultant conducts the factory witness inspection.

(13) Delivery Inspection

Consultant will conduct inspection of the Equipment upon its delivery at the site and issue the Certificate of Inspection if no damage or defect is identified.

9. Documents

(1) Documents for approval

The following documents are submitted after signing the Contract, to Consultant for approval before supply and installation equipment. The number of copies is two hard copies and one soft copy, and one hard copy is returned with the check-results by Consultant within about one week.

Any changes that occur after approval must be informed and confirmed by Consultant in a written form before implementation.

<Submitted documents>

- List of documents

- Plot plan and plot elevation
- Process flow diagram (PFD) and piping and instruments diagram (P&ID) of each unit
- Equipment list of each unit
- Instrument list of each unit
- Material lists and weight list of each unit
- Outside view and block diagram of each control panel
- Control sequence of the boiler
- Schedule and organization of the fabrication and installation
- Piping plan
- Material lists and weight list
- Design data for cabling
- Foundation and anchor plan
- Manufacturers and products list
- Documents of manufacturers
- Plan of installation work
- Any document concerning above if required

(2) Document of purchased equipment

As for the boiler, air compressor, pump and their auxiliary equipment, the following documents is submitted upon delivery. The number of copies is two hard copies and one soft copy.

<Submitted documents>

- List of documents
- Shipping list
- Instruction manuals
- Factory test reports

(3) Document for installation

The documents of related design description and installation procedure are submitted to Consultant before the installation. The number of copies is two hard copies and one soft copy.

(4) Commissioning report (Test Operation Report)

The commissioning report is submitted within two days after completion of the commissioning for approval if no problem is identified. The number of copies is two hard copies and one soft copy.

(5) Document of completion

The following documents are submitted after completion of the installation.

<Submitted documents>

- List of documents
- All the documents of above (1), (2) of final version
- Commissioning report (Test operation report)
- Instruction manual

The number of files of these copies is five and one soft copy and they are submitted within one month after the completion.

(6) Document size and soft copy format

a. Document size: A4 size

Note: In case of A3 size, the document may be reduced to A4 size.

b. Soft copy format: PDF or Microsoft Word

10. Preparation work for commissioning

The following preparation work is done after mechanical completion.

- Air tighten test at every pipe line
- Overall leak test of equipment and pipe line
- Flushing in every pipe line
- Independent test run of every rotating machine
- Measurement of grounding resistance
- Other required preparation works

11. Commissioning (Acceptance test)

After finishing preparation work the commissioning will be performed under responsibility of Contractor together with Consultant based on the commissioning plan given by the Consultant. Contractor shall allocate enough personnel in order to confirm the stipulated performance and function of all the equipment in the Plant.

(1) Boiler unit

a. Condition: 100% load operation, approx. 3 hours
approx. 50 % load operation, approx. 1 hour

b. Contents to be confirmed:

- Each component has the predetermined performance and function.
- Noise level of every rotating machine and exhaust steam is lower than the noise level regulated by the Rulebook on allowed noise level.
- There are no any following problems.
  - Leaking
  - Unallowable vibration
  - Other problems to which the countermeasures are needed

(2) Steam trap unit

a. Condition: under 100% boiler operation, approx. 1 hours

b. Contents to be confirmed:

- Each component has the predetermined performance and function.
- There are no any following problems.
  - Leaking
  - Unallowable noise and vibration
  - Other problems to which the countermeasures are needed

(3) Air compressor unit

a. Condition:

- Inverter: approx. 30 ~ 100 % operation, approx. 2 hours
- On/unload: approx. 50 % operation, approx. 2 hours

b. Contents to be confirmed:

- Each component has the predetermined performance and function.
- There are no any following problems.
  - Leaking
  - Unallowable noise and vibration
  - Other problems to which the countermeasures are needed

(4) Pump unit

a. Condition:

- Inverter: approx. 30 ~ 100 % operation, approx. 2 hours

b. Contents to be confirmed:

- Each component has the predetermined performance and function.
- There are no any following problems.
  - Leaking
  - Unallowable noise and vibration
  - Other problems to which the countermeasures are needed

Contractor submits the Commissioning Report for Consultant's approval within 2 days after the completion of commissioning work.

12. Dispatch of operation instructors after commissioning

(1) Contractor dispatches operation instructors in about one week after the commissioning.

(2) The instructors explain the following contents to persons in charge of the Training Organization.

- Configuration of each unit

- Specifications and characteristics of major equipment
- Operation of each unit by practical training

13. Selection of manufacturers

(1) Requirements and recommended manufacturers of products for the plant installation are shown in the Attachment 1-1 “List of Recommended Manufacturers”.

(2) Some other products can be selected in case they fulfill the specification requests.

(3) The eligible manufacturers of the following equipment are in Italy, UK, Spain, Germany, Sweden, Denmark, France, Slovenia, Turkey, Austria, USA and Japan. However manufacturing factories can be located in countries which are not stated above.
- Boiler and auxiliary equipment
- Air compressor and auxiliary equipment
- Air filter for flow meter
- Pump and auxiliary equipment
- Instruments including autonomous control valve
- Steam trap
- Air blow nozzle of air saving type (Air gun with air saving nozzle and wide wedge air blow nozzle)

(4) The manufacturers of the following equipment shall have their branch or agency in or in the vicinity of Belgrade.
- Boiler and auxiliary equipment
- Air compressor and auxiliary equipment
- Pump and auxiliary equipment

(5) All equipment and materials shall conform to European Norm EN (CE).
However, it is allowed to use the equipment and materials to which this norm is not applicable.

(6) A bidder is required to state the country of origin and specification of each product in its offer.

Unit Specification

Table of Contents

1. General

1-1. Contents of training plant

(1) Attachment-2-1 “Contents of EE&C Training Plant” shows the following contents on the EE&C Training Plant.
   a. Flow scheme of each unit
   b. Layout plan
   c. Equipment list of each unit
   d. Flow diagram of fuel Propane supply system
   e. Instrument list of each unit
   f. Flow diagram of city water supply system
   g. Flow diagram of drainage system
   h. Outline of power supply system

(2) These contents may vary depending on the selected products. The above contents are only for reference.

1-2. Conceptual drawing

(1) Attachment-2-2 “Conceptual Drawing of Piping Arrangement, etc.” shows the following contents.
   a. Arrangement of exhaust gas duct and exhaust steam piping at boiler unit
   b. Piping arrangement of steam trap unit
   c. Piping arrangement of training facility in air compressor unit
   d. Piping arrangement of pump unit
   e. Drainage system including hot drain quenching system
   f. Location of shed of Propane cylinders and pipe line route of fuel Propane to boiler unit
   g. Remodeling of city water supply pipe line
   h. Remodeling of glass window and building wall for stack, pipe lines and ventilators

(2) These contents may vary depending on the selected products, and contractor may propose if there are better contents.

1-3. Boundary point of work scope

The related boundary points of work scope are shown as follows:

a. City water pipe line : Refer to the Attachment 2-1
b. Power supply system : Refer to the Attachment 2-1
c. Signal input to data logger : Each flow sheet in the Attachment 2-1

2. Boiler Unit

2-1. Basic configuration

The boiler unit consists of the followings:

a. Fuel Propane supply system (shed of Propane cylinder with safe guard, pipe line to boiler and auxiliary equipment)
b. A water filter and water softener
c. A boiler feed water tank
d. A dosing unit
e. A boiler feed water pump
f. A steam boiler
g. An economizer with bypass duct and damper
h. Exhaust gas duct and stack
i. Piping (including a steam collector, drain separator, exhaust steam silencer, etc.)
j. Facility for confirming the insulation effect by insulating on uninsulated valve
k. Instruments (flow rate, pressure, temperature, etc.) and the wiring
l. Electricals (motor, instruments, etc.) and the wiring
m. A boiler monitoring and control panel and a separated digital indication panel
n. A process flow display panel

2-2. Requirement of measurement

Measurement requirements are as follows:

(1) Flow rate

a. Boiler feed water
b. Generated steam
c. Fuel Propane

(2) Temperature

a. Boiler feed water tank
b. Boiler feed water at economizer inlet
c. Boiler feed water at economizer outlet
d. Generated steam
e. Boiler exhaust gas at economizer inlet
f. Boiler exhaust gas at economizer outlet
g. Fuel propane burner inlet
h. Steam collector
i. Ambient air temperature

(3) Pressure

a. boiler feed water pump inlet

b. boiler feed water pump outlet
c. Boiler
d. Steam collector
e. Fuel propane at pressure reducing valve inlet
f. Fuel Propane at pressure reducing valve outlet

(4) Level
a. Boiler feed water tank
b. Boiler

(5) Others
a. Oxygen concentration in exhaust gas from boiler
b. Scanning of burner flame
c. Flammable gas leak around fuel Propane pipe line and burner

2-3. Overall requirements (refer to the Attachment 2-1)

a. All the equipment shall be well coordinated in sequence.
b. All the equipment and piping shall be well arranged.
c. The measured data are transferred to a boiler monitoring and control panel or a digital indication panel, and then transferred to a data logger and a personal computer for monitoring and gathering these data.

2-4. Detail of requirements (refer to the Attachment 2-1 and 2-2)

2-4-1. Fuel Propane supply system

The specification of fuel Propane supply system is as follows, in accordance with the recommendation of Propane cylinder supplier.

(1) A shed of Propane cylinders
a. Pre-fabricated metal shed with light metal roof and door
b. Floor area: approx. 6 m^2 for 8 Propane cylinders
c. Floor material: Brick
d. Fence around the shed and sign board for preventing entry of unauthorized person

(2) A regulating header for Propane cylinders

This header consists of header pipe connection hoses with stop valves, a pressure gauge, a pressure safety valve, a pressure regulating valve with pressure gauge for secondary side pressure,

(3) Propane transfer pipe line to the boiler unit

The piping specification is the same as boiler unit.

2-4-2. Boiler unit

(1) Boiler (1 set)

a. Type: Flame and smoke tube boiler
b. Steam generation: 200 kg/hour
c. Steam pressure: 0.8 MPaG
d. Fuel: Propane
e. Startup time: less than 20 min.
f. Burner flame viewing window is required.
   Material: heat withstand glass
g. Burner and combustion air blower:
   - Air ratio can be adjusted within approx. 1.1~1.5.
   - Automatic ignition
h. Combustion air supply: Forced draft.

(2) Water treating unit (1set):

a. Water treating unit is designed based on the feed water (city water) quality in the general specification.
b. Water filter is equipped before the water softener.

(3) Feed water tank (1set)

Use a standard feed water tank of the boiler manufacturer

(4) Feed pump (1 set):

Use a standard pump of the boiler manufacturer

(5) Dosing unit

Use a standard dosing unit of the boiler manufacturer for preventing from boiler system from corrosion and fouling

(6) Economizer: (1 set)

a. With by-pass duct and dampers
b. The dampers are operated manually.

(7) Exhaust gas duct and stack

a. The specifications (Size and material, etc.) conform to manufacturer's standard.
b. The exhaust gas is released to atmosphere at the height of 1.5 m above the rooftop of the building (approx. 30 m from the training room floor)
c. The rain seal is equipped.

(8) Steam collector

a. Pipe size: 4 inch

b. Required nozzles:

- Steam inlet
- Steam outlet
- Heating steam to boiler feed water tank
- Spare nozzle (1 inch)
- Steam to steam trap unit and steam condensate outlet
- Pressure gauge connection
- Thermo gauge connection

(9) Facility for confirming the insulation effect by insulating on uninsulated valve

The following facility is installed for confirming effect on uninsulated valve by comparing the generated steam condensate volume between uninsulated valve and insulated one.

a. Configuration of the facility

Main steam pipe line
↓ (Branching)
Globe valve (2 inch, uninsulated)
↓
Steam trap (1/2 inch, Bi-metal type)
↓
Steam condensate cooler
↓
Drainage pan (discharged to the drainage pan of steam trap unit)

b. Specification of steam condensate cooler

- Type: Natural draft, Coiled tube
- Tube size and material: 10mmø Copper Tube
- Total Tube Length: approx. 2 m

c. An insulation jacket is used for the valve insulation, and it is supplied by JICA.

(10) Instruments

a. Flow meter

Service	Type	Output
Boiler feed water	Not specified	Supplied by boiler manufacturer
Generated steam	Not specified	Supplied by boiler manufacturer
Fuel Propane	Not specified	Range: approx. 0 to 20 kg/h Output: 4-20 mA Accuracy: ±6 % rdg or less

b. Digital thermometer

Service	Type	Remarks
Boiler feed water at economizer inlet	Thermocouple K, Sheathed	Range: 0 to approx. 150 °C Output: 4-20 mA Accuracy: 2 % fs or less
Boiler feed water at economizer outlet	Thermocouple K, Sheathed	Range: 0 to approx. 200 °C Output: 4-20 mA Accuracy: 2 % fs or less
Exhaust gas at economizer inlet	Thermocouple K, Sheathed	Range: 0 to approx. 400 °C Output: 4-20 mA Accuracy: 2 % fs or less
Exhaust gas at economizer outlet	Thermocouple K, Sheathed	Range: 0 to approx. 400 °C Output: 4-20 mA Accuracy: 2 % fs or less
Fuel Propane	Thermocouple K, Sheathed	Range: 0 to approx. 100 °C Output: 4-20 mA Accuracy: 2 % fs or less
Ambient Temperature	Thermocouple K, Sheathed	Range: 0 to approx. 100 °C Output: 4-20 mA Accuracy: 2 % fs or less

c. Digital pressure meter

Service	Type	Remarks
Boiler-1	Manufacturer's standard	Supplied by boiler manufacturer
Boiler-2	Manufacturer's standard	Supplied by boiler manufacturer

d. Pressure gauge

Service	Type	Remarks
Boiler feed water pump suction	Manufacturer's standard	Supplied by boiler manufacturer
Boiler feed water pump discharge	Manufacturer's standard	Supplied by boiler manufacturer
Boiler	Manufacturer's standard	Supplied by boiler manufacturer
Steam collector	Bourdon tube	Range: 0 to approx.1.5 MPaG Size: 100 mmø Accuracy: 2 % fs or less
Fuel Propane line PCV inlet	Bourdon tube	Range: 0 to approx. 1.0 MPaG Size: 100 mmø Accuracy: 2 % fs or less
Fuel LPG line PCV outlet	Bourdon tube	Range: 0 to approx. 0.5 MPaG Size: 100 mmø

		Accuracy: lower than 2 % fs
City water line	Bourdon tube	Range: 0 to approx. 1.0 MPaG Size: 100 mmø Accuracy: 2 % fs or less

e. Digital level meter

Service	Type	Remarks
Boiler feed water tank	Level switch of supplier's standard	Supplied by boiler manufacturer
Boiler-1	Level controller of supplier's standard	Supplied by boiler manufacturer
Boiler-2	Level switch of supplier's standard	Supplied by boiler manufacturer

f. Level gauge

Service	Type	Remarks
Boiler feed water tank	Manufacturer's standard	Supplied by boiler manufacturer
Boiler-1	Manufacturer's standard	Supplied by boiler manufacturer
Boiler-2	Manufacturer's standard	Supplied by boiler manufacturer

g. Flame scanner

Service	Type	Remarks
Boiler burner	Manufacturer's standard	Supplied by boiler manufacturer

h. Oxygen analyzer

Service	Type	Remarks
Exhaust gas duct	Portable type	It can emit the output for displaying the oxygen concentration on digital indication panel.

i. Leak gas detector

Service	Type	Remarks
Fuel Propane pipe line and burner of Boiler around	・LPG service ・Stationary ・Contact burning	1) 2 sets 2) In case to reach the set concentration, the signal makes two shat-off valves on fuel Propane pipe line close.

(11) Control of boiler

a. Sequential start and stop
b. Automatic temperature, pressure and evaporation control
c. Other required control system

(12) Interlock system and safety devices

a. Boiler should be shutdown safely at the following conditions:

- Low level of boiler feed water tank
- Low level of boiler
- High pressure of boiler
- Flame out in burner chamber

b. Two emergency shut off valves are installed on fuel Propane line to shut-off the supply.

c. Two stationary type flammable gas detectors of LPG service are installed around fuel Propane pipe line and boiler burner. When the Propane concentration reaches to the level of preset, the detector generates an audible alert, and a signal to close the two emergency shut-off valves automatically.

(13) Piping

a. The specifications of following pipe lines conform to standards of the boiler manufacturer.
   - Boiler feed water pipe line
   - Steam pipe line
   - City water pipe line and treated water pipe line
   - Other auxiliary pipe lines
b. Fuel Propane pipe line
   - Piping material: Steel
   - Connection: Welding, flange and NPT
c. Exhaust steam pipe line
   - The steam is exhausted to atmosphere at the floor level of the building 5^{th} floor. (approx. 25 m from the training room floor)
   - A silencer is equipped for reducing noise, and the noise level is lower than 70 dBA 5 m away from the silencer.

(14) Sampling nozzle:

a. A fuel sampling nozzle is equipped before the burner. (1 point)
b. A sampling nozzle is equipped before and after the water treatment. (2 point)
c. An exhaust gas sampling nozzle is equipped after the economizer for training of measuring using a portable exhaust gas analyzer. (1 point)

(15) Drainage system and drainage water quenching system (refer to the Attachment 2-1 and 2-2)

a. Hot steam condensate (hot drain) of flash tank, etc. is released to the sewer system (above-ground pipe) intermittently. Since the hot drain has a harmful influence to downstream of the sewer system, the quenching system is installed.

b. Temperature of quenched drain: lower than 50 °C

(16) Remodeling of building

a. Installation of ventilators for the training room

- Number of installations: 2 sets
- Specification:
  - Pressure exhaust ventilator
  - Explosion resistance

b. Making openings on building wall and window

- Remodeling of a window to keep openings for the following pipe lines, etc.(as for the detail, refer to the attachement-2-2)
  - Exhausted steam pipe line
  - Exhaust steam pipe line from blow tank
  - Outlet pipe line of safety valve on fuel Propane pipe line
  - Exhaust gas duct
  - Two ventilators
- Making holes in building wall for the following pipe lines
  - Vent line of boiler feed water tank
  - Fuel Propane pipe line

(17) Drainage connection

a. The water drainage generated in the boiler unit is discharged to a blow tank or open funnel on water drainage system with hot water drain quenching system.

b. In case the water drainage is discharged to open funnel, each drainage point should be elevated higher than the top of open funnel.

2-5. Boiler monitoring and control panel (1 set, supplied by boiler manufacturer)

a. The following instruments for boiler operation control are put in this panel.

- Measuring instruments for boiler operation
- Controllers and sequencers for boiler operation
- Others

b. This panel is located close to boiler.

2-6. Digital indication panel (1 set)

a. Every measured value of remote instruments in the boiler unit are displayed on

digital indicators in a monitoring and control panel of the boiler as well as on a separated digital indication panel.

b. The digital indication panel is located near the boiler monitoring and control panel.

c. A small plate with the tag number and instrument name is attached at lower part of every digital indicator.

2-7. Process flow display panel (1 set)

a. Process flow display panel shall include the following information so that the trainees could learn about the boiler unit and steam trap unit.
   - Process flow of boiler unit and steam trap unit
   - Unit names (Boiler unit and Steam trap unit)

   Size: approx. 1,000 mm^{W} × 700 mm^{H} × 5 mm^{T}

b. Material: Acrylic resin plate

c. Color:
   - Plate: White
   - Process: Use different color for each line (Water, Steam, Power, Control, Fuel Propane, etc.)
   - Characters: Black, in English

d. The process display panel is located on the wall near the boiler unit.

3. Steam trap unit

3-1. Basic configuration

This unit is installed next to the boiler unit, and 5 different types of steam traps including malfunctioned one are demonstrated using the generated steam of the boiler unit.

3-2. Requirement of measurement

Measurement requirements are as follows:

a. Steam pressure and temperature

Note: A bourdon tube pressure gauge and a dial thermometer are installed at the steam collector, and these instruments are included in the boiler unit.

3-3. Overall specifications (refer to the Attachment-2-1)

a. All the equipment and piping is well coordinated.
b. Steam condition: approx.0.8 MPaG, Saturate steam
c. 6 steam trap nozzles are installed.
d. The steam condensate is exhausted onto drainage pan and then drained to an open funnel on drainage piping.

3-4. Detail of requirements (refer to the Attachment 2-1 and 2-2)

(1) Type and number of steam trap

Type of steam trap	Size and connection	Required No.		
		Installed	Spare	Total
[Mechanical type]				
• Inverted bucket type	1/2inch, NPT	1	1	2
• Free float type	1/2inch, NPT	1	1	2
[Thermostatic type]				
• Bi-metal type	1/2inch, NPT	1	1	2
• Balance pressure type	1/2inch, NPT	1	1	2
[Thermodynamic type]				
• Disk type	1/2inch, NPT	2[Note]	1	3

Note: One malfunctioned disc type steam trap is installed for confirming the condition of malfunction.

(2) Piping

a. Piping material: Steel
b. Connection:

- Upstream of steam traps: welding and flange
- Steam trap and the downstream: NPT

(3) Drainage nozzle

a. The steam condensate generated in steam trap unit is discharged to drainage pan, and then sent to open funnel on water drainage system with hot water drainage quenching system.

b. In order to discharge the water drainage to open funnel smoothly, the drainage point should be elevated higher than the top of open funnel.

(4) Water spray facility

A hose reel of water sprinkling for simulating rain fall effect to steam traps is provided.

The specifications are as follows:

- Type: Water sprinkling hose reel for gardening use
- Hose inside diameter: approx. 10 mm
- Hose length: approx. 15 m
- Sprayed water pattern: Changeable

4. Air compressor unit

4-1. Basic configuration

Main components of this unit are as follows:

a. An inverter air compressor (0.8 MPaG, 7.5 kW, Screw, Oil lubrication)
b. An on-load / un-load air compressor (0.8 MPaG, 7.5 kW, Screw, Oil lubrication)
c. An air receiver tank
d. An air filter
e. A Pressure reducing valve
f. A training module for the following studies;
   - Pressure drop of hose and tube
   - Leaking air volume from small hole and the energy loss
   - Effectiveness of high efficient air blow nozzles
g. Instruments (flow rate, pressure, temperature) and wiring
h. Electricals (motor, instruments, etc.) and wiring
i. A digital indication panel
j. A process flow display panel

4-2. Requirement of measuring

Measurement requirements are as follows:

Measurement	Service	Number		Remarks
		Remote	Local	
Flow rate	Training facility inlet	1	1	
Temperature	Air receiver tank	-	1[*1]	[*1]: Supplied by the manufacturer
Pressure	Air receiver tank	1	1[*2]	[*2]: Supplied by the manufacturer
Pressure	Air Filter-1 outlet	-	1	
Pressure	Air Filter-2 outlet	-	1	
Pressure	Training facility inlet	1	1	
Pressure	Training facility outlet	-	1	
Power	Air Compressor-1 motor power	-	1	Power meter is supplied by JICA
Power	Air Compressor-2 motor power	-	1	Power meter is supplied by JICA

4-3. Overall specifications (refer to the Attachment-2-1)

a. All the equipment shall be well coordinated in sequence.
b. All the equipment and piping shall be well arranged.
c. All the equipment and piping of training module shown in 4-1. - f. are mounted on a steel frame.
d. The measured data are transferred to a digital indication panel, and then transferred to a data logger and a personal computer for monitoring and gathering these data.

4-4. Details of specifications (refer to the Attachment 2-1 and 2-2)

(1) Air Compressor-A (1 set)
a. Type: Screw, Oil-lubricant, Inverter control
b. Motor capacity: 7.5 kW
c. Discharge pressure: 0.8 MPaG.

(2) Air Compressor-B (1 set)
a. Type: Screw, Oil-lubricant, On load / unload control
b. Motor capacity: 7.5 kW
c. Discharge pressure: 0.8 MPaG.

(3) Air receiver tank (1 set)
a. Capacity: approx. 900 L
b. With a pressure gauge, thermometer and a safety valve

(4) Air filter-1 (1 set)
a. Since air compressors are oil lubricating type, an air filter is equipped at the outlet of air holder.
b. In case of the air compressors with built-in air dryer, this is not required.

(5) Air dryer (1 set 1)
a. An air dryer is equipped at the outlet of air filter.
b. In case of the air compressors with built-in air dryer, this is not required.

(6) Air filter-2 (1 set)
a. An air filter is necessary to protect the flow meter (mass flow meter) even if a built-in air filter is set, as inflow of oil mist is harmful for Flow meter-1.
b. The specification shall be based on the manufacturer’s recommendation of the flow meter.

(7) Pressure reducing valve (1 set)
a. Type: Pilot type

b. Capacity: approx. 200 Nm3/h
c. Control range: 0.2 ~ 0.7 MPaG

(8) Piping
a. Piping material: Steel
b. Connection: Welding / Flange / NPT

(9) Instruments
a. Flow meter-1 (1 set for inlet of training facility)
- Type: Mass flow, Wide range
- Range: approx. 0.5 ~ 200 Nm3/h (Measurable range)
- Output: 4-20 mA
- Accuracy: ± 5 % rdg or less and 0.1% fs or less

b. Flow meter-2 (1 set for inlet of training facility)
- Type: Ultrasonic, Battery powered
- Range: approx.1.3 ~ 80 Nm3/h (Measurable range)
- Output: No (Local indication)
- Accuracy: 5% rdg or less

c. Digital pressure meter-1 (1 set for air receiver tank)
- Type and size: Bourdon Tube, 100mmø
- Range: 0 to approx. 1.5 MPaG
- Output: Analogue 4-20 mA or 1-5 V
- Accuracy: 2 % fs or less

d. Digital pressure meter-2 (1 set for inlet header of training facility)
- Type and size: Bourdon Tube, 100mmø
- Range: 0 to approx. 1.5 MPaG
- Output: Analogue 4-20 mA or 1-5 V
- Accuracy: 1 % fs or less

e. Pressure gauge (5 sets installed in the unit)
- Type and size: Bourdon Tube, 100 mmø
- Range: 0 ~ approx.1.5 MPaG
- Accuracy: 2 % fs or less

(10) Rubber hose and plastic tube
a. Rubber hose (for study of pressure drop of the hose)
- 10 m length of 21.8 mm^{OD}.× 12.7 mm^{ID} (2 hoses)
- with male connector (1/2 inch of taper thread-in) of the both ends

b. Plastic tube-1 (for study of pressure drop of the tube)
- 20 m length of 8 mm^{OD} × 5 mm^{ID} (1 tube)
- One touch half union of 1/4 inch (10 sets)

c. Plastic tube-2 (for precise measurement of pressures drop between inlet and

outlet of the hose and tube)

- 10 m length of 10 mm^{OD} × 6.5 mm^{ID} (1 tube)
- One touch half union of 1/4 inch (10 sets)

(11) Leaking air test nozzle (3 sets)

Each nozzle has a ball valve and a threaded steel cap with holes of 1 mmø, 2 mmø and 3 mmø respectively

(12) Air blow nozzles and air hoses with joints

a. Air gun with air saving nozzle (1 set, Connection: 1/4 inch, NPT, Hose length: 1 m)
b. Wide wedge air blow nozzle (1 set, Connection: 1/4 inch, NP, Hose length: 1 m T)
c. Conventional air gun (1 set, Connection: 1/4 inch, NPT, Hose length: 1 m)

(13) Scale for demonstrating the effectiveness of high efficient blow nozzle (1 set)

a. Type: Digital kitchen scale
b. Range: 0 ~ 1 kg

(14) Exhaust air silencer

a. A silencer is located at the floor level of 2.5 m.
b. Noise level is 70 dBA at point of 5 m away from the silencer at maximum exhausted volume (approx. 150 Nm^3/h).

(15) Training facility for leaking air, high efficient blow nozzle and pressure drop

All the equipment and piping of this facility are arranged in a steel frame of approx. 2.5 m^L × 1 m^W

(16) Drainage nozzle

a. The water drainage generated in the air compressor unit is kept in appropriate containers (such as plastic bucket) and discharged by appropriate way, because it contains some lubricant oil.
b. In order to discharge the water drainage in the container, each drainage point is should be elevated more than 20cm above floor.
c. The required numbers of containers are prepared.

4-6. Digital indication panel (1 set)

a. Every measured value of remote instruments in the air compressor unit is displayed on digital indicators in a digital indication panel.
b. The digital indication panel is located near the air compressor unit.
c. A small plate with the tag number and instrument name is attached at lower

part of every digital indicator.

4-7. Process flow display panel (1 set)

a. Process flow display panel shall include the following information so that the trainees could learn about the air compressor unit.
   - Process flow of air compressor unit
   - Unit name (Air compressor unit)

b. Size: about approx. 800 mm^{L} × 560 mm^{W} × 5 mm^{T}

c. Material: Acrylic resin

d. Color
   - Plate: White
   - Process: Use different color depends on each line (Air, Power, Control, etc.)
   - Characters: Black, in English

e. The process display panel is located on the wall near the air compressor unit.

5. Pump unit

5-1. Basic configurations

Main components of this unit are as follows;

a. An water tank
b. An inverter water circulation pump
c. Training facility for pipe line pressure drop
d. Instruments (flow rate, pressure, temperature, etc.) and wiring
e. Electricals (motor, instruments, etc.) and wiring
f. A digital indication panel
g. A process flow display panel

5-2. Requirement of measuring

Measurement requirements are as follows:

Measurement	Service	Number		Remarks
		Remote	Local	
Flow rate	Circulation water	1	-	
Flow rate	Inlet of training facility for pipe line pressure drop	-	1	
Pressure	Water circulation pump suction strainer inlet	-	1	
Pressure	Water circulation pump inlet	1	1	
Pressure	Water circulation pump outlet	1	1	
Pressure	Water circulation pump discharge valve outlet	-	1	
Pressure	Inlet of training facility for pipe line pressure drop	-	1	
Pressure	Outlet of training facility for pipe line pressure drop	-	1	
Power	Water circulation pump motor power	-	1	Power meter is supplied by JICA.

5-3. Overall specifications (refer to the Attachment-2-1)

a. All the equipment and piping shall be well arranged.

b. All the equipment and piping are mounted on a steel structure.
c. The measured data are transferred to a digital indication panel, and then transferred to a data logger and a personal computer for monitoring and gathering these data.

5-4. Details of specifications (refer to the Attachment 2-1 and 2-2)

(1) Water circulation pump

a. Type: Single side suction, centrifugal pump, inverter
b. Total head: 30 m (Rated)
c. Flow rate: 18 m3/h (Rated)
d. Motor: 2 poles, approx. 3 kW
e. Shaft seal: Mechanical seal
f. Casing material: Cast iron
g. Impeller material: Cast iron
h. Inverter
- Speed control range: 0-120 %
- With speed control dial
- With control data input facility
- Possible to operate by direct grid power as well

(2) Water circulation tank:

a. Material: SUS304
b. Size: 600 mm^{L} × 500 mm^{W} × 700 mm^{H}
c. Water level control: Ball tap type
d. Connected Pipe lines:
- City water make up line
- Circulation water supply line
- Circulation water return line
- Overflow line
- Drain line

e. A vortex breaker of rectangular plate type is installed an outlet nozzle which is located inside the tank and connected to water circulation pump in order to prevent the pump from inducing air.
f. In order to reduce the water level fluctuation in the tank, the following measures are required.
- A water circulation tank is divided by a partition plate with 50 mm^{H} opening from the bottom of the tank.
  Nozzles for pump suction, level gauge, make-up water are installed in one chamber, and circulation water return pipes are installed in the other chamber.
- The outlet of circulation water return line is lower than the water level

inside the tank

(3) Piping

a. Material: Polymer vinyl chloride (PVC)
b. Valve: Anti rust type
c. Drain nozzle and drain line:
   - Drain nozzles are installed at proper points to discharge the remaining water completely.
   - Drainage is discharged to the existing catch basin of sewer system close to the wall including overflow water of circulation water tank.

(4) Instrument

a. Flow meter for circulation water (1 set)
   - Type: Electro-magnetic flow meter
   - Size: 1-1/2 inch
   - Display: Digital
   - Range: approx. 25 m3/h
   - Output: 4-20 mA
   - Accuracy: 1 % rdg or less
b. Flow meter to training facility for pipe line pressure drop (1 set)
   - Type: Variable area flow meter (Glass tube float type flow meters)
   - Size: 1-1/2 inch
   - Range: approx. 10 m3/h
   - Maximum pressure: approx. 0.5 MPaG
   - Accuracy: 2 % fs or below
c. Digital pressure meters-1 (1 set for water circulation pump suction)
   - Range: approx. -0.1 to approx. 0.1MPaG
   - About 0 to 0.5MPa for discharge
   - Output: 4-20 mA
   - Accuracy: 2 % fs or less
d. Pressure meters-2 (1 set for water circulation pump discharge)
   - Range: approx. 0 to approx. 0.5 MPaG
   - Output: 4-20 mA or 1-5 VDC
   - With pressure guide tubes (with connectors)
   - Accuracy: 2 % fs or less
e. Pressure gauge (5 sets)
   - Type and size: Bourdon Tube, 100mmø
   - Range:
     - Inlet of suction strainer of Water circulation pump (1 set): -0.1 to approx. 0.1 MPaG
     - Water circulation pump suction (1 set): -0.1 to approx. 0.1 MPaG

- Water circulation pump discharge (1 set): -0.1 to approx. 0.5 MPaG
- Pressure drop training facility (2 sets): 0 to approx. 0.5 MPaG

• Accuracy: 2 % fs or less

f. Level gauge for water circulation tank (1 set)
   • Type: Glass tube type level gauge

g. Power meter for water circulation pump (1 set) (Supplied by JICA)
   • Type: Clump on power logger
   • Interface: Pulse output, USB2, SD card

(5) Plastic tube (for precise measurement of pressure drop between inlet and outlet of the pipe)
   • 10 m length of 10 mm^{OD} × 6.5 mm^{ID} (1 tube)
   • One touch half union of 1/4 inch (included in item 4.4.-(10)-c. “Plastic tube-2” of air compressor unit)

5-6. Digital indication panel

a. Every measured value of digital instruments of the pump unit is displayed on digital indicators in a digital indication panel.
b. The digital indication panel is located near the pump unit.
c. A small plate with the tag number and instrument name is attached at lower part of every digital indicator.

5-7. Process flow display panel (1 set)

a. Process flow display panel shall include the following information so that the trainees could learn about the pump unit.
   • Process flow of pump unit
   • Unit name (Pump unit)
b. Size: approx. 800 mm^{L} × 560 mm^{W} × 5 mm^{T}
c. Material: Acrylic resin
d. Color :
   • Plate: White
   • Process: Use different color depends on each line (Water, Power, Control, etc.)
   • Characters: Black, in English
e. The process display panel is located on the wall near the pump unit.

6. Common utility facilities

6-1. Power supply system (refer to the Attachment 2-1)

a. Remodeling of existing main power distribution panel
b. Wiring to newly installed unit power distribution panels for boiler unit, air compressor unit and pump unit

6-2. City water system (refer to the Attachment 2-1 and 2-2)

a. Replacement of 1/2” existing city water pipe line with 1” pipe line from the branch point on main city water pipe line
b. Installation of required unit battery limit valves

6-3. Water Drainage system (refer to the Attachment 2-1 and 2-2)

a. In order to discharge the water drainage generated in boiler unit and steam trap unit to existing sewer system, a drainage system is installed in the boiler unit and steam trap unit.
b. The water drainage system shall have a hot water drain quenching system for preventing hot water drainage from flowing in to existing sewer system.
c. Water drainage generated from air compressor unit and pump unit are treated as follows:
    - Air compressor unit: The water drainage from the air compressor unit is kept and discharged by appropriate way as it contains lubricant oil.
    - Pump unit : The water drainage is discharged to an existing catch basin of sewer system close to the wall including overflow water of circulation water tank.

7. Other common requirement

The following equipment and material are supplied.

(1) Extension power cables (3 set)
- Reel type (drum type)
- with two power points
- With an earth leakage breaker
- Cable length: min. 10 m
- Capacity: min. 2 kW

(2) Tool kit for maintenance of training plant (each 1 set)
- Wrenches (from approx. 10 mm to 30 mm)
- Adjustable wrenches (approx. 200 mm & 300 mm)
- Socket wrenches (from approx. 10 mm to 30 mm)
- Pipe wrenches (approx. 200 mm & 300 mm)
- Screw drivers set
- Nippers (approx. 150 mm)
- Pliers (approx. 150 mm)
- Hammer
- Tape measure (Steel type, length 10m)
- A soldering kit
- A box for accommodating above tools

(3) Bench vice for maintenance of training plant (1 set)

(4) Threaded fitting

Name	Size Inch	Connection	Max. Working Press. MPaG	Req'd number
Nipple	1/2	NPT	≧ 1.0	4
	3/4	NPT	≧ 1.0	2
Socket	1/2	NPT	≧ 1.0	4
	3/4	NPT	≧ 1.0	2
Tee	1/2	NPT	≧ 1.0	4
	3/4	NPT	≧ 1.0	2
Bushing	1/2 × 1/4	NPT	≧ 1.0	4
	3/4 × 1/2	NPT	≧ 1.0	2

(5) Hose

Kind of hose	Size Inch	Length m	Allowable max. temp. °C	Allowable max. press. MPaG	Connector of both ends	Req'd number
Steam hose	1/2	10	≧120	≧ 1.0	NPT	2
Air hose	1/2	10	≧60	≧ 1.0	NPT	2
Water hose	1/2	10	≧60	≧ 0.5	NPT	2

(6) Burdon tube pressure gauge

Pressure range MPaG	Size of Gauge Mm	Connection	Req'd number	Remarks
-0.1 – 0.1	100φ	1/2 inch, NPT	1	Same specification as the installed one
0 – 0.5	100φ	1/2 inch, NPT	1	Ditto
0 – 1.01	100φ	1/2 inch, NPT	1	Ditto
0 – 1.5	100φ	1/2 inch, NPT	1	Ditto

(7) Valve

Kind of valve	Body material	Size and Connection	Req'd number	Remarks
Ball valve	SUS	1/2 inch, NPT	2	Same specification as the installed one
Ball valve	Plastic	1/2 inch, NPT	1	Ditto

(8) The following materials are supplied enough for 2 years maintenance after completion.

- Gasket
- Bolt and nut
- Insulation material
- Seal tape for screw connection
- Electrical tape
- Fuse
- Others

(9) The following consumables are supplied enough for two years operation after the completion. In addition, the boiler unit and air compressor unit are operated intermittently according to training schedule, and it is estimated that the maximum operation hour of each unit is about 200 hours per year.

a. Boiler unit
   - Ion exchange resin for water softener
   - Sodium chloride for water softener
   - Chemical for dosing unit

b. Air compressor unit
   - Lubricant oil for air compressor
   - Air filter element

8. Additional Works based on Fire Safety Design and Instruction by Fire Police Department

The following works shall be conducted as additional works.

8-1. Additional work based on fire safety design

(1) Installation of one emergency lighting

(2) Installation of one fire alarm and supervisory system for gas detection and fire alarm

Note: Installing two gas detectors is included in the original work scope.

(3) Cabling work for installing emergency lighting, gas detection system and fire alarm system

(4) Service

- Professional supervision of installation work
- Customer training of manipulation and basic service
- Issuing 3 as built drawings

(5) Fire safety design

(6) HVAC installation

- Installation of air intake duct for ventilators
- Installation of grid for exhaust air
- Installation of two external fixed louvres

8-2. Additional work based on instruction by Fire Police Department

(1) Changing the structure of the home with propane bottles

[Original]

Prefabricated light weighted steel ware house

[Revised by the FPD instruction]

- Installation of concrete on perimeter beam
- Installation of concrete block wall (3 sides)
- Installation of aluminum trapezoidal sheet metal for the roof
- Installation of aluminum double doors filled with fabrics
- Plastering mortal on concrete block wall
- Installation of floor rubber mat in the home with propane bottles

Note: Additional work cost is the balance with the original one.

(2) Installation of fire resistance lining on propane pipe line through an escape route

(3) Relocation of existing cable for outdoor lighting that crosses the home with propane bottles

Training Manual of Energy Conservation Training Plant for Trainers

2016.3

JICA Consultant

Contents

Appendix 6: Tips on Energy Audit

1. Attitude of Energy Auditor

(1) The Energy Auditor shall Moderate their Comments

There will be an energy specialist at the audit site. The energy specialist is usually displeased when the energy auditor points out problems on energy use and submits improvement measures, because the energy specialist believes that they are the most suitable person to conduct energy management at the site. Therefore, when the energy auditor visits an audit site, they shall be respectful to that site's energy specialist.

It is recommended that the energy auditor first expresses to the energy specialist "It seems that it may be difficult to identify improvement measures easily, but today I would like to confirm the energy use environment in which your staff operates".

Although the energy auditor is a specialist in energy conservation, they must recognize that they know nothing about the site to be audited. Moreover, it is important for the energy auditor to make a good impression at the site in any case.

(2) The Energy Auditor shall be a Persuader

It is important to make the energy specialist understand the problems regarding energy use and the improvement measures during the site survey. To do this, it is useful to explain the issues to the energy specialist by drawing diagrams on a notebook (visualization for easy understanding).

In many cases the energy specialist understands some of the energy use issues, but does not know how to address them so improvement measures will not have been carried out. Therefore, it is very important that the energy auditor explains to the energy specialist the details of the problems and persuades them to agree to the improvement measures.

Once an energy specialist understands sufficiently, their manner changes completely. They proactively explain the situation at the site, offer information on problem areas and ask the energy auditor to suggest improvement measures.

This shows that the energy auditor has gained the trust of the energy specialist at the audit site.

2. Suggestions for the Site Survey

(1) Methodology

It is difficult to identify problems at an audit site when an energy auditor visits for the first time. Therefore, it is very important for the energy auditor to use their physical senses (especially one's eyes, ears, nose and hands (for temperature and vibrations)).

(a) Identify problems using eyes, ears, nose and hands (temperature, vibrations)

- Check noisy places, and source of noise (energy loss via noise)
- Check facility specifications

[Example]

- Check difference between rated ampere and actual ampere of motors. Actual ampere/Rated ampere: In cases where this difference is either great or small, there are energy conservation possibilities.

・Check temperatures on motor surfaces and vibrations at facilities by touching with fingers
(performing such tests in a safe manner).

(b) Prepare notebook and small flashlight

・The notebook will be used not only for recording information related to the energy audit but also for explaining issues in a more persuasive manner by using diagrams.
・A small flashlight is necessary for confirming facility specifications on name plates. (There will be many places without illumination.)

(c) Carefully listen to EM's and MM's responses

・During the site survey, the energy auditor conducts a question and answer survey with the Energy Manager (EM) and Maintenance Manager (MM). If the auditor does not pay attention and carefully listen to their answers at this time, the auditor will not pick up clues that may help in the development of energy reduction measures.
・In one example case of an audit at a wine warehouse, as a result of carefully listening to information from the MM regarding inventory loading/unloading and the lighting range, the auditor came up with an idea to have the lighting turn on only when work was being conducted, by installing sensors to sense forklifts. This led to a reduction in electricity of 114,000 kWh/year.

(d) Use BMS information in the survey

・Diagrams of various systems are built into the Building Management System (BMS), and energy consumption data is accumulated by it.
・During the site survey, in addition to checking each energy consumption area, BMS information should be used effectively. If the data accumulation is in one hour units, it becomes easier to ascertain energy consumption trends through detailed analysis and graph creation using annual data.

(e) Do not conduct energy audits for production facilities

・Changes in production conditions can lead to defective products.
It may be better to focus on incineration facilities (Boilers, Drying furnaces, Heating equipment), Air compressors, Pumps, Fans, and Blowers.

(f) Clearly show the calculation basis for energy reduction effects

・Calculation conditions are presented in the energy reduction effects calculation, but the grounds for each should be clearly stated.
・Although the results of interviews with questionnaires and on-site surveys are clear, the numerical values specifically selected by energy auditors present those results factually. If an energy auditor receives a question on an estimated numerical value, he/she must be able to succinctly explain the thinking behind it.

(g) Conduct energy audits with safety as a paramount concern.

・Safety clothing and a safe energy audit procedure are required to prevent

accidents. Any dangerous areas should be confirmed in advance.

Appendix 7: Achievement of Outputs (As of October 2016)

Outputs	Verifiable Indicators	Achievement
1. Scheme design of Energy Management and Audit System is established.	1-1. Published all Rulebooks, by November 2016 1-2. List and number of DOs, by August 2016 1-3. Guidebook of EMS 1-4. Database for EMS and Energy Audit 1-5. Provision of any financial incentive to promote EMS , by the end of 2017	Achieved 70%. 1-1: By October 2016, 1 Decree, 5 RBs and 1 Decision were published. 6 RBs are drafted and will be published by November 2016. 1-2: 100 Municipalities identified as DOs: 30 DOs identified from Industry and Buildings so far. 1-3: In process. 1-4: With consultation of Japanese Expert on Database, MOME procured IT company to develop Database with donation from Norway, which enables monitoring of EMS implementation together with a record tracking on licensed EM, authorized EAs and DOs. 1-5: None. No incentive to promote EMS due to budget restriction by IMF. "Energy Efficiency Fund (subsidies to municipalities)" exists, but at this moment it is not promoting EMS.
2. Classroom training program of Energy Managers and Auditors is established.	2-1. By June 2016, at least 4 trainers receive instruction for performing the training for EMs. 2-2. By February 2017, candidate EMs from all identified DOs complete the classroom training course. 2-3. By March 2017, at least one training for candidate EAs is implemented.	Partially achieved. 2-1. Achieved at satisfactory level. 11 candidate trainers completed TOT. 2-2. In process. 70 out of 240 (tentative) participants trained. 2-3. Not started. Only licensed EMs can enroll in the training course, therefore 2-3 will not be fulfilled until EM trainings for candidate EAs is conducted.
3. Practical training program of Energy Managers and Auditors is established.	3-1. *By June 2016,* all training facilities are installed. 3-2. *By April 2016*, at least 4 trainers for EMs and EAs complete the practical training course. 3-3. *By March 2017,* at least one practical training course for EAs is implemented. 3-4. *By February 2017*, at least 100 EMs complete the practical training.	3-1. Achieved. Installed in March 2016. 3-2. Achieved. 9 trainers completed the course. 3-3. Not started. 3-4. Not started. It is planned 100 participants will complete the practical training by February 2017.
4. Qualification and examination system of Energy Managers and	4-1. *By February 2017,* at least 100 DOs have persons qualified as Energy Managers	4-1. Not started. 4-2. It is predicted that EAs will not

Outputs	Verifiable Indicators	Achievement
Auditors are institutionalized.	4-2. *By April 2017*, at least 15 persons are qualified as EAs	be qualified by April 2017.
5. Capacity of MOME to implement Energy Management and Audit System is strengthened.	5-1 CPs of MOME by themselves can conduct a dissemination and awareness program for energy efficiency. 5-2 CPs of MOME by themselves can monitor DOs according to manuals, based on their report and data. 5-3 CPs of MOME by themselves can review implementation of EMS and make revisions according to necessity.	5-1 Achieved. 2 seminars were conducted 2 times in April 2016 for Municipalities and private sector. (See Table 5 for details) 5-2 Not started. Database was established to monitor DOs, however it is observed that it would be difficult to monitor unless MOME secures human resource for this EMS monitoring system. 5-3 Achieved. Know-how has accumulated within MOME, however, there is a concern with lack of human resources in MOME.

Appendix 8: Achievement of the Project

Overall Goal

Target	Overall Goal	Verification Method
DO	Five years after the introduction of EMS, on the average of total DOs for five years, the percentage of total energy consumption reduction will be 1 % for a year.	Periodical Reports
DO	Five years after the introduction of EMS, energy audit must be conducted for all DOs in industry sector.	Energy Audit Reports

Project Purpose

Target	Expected Output	Verification Method	Achievement
DOs	100 DOs analyze current situation on energy consumption.	Energy Consumption Survey	- 72 Industries - 79 Municipalities - 8 Buildings
DOs	100 DOs prepare the plan to enhance energy efficiency in their periodical report.	Submission of Periodical Reports	- 41 Industries (66 Sites) - 14 Municipalities

Output 1: Scheme Design of Energy Management and Audit System

Target	Expected Output	Verification Method	Achievement
Rulebooks	Published all Rulebooks	Interview to MOME	5 rulebooks regarding EA still remains as of December 2017
DO List	List and number of DOs	Periodical Reports	- 72 Industries - 79 Municipalities - 8 Buildings
Guidebook	Guidebook of EMS	Prepared by PT with MOME	Distributed at the Final Seminar (December 13, 2017)
DB	Database for EMS and Energy Audit	Pictures	It completed in August 2016.
Financial Incentive	Provision of any financial incentive to promote EMS , by the end of 2017	Interview to MOME	Related documents

Output 2: Classroom Training Program of Energy Managers and Auditors

Target	Expected Output	Verification Method	Achievement
EM & EA Instructors (Classroom)	At least 4 trainers receive instruction for performing the training for EM and EA.	SEEC Activity Report	14 trainers for Municipality, 14 trainers for Industry have been authorized in SEEC Activity Report in 2016. 8 candidate instructors conducted a demonstration EA training in December 2017.
EM Trainees (Classroom)	Candidate EMs from all identified DOs complete the classroom training course.	SEEC Activity Report	- 75 Trainees from Municipality - 131 Trainees from Industry - 66 Trainees from Building
EA Trainees (Classroom)	At least 1 training for candidate EAs is implemented.	SEEC Activity Report	It will be conducted in April 2018. However a demonstration EA training was conducted in December 2017.

Output 3: Practical Training Program of Energy Managers and Auditors

Target	Expected Output	Verification Method	Achievement
Training Facilities (TF)	All training facilities are installed	Pictures	It completed in March 2016.
TF Instructors	At least 4 trainers for EMs and EAs complete the practical training course.	SEEC Activity Report	7 trainers have been authorized in SEEC Activity Report in 2016.
EA Trainees (TF)	At least 1 practical training course for EAs is implemented.	SEEC Activity Report	It will be conducted in April 2018. However a demonstration EA training was conducted in December 2017.
EM Trainees (TF)	At least 100 EMs complete the practical training.	SEEC Activity Report	- 131 Trainees from Industry - 66 Trainees from Building

Output 4: Qualification and Examination System of Energy Managers and Auditors

Target	Expected Output	Verification Method	Achievement
DO	At least 100 DOs hold qualified Energy Managers.	Interview to MOME	- 64 EM from Municipality - 62 EM from Industry - 33 EM from Building
EA	At least 15 persons are qualified as EAs.	SEEC Activity Report	It will be conducted in April 2018. However 21 persons participated in a demonstration EA training which was conducted in December 2017.

Output 5: Capacity of MOME/MFBU to Implement Energy Management and Audit System

Target	Expected Output	Verification Method	Achievement
MOME	CPs of MOME by themselves can conduct a dissemination and awareness program for energy efficiency.	Interview to MOME	MOME participated in some seminars and made presentation.
MOME	CPs of MOME by themselves can monitor DOs according to manuals, based on their report and data	Periodical Reports	MOME monitors DOs through DB, telephone and e-mail.
MOME	CPs of MOME by themselves can review implementation of EMS and make revisions according to necessity.	Interview to MOME	MOME proposed the required staff costs for MOF to maintain the capacity.