Activity Report 2009

International Infrastructure Development Project for Efficient Use of Energy

Human Resources Development Project for Energy efficiency and conservation

Promotion of Energy Efficiency and Conservation Project for Major Industries in ASEAN Countries

March 2010

The Energy Conservation Center, Japan

Preface

While the mitigation of global warming has become the challenge shared among humans in recent years, humans are also pursuing sustainable development of the economy in each country. We currently face a difficult challenge in finding ways to make these contradictory goals. Succeeding in such a difficult challenge, some technological innovations will be required in the efficient use of energy, ways to use energy while keeping the environmental burden to a minimum, and development of environmentally friendly energies. Understanding of the status of energy use and environmental conservation of developing countries is essential in promoting balanced development of the economies and the environment of these countries. At the same time, acceptable and proper assistance for the target countries based on sufficient investigation of the country-specific status of infrastructure development and lifestyles are also required.

Under such circumstances, an energy audit of one industry in each country and the transfer of auditing technologies were conducted in the targeting ten ASEAN countries as Phase 1 of the project in fiscal years 2000 to 2003. As a continuation of the project, along with the energy audit, energy efficiency and conservation promotion infrastructures were established to implement and promote improvement efforts as Phase 2 in fiscal years 2004 to 2008.

At the end of Phase 2, the PROMEEC committee evaluated the project. As a result, they made a commitment to work toward the utilization of transferred energy efficiency and conservation promotion infrastructures through the independent efforts of ASEAN countries, as well as promulgation and infiltration of utilization within the ASEAN countries in Phase 3. Based on these goals, the committee made a commitment to assist in spontaneous energy audits by ASEAN countries in fiscal 2009 and promote the implementation and spread of improvement measures.

The energy audits implemented in new factories to ensure the spread of energy audit technologies within the areas. In addition, follow-up investigations were conducted to identify the implementation of the recommended improvement measures in factories where energy audits were conducted in the past. Furthermore, they created the technical directory (TD) and built in-house databases for each industry (IHDB) and benchmarks (BM).

In this fiscal year, energy audits were conducted in an automobile factory in Myanmar, an oil refinery in Brunei, and a medical supply factory in the Philippines. At the same time, a seminar workshop was held in each country to which government and factory officials were invited from different industries in the host countries. Some best practices of energy efficiency and conservation were presented, and the information was shared to the foundation of promotional activities. Ways to utilize the completed TD and IHDB in energy efficiency and conservation activities in actual factories were discussed, and some examples were presented in the seminar workshop.

We hope that this project will contribute to energy and environmental conservation in the industries of ASEAN countries and that the countries will successfully realize sustainable economic development in harmony with the environment. At the same time, we hope this project will promote technological interaction and friendship between Japan and the applicable countries.

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Table of Contents

The following abbreviations are used in this document.

<u>General</u>

AHU	Air Handling Unit
AVR	Automatic Voltage Regulator
BMS	Building Management System
CDU	Crude Distillation Unit
CFL	Compact Fluorescent Lamp
COP	Coefficient of Performance
CSR	Corporate Social Responsibility
DCS	Distributed Control System
DB/BM	Database / Benchmark
DHCR	Direct Hot Charge Rolling
DO	Dissolved Oxygen
EE&C	Energy Efficiency and Conservation
EEI	Energy Efficiency Indicator
EM H/B	Energy Management Handbook
EMS	Energy Management System
ESCO	Energy Service Company
FP	Focal Point
FRL	Fluorescent Lamp
GDP	Gross Domestic Product
GMP	Good Manufacturing Practice
GTG	Gas Turbine Generator
HACCP	Hazard Analysis and Critical Control Point
HVAC	Heating, Ventilation, and Air Conditioning
IDF	Induced Draft Fan
IHDB	In-house Database
ISO	International Organization for Standardization
JBIC	Japan Bank for International Cooperation
KPP	Key Process Parameter
LED	Light Emitting Diode
OJT	On-the-job Training
PCB	Printed Circuit Board
PROMEEC	Promotion on Energy Efficiency and Conservation
SEC	Specific Energy Consumption

SCADA	Supervisory Control and Data Acquisition
SH	Sensible Heat
TD	Technical Directory
TOD	Total Oxygen Demand
TPM	Total Production Management
VAP	Voluntary Action Plan
VSD	Variable Speed Drive

ASEAN & UN

ACE	ASEAN Centre for Energy
ADB	Asia Development Bank
APAEC	ASEAN Plan of Action for Energy Cooperation
ASEAN	Association of Southeast Asian Nations
EAS-ECTF	East Asia Summit - Energy Cooperation Task Force
SOME-METI	ASEAN Senior Officials Meeting on Energy - METI
UNEP	United Nations Environmental Program
UNIDO	United Nations Industrial Development Organization
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific

Japan

AOTS	Association for Overseas Technical Scholarship
ECCJ	Energy Conservation Center, Japan
METI	Ministry of Economy, Trade and Industry

Myanmar

MAF1	Myanmar Automobile Factory (1)

Brunei Darussalam

BHC	Butra Heidelberg Cement
BLNG	Brunei Liquefied Natural Gas
BSP	Brunei Shell Petroleum
DES	Department of Electric Service
ITB	Institut Teknologi Brunei
PMO	Prime Minister’s Office
UBD	Universiti Brunei Darussalam

Philippines

DOE	Department of Energy
MERALCO	Manila Electric Railroad and Light
PCIERO	Philippines Council for Industry & Energy and Development
PNOC	Philippines National Oil Corporation

Malaysia

PTM	Pusat Tenaga Malaysia

Indonesia

EMI	Energy Management Indonesia (PERSERO)

Overview

The economies of ASEAN countries are rapidly growing. The amount of energy consumption is also expected to increase at a rapid pace in the future, and efficient energy use and consideration toward mitigation of global warming will be increasingly important. This project is in its tenth year. The activities of ACE, the counterpart to this project, and organizations involved in ASEAN countries have been improved and solidified. With the background of the recent increase energy price due to the surge in oil prices and the Kyoto Protocol entering into force on February 16, 2005, awareness reform toward reduction of energy consumption has been spreading in the target countries.

This year was positioned as the first year of Phase 3 to integrate the outcomes of activities over the past nine years and to solidify the implementation and spread of the past accomplishments through strengthened independent efforts. That is, this is the year to establish infrastructures to promote energy efficiency and conservation to implement and spread the findings of energy audits conducted in the factories of ten industries in all ASEAN countries over the past nine years. Specifically, the following activities were conducted in three countries: Myanmar (auto industry), Brunei Darussalam (oil refinery industry), and the Philippines (medical supply industry).

♦ Energy audits, follow-up investigations, and visiting guidance
  Implement energy audits in factories that have not been diagnosed before, follow-up investigations in factories that have been examined in energy audits in the past, and one-day visiting guidance in small factories.
♦ Hold seminar workshops
  With the participation of factory officials in the target countries, including those from different industries, as well as factory and government officials from other ASEAN countries, they presented the activities and examples of improvements each other and spread outcomes including best practices and knowhow to ASEAN countries.
♦ Production of technical directory (TD)
  Introduce technologies and best practices that might be effective in ten types of industries in ASEAN countries, share information, and increase possibilities to implement and spread those technologies.
♦ Establishment of in-house databases (IHDB)
  Continuing from the last fiscal year, work toward the implementation and spread of

IHDBs in actual factories in the steel industry and the ceramics industry. In addition, develop IHDBs for the auto, oil refinery, and medical supply industries, test them in actual factories, and examine their validity.

In investigations in individual countries, Japanese experts provided on-site guidance to local officials and worked to solidify technological transfers as they checked the learning status of energy audit technologies that had been transferred in the past. In factories that had not sufficiently implemented suggestions, the experts examined and discussed factors that had impeded implementations and provided clues for future implementation and promulgation.

Many factory and government officials attended seminar workshops in each countries. The seminar workshops played important roles in sharing and promulgating information.

The following section describes details of this year’s activities in the major industry project.

I. On-site activities in Myanmar at September 28, 2009 to October 6, 2009:

1. An energy audit was conducted in an automobile factory in Yangon. The local audit team consisted of engineers from the Ministry of Industry (1), Ministry of Industry (2), and Ministry of Energy, as well as engineers from government-related organizations. The leader of the team was an engineer from the Ministry of Industry (2). The audit was conducted based on the OJT method, and auditing technologies were transferred to Myanmar engineers.
2. Fifty-two people attended the seminar workshop and engaged in an active exchange of information through the following presentations and discussions. An exercise in boiler heat balance was conducted as a first attempt in this project, some assignments were given to the participants, and some participants presented their answers and got some instructions from experts.

(1) Presentations by the Myanmar and Japanese delegates about energy efficiency and conservation policies and programs
(2) Presentations by the Myanmar officials and officials of other ASEAN countries about some examples of energy efficiency and conservation efforts
(3) Presentations by the on-site auditing team about the outcomes of the energy audits

(4) Exercise in boiler heat balance

(5) Presentations by ACE and ECCJ about creating TD and IHDB establishment activities

II. On-site operations in Brunei Darussalam at October 19, 2009 to October 27, 2009;

1. Energy audits were conducted in the oil refinery in Seria, Brunei Darussalam. The on-site auditing team consisted of engineers from the Office of the Prime Minister, Electricity Service Department, Institut Teknologi Brunei, Brunei LNG, and Brunei Shell Petroleum Company. The leader was an engineer from the Office of the Prime Minister.
2. A follow-up audit was conducted in the cement factory where the OJT audit was conducted in 2000. The follow-up team consisted of engineers from the Office of the Prime Minister and the Institut Teknologi Brunei.
3. Forty-one participants attended the seminar workshop, including engineers from the Office of the Prime Minister, the Electricity Service Department and the Institut Teknologi Brunei, as well as officials from oil refinery, LNG production, and cement companies. Officials from ASEAN countries gave presentations about best practices and reported on the outcomes of audits of the oil refinery factories. The exercise in boiler heat balance was also conducted.

III. On-site operations in the Philippines at November 29, 2009 to December 6, 2009;

1. An energy audit was conducted in a medical supply factory in the southern part of the city of Manila. The on-site auditing team consisted of engineers from the Ministry of Energy, medical supply companies, and the factory to be diagnosed. The audit was conducted based on the OJT method, and auditing technologies were transferred to Filipino engineers.
2. Forty-five participants attended the seminar workshop. The seminar workshop was successfully conducted with participants from the Ministry of Energy, medical supply companies, energy technology service companies, and the hotel industry. Officials from ASEAN countries gave a presentation on best practices and reported the outcome of an audit of a medical supply company. An exercise in boiler heat balance was also conducted.

In the end, officials from ACE, relevant organizations in different countries, and relevant companies agreed to provide full support for implementation of this project, we would like to express our sincere appreciation for their support.

I. Purpose and History of the Project

The purpose of this project is to contribute to energy efficiency and conservation, as well as environmental protection in ASEAN countries, by assisting in the promotion of measures for energy efficiency and conservation in major industries in the target countries, which can be achieved by assisting in the activities of those countries to promulgate and promote the technologies for energy efficiency and conservation in major industries.

Started in 2000 under the initiative of ASEAN Centre for Energy (ACE), this project aims to reduce the amount of energy consumption in the growing industries of the ASEAN regions. The ASEAN side calls this project PROMEEC (Major Industries). PROMEEC stands for the Promotion of Energy Efficiency and Conservation, the cooperative project agreed on between the committee of energy-related ministers from ten countries and the Ministry of Economy, Trade and Industry of Japan. The project provides technological and administrative assistance to promote energy efficiency and conservation in the industries of the ASEAN countries through this project.

The purposes of this project are as follows.

1. Tighten the cooperative relationship between ASEAN countries and Japan in the energy sector.
2. Promote energy efficiency and conservation in major industries in ASEAN countries.
3. Promote the transfer of Japanese technologies and the implementation of outstanding efforts to improve energy efficiency in major industries in ASEAN countries.
4. Improve the technological levels of ASEAN countries through energy audits and its OJT.
5. Establish the technical directory (TD), database (DB), and benchmark (BM) for energy audits in ASEAN countries.

Based on past discussions with ASEAN countries, including ACE, this year's support project is positioned as the first-year activity of Phase 3 under the recognition that the entire project is implemented in the following three phases.

Phase 1: Transfer technologies and experience from Japan to ASEAN countries.
Phase 2: Implement improvement measures as a joint effort between Japan and ASEAN countries and spread the measures to other countries.

Phase 3: Promote energy efficiency and conservation as the independent efforts of ASEAN countries.

In Phase 1, energy audits in one industry in each of ten ASEAN countries and the transfer of auditing technologies were conducted (completed in fiscal 2003). In Phase 2, while conducting energy audits, the infrastructures for energy efficiency and conservation were built to implement and promulgate improvement measures (completed in fiscal 2008). In Phase 3, the project aims for utilization of the energy efficiency and conservation infrastructures, including the transferred technologies through the independent efforts of individual ASEAN countries, as well as the spread and promulgation of them within ASEAN countries (started in fiscal 2009).

Based on the above history and purposes, independent energy audits of individual ASEAN countries are to be supported, and implementation and promulgation of improvement measures are to be promoted in fiscal 2009. Specifically, energy audits to ensure regional promulgation of energy auditing technology were conducted in new factories. Follow-up investigations on the implementation status of recommended improvement measures were conducted in factories where energy audits had been conducted in the past. Technical directories (TD) were created and in-house databases (IHDB) and benchmarks (BM) were also built. Energy audits were conducted in automobile factory in Myanmar, oil refinery in Brunei Darussalam, and medical supply factory in the Philippines. Along with the energy audits, a seminar workshop was held to which government and factory officials were invited from different industries in the host countries. The participants gave presentations on best practices of energy efficiency and conservation efforts and shared information within the ASEAN region.

II. Myanmar

1. Activity Overview

In the International Infrastructure Development Project for Efficient Use of Energy, which is the project contracted by METI, officials visited Myanmar from September 28 to October 6 to implement the Energy Efficiency and Conservation Promotion Project for Major Industries in ASEAN Countries. They implemented OJT audits at national truck factories, visiting guidance at national LED lamp factories and private consumer electronics factories, and seminar workshops to exchange information with the people in industries in Myanmar and officials from ASEAN countries. Twenty-six engineers from the Ministry of Industry (1), Ministry of Industry (2), Ministry of Energy, Ministry of Science and Technology, Ministry of Agriculture and Irrigation, Myanmar Engineering Society, consultants, ECCJ, and ACE participated in the OJT audits and the visiting guidance. A seminar workshop was successfully held in Nay Pyi Taw, the capital city of Myanmar, with 52 participants from the Vice Minister of Industry (2), Yangon Institute of Technology, and Mandalay Technological University, as well as two participants from the Philippines and Malaysia.

Delegates: Mr. Taichiro Kawase, Mr. Kokichi Takeda, and Mr. Hidetaka Urakubo,
Technical Experts of Technology Cooperation Department, ECCJ

Activity schedule:

- Sep. 28 to Oct. 1: OJT audit (Myanmar Automobile Factory (1) (herein after called as MAF1))
- Oct. 2: Visiting guidance (LED, Nibban Electronic)
- Oct. 5: Seminar and workshop (at Nay Pyi Taw)
- Oct. 6: Wrap-up meeting (Ministry of Industry (2))

2. OJT audit for MAF1

(1) Participants: 26 people

Ministry of Industry (2): Mr./U San Lynn (Director, Local Team Leader),
Mr./U Thaw Da Pu (General Manager, MAF1 Factory Manager) and others

Ministry of Industry (1): Mr./U Wai Zin Oo (Assistant Manager) and others

Ministry of Energy: Ms./Daw Saw Mu (First Engineer) and others

Ministry of Science & Energy: Dr. Aye Thant (Assistant Director) and others
Ministry of Agriculture & Irrigation: Mr./U Myint Soe (Assistant Director) and others
Consultant: Mr./U Ohn Myint (Myanmar Engineering Society)
Mr./U Htun Naing Aung (Kaung Kyaw Say Co., Ltd.)
Mr./U Shane Kyi (Uni-tech Co., Ltd.)
Two from ACE (Ms. Maureen Balamiento, Mr. Bernard Ginting)
Three from ECCJ (Mr. Urakubo, Mr. Takeda, Mr. Kawase)

(2) Factory overview

Factory manager Mr./U Thaw Da Pu explained the overview of the factory in the first.

Factory: Myanmar Automobile & Diesel Engine Industries (MADI), which is under the jurisdiction of the Ministry of Industry (2), possesses three assembly factories and three parts factories. MAF1 is one of the three assembly factories and is located in a residential area in the Mayangon region, about 10 kilometers north of Yangon. MAF1 adopted the facilities and technologies of Hino Motors and started operations in 1962. The support of Hino Motors ended in 1970. Since then, MAF1 has been manufacturing old-style cab-behind-engine trucks with their own technologies. The factory is also manufacturing their own nuts and bolts. Their local content is as high as 80%.

Manufactured goods: 6.5-ton trucks (manufactures about 300 trucks per year)

Market: 100% domestic sales

Manufacturing facilities: Press machines, flat spring manufacturing facility, nuts and bolt manufacturing facility, clutch manufacturing facility, assembly system

Energy consumption: fuel oil 28,200 gal/year, LPG 25,800 kg/year, electricity 1,025 MWh/year (unit 25 kyat) (Reference: 0.09 JPY/kyat as of Dec. 2008)

Employees: 650

(3) Audit overview

1) Participants in the auditing team

Twenty-seven engineers from the Ministry of Industry (1), Ministry of Industry (2), Ministry of Energy, and government agencies joined the local team. The participants mostly belonged to national companies in the truck and diesel, tire and rubber, fiber, food, paper and pulp, or tool and electricity industries. Mr. San Lynn of the Ministry of

Industry (2) was assigned as the team leader.

2) Identification of problems through on-site inspection

An on-site investigation was conducted in walk-through method by the ECCJ experts and the auditing team. Based on a request from the factory, the inspection focused on the heat treatment furnaces, zinc plating system, pneumatic system, and power receiving system. The inspection identified the following subjects. The identified subjects can also be called indicators of chances to conserve energy.

(a) Heat treatment furnace

There are nine furnaces, all of which are batch feed incinerators. Since seven of them are small and the operation rate is low, it is difficult to secure the profitability of energy saving facilities. Possible low-cost measures include improvement in thermal insulation. The inspection suggested that the old bricks that were currently used as insulation did not have very high heat conductivity. If the measurement of surface temperature is high, profitability may be improved by replacing the bricks with ceramic fiber as insulator. The remaining two are the heating furnace and the tempering furnace for flat springs. They are large and frequently used; thus, the examination of the following energy conservation measures may be necessary:

・The burners are turned on even during non-manufacturing periods, which means a loss of energy. The factory should either stop the burners or reduce the power of the burners. As a first step, they need to identify the ratio of time when the furnaces are not used for manufacturing.
・Improve the insulation in the furnace walls: It is necessary to measure surface temperatures in different spots on the furnace walls, because surface temperatures are often high. Since the furnaces are used in batch operations with frequent cooling and heating cycles, the loss of accumulated heat from the furnaces is significant. Using insulators with small heat capacity, for example ceramic fiber, may be effective as energy saving measures.
・Radiation loss from the opening of a furnace: The opening of the entrance/exit is large and requires installation of heat shield curtains. Heat resistant ceramic fiber is effective as a material for the heat shield curtain.
・The furnace pressure tends to be positive pressure, and the inspectors observed a small amount of hot air spewing from the furnace. Adjustment of the damper and the rotation speed of the fan and consideration of strengthening the chimney draft are

necessary to keep the furnace pressure slightly negative. Appropriate measures to adjust the rotation speed include installation of a low-price inverter that can be manually adjusted or increasing the number of poles in the motor.

- The factory should consider installing an air pre-heater after measuring the temperature of the exhaust gas, if the temperature of the exhaust gas is high. If the oxygen concentration is high, they need to adjust the burner.
- If the damper opening at the exit for the air fan and exhaust gas fan is kept small, the factory should consider fine-adjusting the rotation speed of fan in order to reduce damper loss.

(b) Zinc plating system

The zinc plating system consists of a small plating bath and a rectifier. Rooms to reduce energy consumption include thorough cleaning of the polar surface of the plating bath to keep the residue-based increase of electrical resistance to a minimum. Since the system is small, however, it may be difficult to ensure economic profitability.

(c) Pneumatic system

Of the five systems (four reciprocating engines and one screw engine), the team inspected three reciprocating engines and one screw engine. The five systems are installed in each factory, and there is no pipe that connects them. Since the capacity of the pneumatic system is medium to small, installation of connecting pipes is not economically efficient. The team identified a loose belt in one of the two reciprocating engine systems in the parts manufacturing factory. The team measured the electric current in the other engine and confirmed that the system was in unload status about 30% of the operation time.

At the screw engine system in the assembly factory, the team measured the electric current for a few hours to check whether the unloading time could be shortened. Inspection of the status at the user end discovered multiple leakages. There seemed to be problems in management, such as failure to tighten the end valves. Employee training for improvement in awareness is required. To quantitatively identify the amount of air leaks, the team stopped the pneumatic system after work of the day and observed how the pressure in the receiver tank would drop (pressure drop test). As a result, the team estimated that a considerable amount of air was leaking (about 50% in a provisional calculation). It was possible that the pneumatic systems in other factories share similar problems.

(d) Power receiving system

The team inspected four power receiving and transforming stations. All of them dropped the voltage from 6,600 V to 400 V. Load factors and other aspects are currently being examined. The power factor could not be measured. The capacitor for power factor compensation was not installed in either of the transforming stations.

(e) Hydraulic system

Hydraulic systems and air pressure systems are used to move equipment in many parts of the factories. Although press machines are standing by when they are not pressing, the hydraulic pumps are in operation during the times of standby and wasting energy. Thus, the team inspected the hydraulic press and air pressure press in the press factory. They confirmed that the hydraulic press spent most of the time in standby. The factory needs to implement measures, such as installation of electromagnetic valves, for example.

(f) Lighting

The factory has been making considerable efforts to cut energy use, such as thinning down the number of lamps in the office area, using the latest high-efficiency fluorescent lamps, and turning off lights during lunch breaks. Also, the factory buildings were designed to take in daylight. The remaining measures to cut energy only include installation of reflectors in fluorescent lights and using task-ambient lighting in the Quality Inspection Division.

3) Measurements

The factory supplied a clamp-style power meter and infrared thermometer as measuring instruments. The same type of instruments was also supplied from ACE. ECCJ supplied a contact-type thermometer. The team effectively used all instruments and obtained a substantial amount of data. The team used a power meter to measure the load of motors for two fans and the load factor of the motors of pneumatic systems. The team used the thermometer to measure the temperature of the furnace walls of the heating furnace. Factory engineers operated power meters to ensure safety.

Measuring instruments highly required for future measurements include oxygen meters for combustion gas analyses and hot wire anemometers or vane anemometers to measure the air capacity of fans. These are instruments necessary for combustion management and evaluations of inverter control, which are frequently conducted as energy saving measures.

4) Data analysis (simple) and report

Subjects identified in the factory audit discussed in the last section were presented. Then, data to examine measures to solve these problems were collected. Attachment II-1, “Recommendations for the Myanmar Automobile Factory (1)”, lists provisional outcomes of the OJT audit. These are reported to the factory executives and the audit team as a flash report on the final day of the audit. The flash report was also presented at a seminar workshop in Nay Pyi Taw.

Participants actively exchanged questions and responses about this flash report. Main discussion topics are listed below:

・Information of costs required to implement cost reduction measures
・Profit and loss associated with replacing a compressor with a blower
・Mechanism of the micro gas turbine
・Examination of energy conservation measures
・Effects of the batch furnace door (from the perspective of energy conservation and safety)
・Improvement in the bending procedure
・Installation of a suction hood in a quenching bath
・Profitability of renewing aged facilities
・Profitability of replacing the carburizing furnace from the current electric furnace from the gas burner furnace.

5) Data analysis (detailed)

The data collected in Myanmar were brought back to Japan for detailed analysis.

5-1) Examination of energy conservation measures in thermal aspects (see Attachment II-3)

Eight furnaces are installed in this factory. OJT audits were conducted on the LS 5 and LS 7 furnaces with large combustion intensities. The operation status, outcomes of heat balance examinations, and energy conservation measures are described below.

(a) LS 5 furnace

(i) Operation status

This furnace is used to quench the springs. The furnace is a continuous feed incinerator type, but there is no distinctive zoning, such as the pre-heating zone and cooling zone, because the furnace is small. Workpieces are carried into the furnace on the conveyor installed on the furnace bottom. Workpieces are manually placed on the conveyor. The opening of the conveyor is an elongated space 1,900 mm wide and 40 mm high. A dividing shutter is installed at the opening to completely separate the internal space of the furnace from the ambient air. However, the shutter is not closed while the furnace is in operation (when workpieces are fed into the furnace) even when workpieces are not fed for a short period of time. This is probably because the shutter is manually operated, and the operation is troublesome. The workpieces exiting the furnace go through hot working for a short period of time and are then immediately cooled in the quenching oil bath.

(ii) Trial calculation of heat balance

(Heat Input) : (MJ/hr)		**(Heat Output)** : (MJ/hr)		
Combustion of the burner	3,903	Stack loss	2,953.6	
		Gas loss from flame leak	615.0	(15.8%)
		Radiation loss	48.6	
		Loss from wall surface	93.2	
		Heat output of workpiece	192.6	(4.93%)
(Total)	3,903	(Total)	3,903	

(iii) Auditing findings

・The greatest problem with this furnace is that most measuring instruments around the furnace are out of order. The most important ones, the in-furnace thermometer and draft meter, which indicates the pressure inside the furnace, are both broken and do not work. The furnace originally had a system that measured in-furnace temperature and controlled the fuel supply rate to the burner. However, since automatic control, which is based on measured temperatures, is out of order, the fuel is manually supplied to the burner. Actually, skilled workers in the factory (apparently there are two of them) visually check the color of the workpieces inside the furnace and manually control the fuel supply. These two seem to be highly skilled, and reportedly, there are no problems with the actual manufacturing with this method. (See Photograph 1) The team advised the factory to immediately repair the in-furnace thermometer and the draft meter.

・There is an opening at the entry/exit of workpieces, since it is a continuous-style heat treat furnace. A rolling door is installed at the opening of the furnace. The rolling door is left open while the furnace is in operation, however, because workpieces frequently enter and exit during the operation, and the door must be manually opened and closed. As shown in the heat balance above, the heat loss from this opening is considerably large; the loss is 15.8% in calculation. Improvement is urgently required, such as improving the rolling door or installing a metal curtain.

・The amount of heat absorbed by workpieces, the indication of actual heat efficiency, is 4.93%, which is extremely small; this is a serious problem for energy conservation. Unlike a boiler, this is a small annealing furnace, and it is difficult to improve heat efficiency. Nonetheless, it is necessary to keep this value 20% or higher. Urgent measures are necessary, including the reduction of flame leak loss and reduction of ambient air intake. Although no measurements were taken due to the lack of an oxygen meter on the day of the inspection, based on the heat balance, it is likely that the combustion gas contains a considerable amount of oxygen (about 13%).

5-2) Examination of energy conservation measures in electrical aspects (see Attachment II-4)

(a) Air compressor

Air compressors are placed in individual shops in this factory. This inspection focused on specific devices and investigated their unload rates and took on-site measurements of air leaks.

(i) Air compressors for press and assembly shops (AC1)

The air leak test found that the air leak rates were high (50%). Thus, the first priority is to improve air leaks.

・Repair areas of air leaks and strengthen routine inspections (air leak checks and follow-up of the outcomes)

Strengthen management of negligence of users to close compressed air (employee education and establishment of management system)

(Rough calculation of energy to be saved from improving air leak)

Assume that the air leaks are improved by about 50% to 10%. (Forty percent reduction in the amount of air use)

As a result, the on-load rate becomes 55% (91% × 0.6) and the unload rate 45%.

$$\Delta kW = (54\ kW \times 0.91 + 25\ kW \times 0.09) - (54\ kW \times 0.55 + 25\ kW \times 0.45)$$
$$= 51.4 - 41.0 = 10.4\ [kW]$$

Energy conservation ratio = 10.4 / 51.4 × 100 = 20.2 [%]

The unload time ratio decreases after improving the air leaks and requires measures to reduce unload loss.

・Reducing the capacity of air compressors etc.

(Rough calculation of energy conservation through the reduction of air compressor capacities): Temporarily suppose that the margin of capacity is 10%.

Suppose that the on-load input of small-capacity air compressor is 36 [kW](54 kW × 0.6 × 1.1), ratio 83[%](55 × 54/36), unload input 17[kW](25 kW × 36/54), and time ratio 17[%].

$$\Delta kW = (54\ kW \times 0.55 + 25\ kW \times 0.45) - (36\ kW \times 0.83 + 17\ kW \times 0.17)$$
$$= 41.0 - 32.8 = 8.2\ [kW]$$

Energy conservation rate = 8.2 / 41.0 × 100 = 20 [%]

Actual capacities of compressors vary slightly because they are selected from the standard specifications of manufacturers.

(ii) Air compressors for machine tool/spring shops (AC2, AC3)

The measured unload rate is 29%. However, the unload rate may be worse after improving air leaks depending on air leak tests that are similar to AC1. Thus, the possible perspectives of energy conservation include the following.

・Identification of the amount of air leaks and measures to deal with air leaks

・Reduction of unload loss (examination points after implementing the measure (i))

Reduce air compressor capacities or employ a high-efficiency capacity controller (inverter device).

However, since two compressors, AC2 and AC3 may be in operation at the same time, it is necessary to take operation conditions into account to deal with maximum loads when considering air compressor capacity reduction.

The current unload loss = 17 kW × 0.29 = 4.93 [kW]

Ratio to the entire AC2 = 4.93 /(60 × 0.71 + 4.93) × 100 = 10.4 [%]

(iii) Air compressors for large automobile parts manufacturing plants (AC4)

Partial load control function is absent in these compressors. The pressure of receiver tank increases, and the safety valve is turned on during light loads. Start/stop control is manually conducted at the equipment side based on the communication from the user side. Thus, there is a risk of unload loss, but we cannot provide a quantitative evaluation because we were unable to obtain data, such as unloading time. The perspectives for future energy conservation are the same as the section (b) of AC2.

・Identification of the amount of air leaks and measures to deal with air leaks

・Identification of unloading time and consideration of using automatic unloading control, as well as a reduction in air compressor capacity or using a high-efficiency capacity controller if the unload ratio is high.

(b) Combustion air fan

Combustion air fans for the furnace in the leaf spring shop and temper furnaces were investigated.

(i) Combustion air fan in furnace

Expected motor outputs based on measured data are mostly the same as the shaft power when the fan operates at the rating. The fan is used mostly at the rated air capacity, but the air capacity variability depending on different settings of the air-fuel ratio was not confirmed. As a suggestion for conserving energy, can they reduce the air capacity to use and pressure from the current furnace operation? When considering the employment of inverters in the future, it might be difficult to establish a case for investment efficiency if they need to customize or employ an air fuel ratio control system.

(ii) Combustion air fan in the temper furnace

The energy consumption of applicable fans is small, and great effects from energy conservation cannot be expected. Nonetheless, the team conducted a trial calculation of the amount of energy conservation when the rotation speed is reduced, which will be used as reference information for the energy conservation calculation of the fans.

$$\Delta kW = kWb' - La \times (Nn/No)^3 ／ (\eta_{tc} \times \eta_{mb}) \times \eta_{fa} / \eta_{fb} \text{ [kW]}$$

$$= 1.44/0.8 - 1.53 \times (0.91)^3 ／ (0.95 \times 0.8) = 1.80 - 1.51 = 0.29 \text{ [kW]}$$

Energy conservation ratio = 0.29 / 1.80 × 100 = 16 [%]

When the fixed resistance (suppose that the required pressure in front of the burner is 600 mmAq) is high like the applicable fans, the effect of reducing the rotation speed is small, and it is difficult to establish a case. Suggestions for energy conservation are the same as section (a) (such as the air capacity to use and reducing pressure).

6) Status of energy management

The company was implementing top-down activities to improve awareness of energy conservation among employees. Specifically, as measures to conserve energy from lighting devices, they were diligently turning off lights during lunch breaks and employing the latest high-efficiency fluorescent lamps, FRL. They were also thinking about reducing the number of fluorescents lights throughout their facilities. We suggested the following as future issues to work on in order to further improve the above activities:

・Establish an energy management system.
  Organize an energy conservation promotion committee, which requires strong support from factory executives.
  Appoint energy leaders for individual facilities.
  Promote employment education, especially worker education.
  Request some competent authorities to provide advice.
・Facility maintenance
  Further improve management with a special focus on devices, such as furnaces, pneumatic systems, and hydraulic devices to elongate their service lives.
・Measurement and records
  Conduct monitoring and recording of energy consumption data.

(4) Remarks

1) Honestly, we were surprised to find that the factory was still using the machines and equipment with great care that Japan had provided before 1970. Machines from Japanese manufacturers, such as Hitachi, Komatsu, Mitsubishi, Toshiba, and Niigata, were still standing and in great shape in the factory. These technologies seemed only able to manufacture 6.5-ton-level bonnet trucks back then; it was truly strange to see the trucks still being manufactured in front of our eyes. People in the factory repeatedly told us that Japanese machines lasted for a long time. We first thought they were just being nice to us, but in the end, we actually felt that the people in Myanmar sincerely respected Japanese technologies.

2) Mr. San Lynn, the industry coordinator for PROMEEC and officials of the Ministry of Industry (2) prepared for our visit well. Many engineers from industry-related government agencies joined the local team. Although there were only power monitors and infrared thermometers, they provided us with measuring instruments. The factory was well prepared for our visit. For example, they prepared a PowerPoint presentation

to explain the factory overview and their energy efficiency and conservation activities. Thanks to their efforts, we were able to shorten the time for interviews and other activities and spend a lot of time on the facility inspection and discussions.

3) Unfortunately, there was little progress in the factory's status of energy efficiency and conservation. Especially, the concept of energy management has not been infiltrated, and maintenance was not sufficiently conducted. Many no-cost and low-cost energy efficiency and conservation measures were pointed out in the walkthrough. We hope that they will immediately put our suggestions into practice.

4) Many engineers from other industries participated in this OJT audit. We expect that they efficiently learned the meaning of energy management, the importance of maintenance, and no-cost and low-cost energy efficiency and conservation measures through actual examples. I hope that the outcomes of this OJT will spread to industries besides the auto industry.

3. Visiting Guidance

(1) Circumstances

The initial plan included a follow-up investigation in the fiber factory where the OJT audit was conducted last year. At the request of the Myanmar side, however, we suddenly decided to visit the national LED factory and the private consumer electronics parts factory

(2) Date, time, and participants

October 2, a.m.: LED Lamp Factory (state owned)
p.m.: Nibban Electric & Electronics (private)
26 participants (everyone who participated in the OJT audit)

(3) LED Lamp Factory

1) Factory overview

History: This is a state owned factory under the jurisdiction of the Ministry of Industry (2). It was a factory that manufactured tumbler switches before last year but transformed into a factory to manufacture LED lights for decorations last year. Equipment and technologies were brought in from China.

Products: LED lights for decoration

Sales target: 100% domestic consumption

Manufacturing capacity: 50,000 products/shift

Manufacturing process: Lead frame → Epoxy bond → Die bond → Wire bond → Phosphor → Mold → 1st cutting → 2nd cutting

Materials: Epoxy covers, colors, circuit boards (imported from China)

Employees: 100 people

Assigned official: Mr. Myo Myint (former factory manager)

2) Main energy facilities

Transformer 300 kVA (6600 V to 230 V)

Diesel in-house power generator

Pneumatic system to drive manufacturing devices

Oven for soldering gold

Package air conditioner for lamp manufacturing room

Cooling tower for air conditioning in workroom (evaporative air conditioner)

Lighting equipment in workrooms and offices

3) Outcomes of walkthrough and details of guidance

・As the 300 kVA transformer indicates, this is a small factory. Organized energy efficiency and conservation measures have not been started yet. We advised the factory to appoint leaders and keep records of purchased power and fuel for in-house generation.

・Many old-fashioned tubular fluorescent lamps were installed in workrooms and corridors. Since there were lamps without reflectors and some were dirty, we recommended installation of shiny metal reflectors, installation of pull-switches, and sequential replacement of the old lamps with high-efficiency fluorescent lamp FRLs. Local lighting was already installed.

・The temperatures in the workrooms and corridors were 25 °C to 30 °C. The package air conditioner was manually controlled. It seemed as if meticulous temperature and humidity control was unnecessary for lamp manufacturing.

・The oven for soldering gold was separated in another room, which prevented heat contamination from the workrooms. The exhaust pipe of the oven was not insulated, and its surface temperature was 104 °C. We advised covering the pipe with simple insulation.

・The in-house power generator was running during our visit. We were told that the generator was turned on once a day on average. We advised recording the liquid level of the rectangular parallelepiped light oil tank to monitor changes in the amount of fuel used.
・The air compressor is operated in on-off control. On-site inspection observed that the system was turned off for a long time, which means that the capacity of the air compressor is too large. The factory needs to consider employing smaller systems, such as baby compressors.

(4) Nibban Electric & Electronics (private)

1) Factory overview

Location: The factory was located in the Dagon Industry Complex in the rice paddy area, which was 30 minutes by car to the east of Yangon. Mr. Aye Ko, the assistant manager of manufacturing, received us. He participated in the AOTS training (YKC) about *kaizen* ("improvement" in Japanese) in 2008. The founder of the factory was inspired by Japan's *kaizen* activities and named the company Nibban, which means "second in line" in Japanese to advocate his attitude toward running the company.
Products: TV antennas, antenna boosters, AVR, voltage regulators, rice cookers
Manufacturing devices: Antenna assembly system, PCB system, transformer coil winding system, varnishing system, sliding system, metal plate cutting/ punching system, powder coating system, machining center, injection machine, etc.
Obtained certification: ISO 9001-2000
Employees: 200 people
Assigned official: Mr. Aye Ko (assistant manufacturing manager)

2) Main energy facilities
Paint baking oven (LPG burner)
Transformer (6600 V to 230 V)
Diesel in-house power generator (2 units)
Air compressor (4 units)
Cooling tower for cooling injection machine (2 units)
Package air conditioner for offices

Lighting devices for workrooms and offices

3) Outcomes of walkthrough and details of guidance

・As mentioned in the previous section, this factory has been working on *kaizen* activities since 1997. There was a note on the wall of Mr. Aye Ko's office that described the 5S (five improvements) and 7W (seven wastes). The factory seemed to have produced certain results, such as the diligent practice of turning off lights in unused rooms. The next step is to progress from activities by some employees to activities by all employees.

・Energy consumption monitoring systems called PLC (power line carrier) are installed in this factory. Three energy monitors are installed and monitor energy consumption while storing data in the computer. This is a quite advanced effort in a small factory.

・One large building in this factory has low partitions to divide the space, and different work processes are located in the divided spaces. While the factory has no air conditioning system, insulation that appeared to be blankets were placed wall to wall in the attic to block heat from the roof. Also, there are windows in the roof with transparent glass to allow in natural daylight; they maintain the balance between the effect to block heat and the use of daylight.

・Combined lighting is used in the work processes: local lighting with tubular fluorescent lamps and general lighting with halogen lights installed to cover the local lighting. Since the reflectors for the fluorescent lights were dirty, we advised replacing them with shiny metal reflectors.

・Paint baking system is a two-room batch system and maintains a combustion temperature of 170 °C with an LPG burner. Waste heat is not collected. Since it is a small system, profitability from a waste heat collector cannot be expected. Since there is no stack for exhaust gas, we advised installing a stack for safety and environmental perspectives.

・Energy efficiency and conservation measures to be considered generally include insulation of the heating barrel, insulation of a resin dryer, reduction in the amount of water for cooling, and reduction in power while the hydraulic pump is standing by. Since the molding press in this factory is small, it is probably difficult to improve profitability from these measures. Possibilities include insulation of the heating barrel and a reduction in the amount of cooling water.

・When considering insulation of the heating barrel, it is necessary to select a ceramic insulation blanket with the lowest price possible.

There is also a possibility of maintaining profitability from reducing the amount of cooling water. The following outcomes are found from measuring the surface temperature of cooling water pipe using a contact thermometer:

Entrance of oil cooler 27.3 °C
Exit of oil cooler 27.9 °C
Entrance of cooling water Impossible to take measurements
Exit of cooling water 26.4 to 27.0 °C

The temperature differences at the entry/exit of the oil cooler and at the entry/exit of the cooling tower in the design are both 5 °C. Thus, the above data indicate the possibility that the amount of cooling water in circulation is excessive. Then, as the first step, reduce the amount of cooling water in circulation and make sure that it does not interfere with the operation of the injection machine. Then, as the second step, we recommend considering implementation of measures to reduce the pump power, such as controlling the cooling water pump speed.

・Although the diesel in-house power generator is for emergency use, it is reportedly turned on for four hours a day in the present situation. Effective energy efficiency and conservation measures for a diesel power generator include heat collection of potential heat from the exhaust gas and waste heat from the cylinder cooling water. The temperature measured on the surface of the exhaust gas pipe was very high at 400 °C. A general practice is to collect the waste heat from both devices as hot water, but this method is not applicable because hot water is not used in this factory. Another method is the production of cool water using a waste heat absorption refrigerator, but since the installation cost is expensive, it is probably difficult to employ this method in this factory.

(5) Remarks

・Both of the two factories we visited this time are small, and profitability cannot be established because the effects of the many possible options to conserve energy are small.

・Of the possible measures, energy conservation through lighting equipment is easy to implement and actually produced considerable effects in both factories. Nonetheless, the reduction in the number of lamps through the improvement of reflectors was yet to be implemented; we expect the factories to improve the reflectors in the future.

・Although we didn't have time to inspect in this visit, leaks of compressed air tend to be overlooked; we request the factories to check leaks. The amount of compressed air leaks can be easily estimated by measuring how the pressure in the air receiver decreases when the air compressor is turned off after a work of day. We definitely encourage the factories to try this method.

4. Seminar workshop

(1) Date, time, and location

October 5, 2009, 08:30–17:00

Chatrium Hotel, Nay Pyi Taw, Myanmar

(2) Participants: 52 people

Ministry of Industry (2) : Total of 13 people

Mr. Kyaw Swa Khine, Deputy Minister

Mr. Myoe Aung, Director General, Directorate of Myanmar Industrial Planning

Mr. San Lynn, Director, Myanmar Industrial Construction Services, (Coordinator for PROMEEC industry)

Engineers from national factories (tool and electric, truck and diesel, tire and rubber)

Ministry of Industry (1) : Five people

Mr. San Tai Myint, Deputy General Manager

Engineers from national factories (fiber, food, beer, sugar, paper, pulp)

Ministry of Energy : Nine people

Mr. Soe Aung, Director General, Energy Planning Department (focal point)

Ms. Wah Wah, Deputy Director and others

Ministry of Agriculture and Irrigation : Five people

Mr. San Thein, General Manager and others

Yangon Technological University : Three people

Mandalay Technological University : One person

Myanmar Engineering Society : Four people

Mr. Ohn Myint, Executive Committee Member (former focal point)

Mr. Myint Kyaw, Work（？）ing Committee Member and others

Suntac Technologies : Two people

Kaung Kyaw Say Co., Ltd. : Two people

AE Engineering Co., Ltd. : One person

ASEAN (speaker) : Two people

Mr. Zul Azri Bin Hamidon, Expert, PTM, Malaysia

Mr. Marlon Romulo Domingo, Senior Specialist, DOE, The Philippines

ASEAN Center for Energy (ACE) : Two people

Ms. Maureen Cruz Balamiento, IT Specialist

Mr. Bernard Ginting, Technical Officer

The Energy Conservation Center, Japan (ECCJ) : Three people

Mr. Taichiro Kawase, Technical Expert, International Engineering Department

Mr. Kokichi Takeda, Technical Expert, International Engineering Department

Mr. Hidetaka Urakubo, Technical Expert, International Engineering Department

(3) Presentation overview

Session 1: Policy and Initiatives on EE&C in Major Industries

1) Updates of ASEAN Energy Efficiency (EE&C) Activities

Ms. Maureen Balamiento described the activity overview of ACE based on the following topics.

・APAEC Program 2004-2009
・ASEAN-Japan Cooperation (SOME-METI, PROMEEC, and Multi-Country Training)
・ASEAN Best Practice Competition (energy conservation section)
・ASEAN + 3 Energy efficiency and conservation/Renewable Energy Forum
・Other cooperation programs with EAS-ECTF, UNEP, ASEAN Foundation, ADB, and CDC.

Of these topics, she explained about the APAEC Program 2004–2009 in detail: this program includes six program areas, and energy efficiency and conservation are implemented in program area 4; the purpose is to strengthen the cooperation of the ASEAN region through the capability establishment of energy efficiency and conservation organizations, the involvement of the private sector, and the expansion of the market for energy saving devices; and this program intends to implement activities in six categories in order to achieve its goals.
(Information sharing and networking, ASEAN energy standard and labeling, participation of the private sector, capability building, training of ESCO companies, and energy efficiency and conservation in the transport sector)
As main activities in the program area 4, she then introduced PROMEEC activities based on circumstances of leading to Phase 1, Phase 2, and Phase 3, as well as outcomes

and future perspectives.

2) Overview of Plans & Programme on EE&C in Myanmar

Ms. Wah Wah of the Ministry of Energy explained the latest energy efficiency and conservation policies of Myanmar based on the following 3 categories:

- Focuses of energy policies
- Agencies assigned to the energy sector
- Energy efficiency and conservation measures

The focuses of Myanmar's energy policy are on energy independence, utilization of new and renewable energies, promotion of energy efficiency and conservation, and promotion of alternative fuel for domestic use.

The following agencies are assigned to the energy sector:

- Oil and gas – Ministry of Energy (focal point of the energy sector)
- Electricity (hydropower) – Ministry of Energy (1)
- Electricity (thermal and transmission) – Ministry of Energy (2)
- Coal - Ministry of Mines
- Biomass - Ministry of Forestry, Ministry of Agriculture and Irrigation, and Ministry of Science and technology
- Renewable energy - Ministry of Science and technology
- Nuclear energy - Ministry of Science and technology
- Past energy efficiency and conservation activities
- UNDP/ADB Project (1991, energy audit etc.)
- UNESCAP Seminar (three sessions, energy efficiency and conservation)
- PROMEEC Project (several times, training, audit, seminar)

3) Japan's Energy Conservation Policy & Measures for Industrial Sector

Mr. Taichiro Kawase of the Energy Conservation Center, Japan explained Japan's energy efficiency and conservation policies and policies in the industry sector based on the following five perspectives:

- Changes in the basic unit of energy in individual industries in Japan
- Legal measures and energy efficiency and conservation measures in the industry sector of Japan
- Voluntary activities of private companies and organizations in the industry sector

・ Roles of the Energy Conservation Center and activity overview

Session 2: EE&C Best Practices in Industries

4) EE&C Practices of Steel/Cement Companies and Energy Labeling in the Philippines

Mr. Marlon Domingo of Department of Energy, the Philippines reported energy conservation audits that Department of Energy is implementing and energy efficiency and conservation measures implemented in steel factories and cement factories in the Philippines.
The Philippines has five electric furnace manufacturers that manufacture billets. Billets are processed into bar steels, wires, and other forms in a metal roller. Main energy facilities in a bar steel factory include walking bean furnace, waste heat recuperator, tandem metal roller, pneumatic system, and cooling water system. The following energy efficiency and conservation measures were implemented in the walking beam furnace.

・ Replacement or alteration of waste heat recuperator
・ Reduction of energy use during non-production periods
・ Additional lining of ceramic fiber in furnace walls
・ Strengthened management of cooling water for furnaces (installation of a flow meter)
・ Avoidance of simultaneous launching of AC motors
・ Use of transparent resin roofing for the roofs of factories and storages (to use daylight)

The Philippines has 15 cement factories, including small factories that produce 0.1 million tons a year and large ones that produce 0.5 million tons a year. Many of the manufacturing processes employ dry method, but semi-dry processes still remain in some processes. Major energy efficiency and conservation measures implemented so far are as follows:

・Renovation of a semi-dry kiln into dry kiln
・Improvement of capacity through additional installation of precalciners
・Improvement of capacity through the renovation of a clinker cooler
・Install a high-efficiency fan into a clinker cooler
・Installation of a five-step NSP kiln
・Employment of vertical roller mill

・Conversion from damper control of different types of fans into variable speed control
・Use of rice husk fuel
・Installation of an online O_2 analyzer to monitor air leak from a calciner
・Improvement of a process control system

The employment of waste heat recovery and power generation using the waste gas from the clinker cooler or suspension pre-heater is being considered.

5) Energy Efficiency & Conservation in Food Factory in Malaysia

Mr. Zuri Hamidon of PTM Malaysia Energy Center reported the case of a food factory that produces 22,500 cans of food a day. This factory pre-processes frozen seafood in the process of thawing, simmering, and frying and then packs them in cans with seasoning manufactured in a separate line. The cans then go through the process of extracting air from cans, seaming, sterilizing, labeling, and packaging. They are shipped after this process. We conducted an energy audit and suggested the following:

- The setup temperature of the freezer storage was determined with the expectation of three to six months of storage, but the setup temperature was increased because the actual storage period is two weeks at the most.
- The live steam produced in the retort sterilization facility was used as deaerated steam in the deaerating boiler.
- Install a deaerator and collect condensation and excessive steam.
- Enclosures were installed throughout the entire simmering facility and reduced steam loss.
- The steam produced from the air extraction facility which used to release the exhaust is effectively used in the simmering facility and frying facility.
- The simmering facility, frying facility, and steam pipes were insulated.
- Simplified water treatment system was installed, and treated water was used for washing, cooling cans, and cleaning.
- After checking the required pressure at the demand side, the compressed air supply pressure was lowered to 6 bar (g).
- Since the power factor was low at 0.74, a power factor compensation capacitor was installed.

6) Best Practices in the Japanese Automobile Industry (heat energy)

Mr. Hidetaka Urakubo of the Energy Conservation Center, Japan, reported two energy efficiency and conservation examples in Japan's automobile factories. The first case is about furnaces for carburizing differential gears. Measures, including improvement in the process of loading workpieces into trays and uniform supply of carburizing gas, reduced the work treatment time and successfully achieved about a 15% energy conservation effect. The truck factory in Myanmar where an OJT audit was conducted during this visit also has a batch-style carburizing furnace. Thus, the factory probably found this report quite helpful.

The second case is about management improvement in the steam traps. Although this is not a case of an automobile factory, the report is perhaps useful because there are many factories with boilers in Myanmar.

7) Best Practices in Japan (electrical energy)

Mr. Kokichi Takeda of the Energy Conservation Center, Japan, reported the following cases concerning energy efficiency and conservation measures of electric energy:

- Measures involving conveyance systems, hydraulic system of carburizing furnaces, and main shaft motors in engine factories.
- Improvement in the operation of power receiving systems (such as lowering supply voltage during non-manufacturing periods and reducing standby power during weekends and holidays)
- Employ inverter operation in the hydraulic pumps of carburizing systems.
- Employ an inverter operation in the air supply fans and exhaust fans of air conditioners of paint booths.
- Employ an inverter-operated pneumatic system in the compressed air system and control the number of units.
- Energy efficiency and conservation measures for compressed air systems (accumulation of low-cost measures)
- Energy efficiency and conservation measures for air conditioners (automatic control of freezer operation, damper control etc.)
- Energy efficiency and conservation measures for lighting devices (employment of high-efficiency fluorescent lamps etc.)

These cases involve essential facilities and devices for automobile factories and are applicable to automobile factories in Myanmar.

8) Results of OJT Audit in Myanmar Automobile Factory (1)

Mr. Thaw Oo of the Ministry of Industry (2) who participated in the local team reported about the outcomes of the OJT audit conducted in the Myanmar Automobile Factory (1). See Attachment II-2 for details. Major parts of the suggested measures include energy efficiency and conservation measures for metal furnaces and compressed air systems. There were also suggestions about the maintenance of old facilities and energy management systems; they were all useful to engineers at the national factories who attended this seminar.

Session 3: Workshop on Energy Management Tools

9) Heat balance of fired heater

Mr. Hidetaka Urakubo of the Energy Conservation Center, Japan, gave a lecture on heat balance. This lecture aimed to build fundamental knowledge for the full use of energy management tools. Industrial furnace used in many factories was selected as an example to demonstrate heat balance. The time allowed for this lecture was short, and only a lecture was given in this session, but we will make improvements so that a calculation exercise can be included in the future. Heat balance calculation homework was assigned as a new attempt. While the submission of the homework was not mandatory, the procedure to submit answers to ECCJ and how the ECCJ experts would correct and return them were presented.

10) Updating of TDs, IHDBs, EMHBs and Cyber Search

Mr. Bernard of the ASEAN Centre for Energy (ACE) explained the purposes, production method, format, and entry example of the four types of ASEAN energy management tools: the technical directory, in-house database, energy management handbook, and cyber search system.

11) IHDB for automobile industry and textile industry

Mr. Taichiro Kawase of the Energy Conservation Center (ECCJ) , Japan, provided an overview and instructions on how to fill out the entry format for the in-house database (IHDB) for automobile factories and fiber factories. The characteristic feature of IHDB as an energy management assistance tool to be used in factories is that it includes manufacturing data, energy data, and equipment data in addition to important operational parameters and energy efficiency indices. These features supply reference information to divisions within a factory for efficient energy operation. Based on the perspective of promulgating them to the ASEAN countries, we requested the participants to actively employ them in automobile factories, fiber factories, food factories, and cement factories in Myanmar. The following procedures were presented for their employment:

a. Select participating factories in each industry (about two companies in one industry)
b. Produce an organization chart for the test employment of IHDB (clarification of role assignment)
c. Determine data to be entered in the IHDB (be careful not to include too much data)
d. Start data collection and accumulation (each participating factory is to individually implement this procedure)
e. Progress management of test employment (focal point is to implement this procedure)
f. Follow-up (report at the next inception workshop)
g. Create a roadmap (create a mid- to long-term plan with ACE)

12) Myanmar primary energy resources, activities of EE&C and electrification of rural village with RE

Mr. Myint Kyaw of the Myanmar Engineering Society (MES, under the jurisdiction of the Department of Energy) gave a presentation on aspects, including the recent supply and demand for primary energy in Myanmar, the development of renewable energy (RE), energy efficiency and conservation measures, and efforts to distribute electricity to agricultural and village areas.

Primary energy supply/demand data [2008, KTOE]

Supply	Crude oil etc.	1,789	Demand	14,889
	Natural gas	1,721		
	Coal	558		
	Hydro	1,541		
	Biomass	9,280		

The supply of RE in May 2009 (MW)

Equipment capacity	Hydro	1,321
	Wind (25 units)	0.52
	Solar (82 units)	0.25
	Bio gas	1.6
	Biomass gasification (428 unit, rice husk etc.)	21.50

(4) Remarks

1) More than 50 participants attended this session. The participants included the vice minister of the Ministry of Industry (2), Ministry of Energy (focal point), Ministry of Science and Technology (university professor), engineers from national factories under the jurisdictions of the Ministry of Industry (1) and Ministry of Industry (2), and engineers from the Ministry of Agriculture and Irrigation and engineers from the Myanmar Engineering Society.

2) Engineers and consultants from these ministries talked to us about various topics. According to the presentation of the Ministry of Energy, Japan's PROMEEC is the only assistance from a foreign donor in the field of energy efficiency and conservation. We viewed the expectations of the participants toward this project as opportunities to gain information from foreign countries.

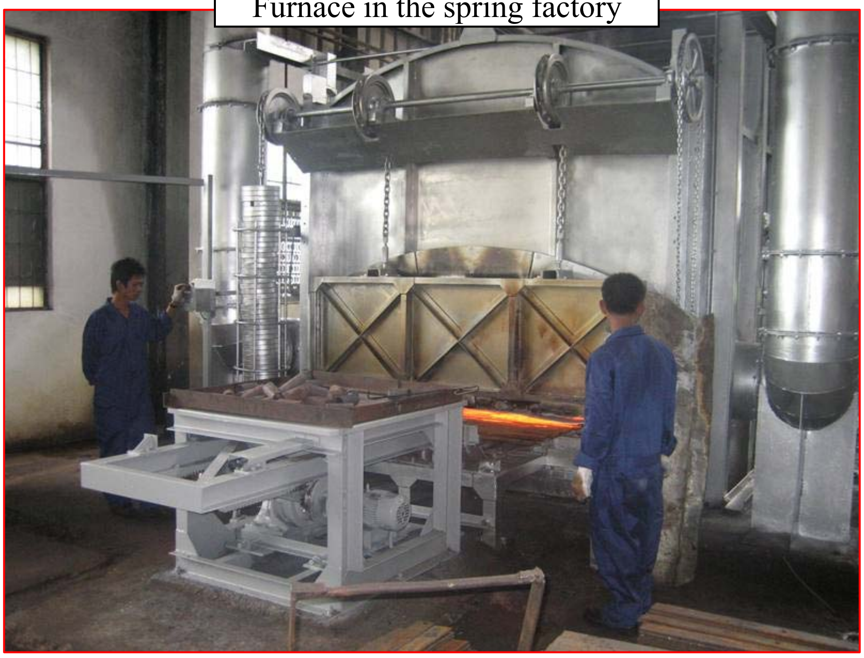
3) The staff efficiently operated this session including the preparation of the site, distributing documents, and arranging lunch services. We would like to express our gratitude toward Mr. San Lynn, the industry coordinator of PROMEEC and government officials of Myanmar.

END

Myanmar Automobile Factory (1) OJT audit

Mr. Thaw Da Pu (factory manager) front, center
Mr. San Lynn (PROMEEC industry coordinator) front, the fourth from the left

Furnace in the spring factory

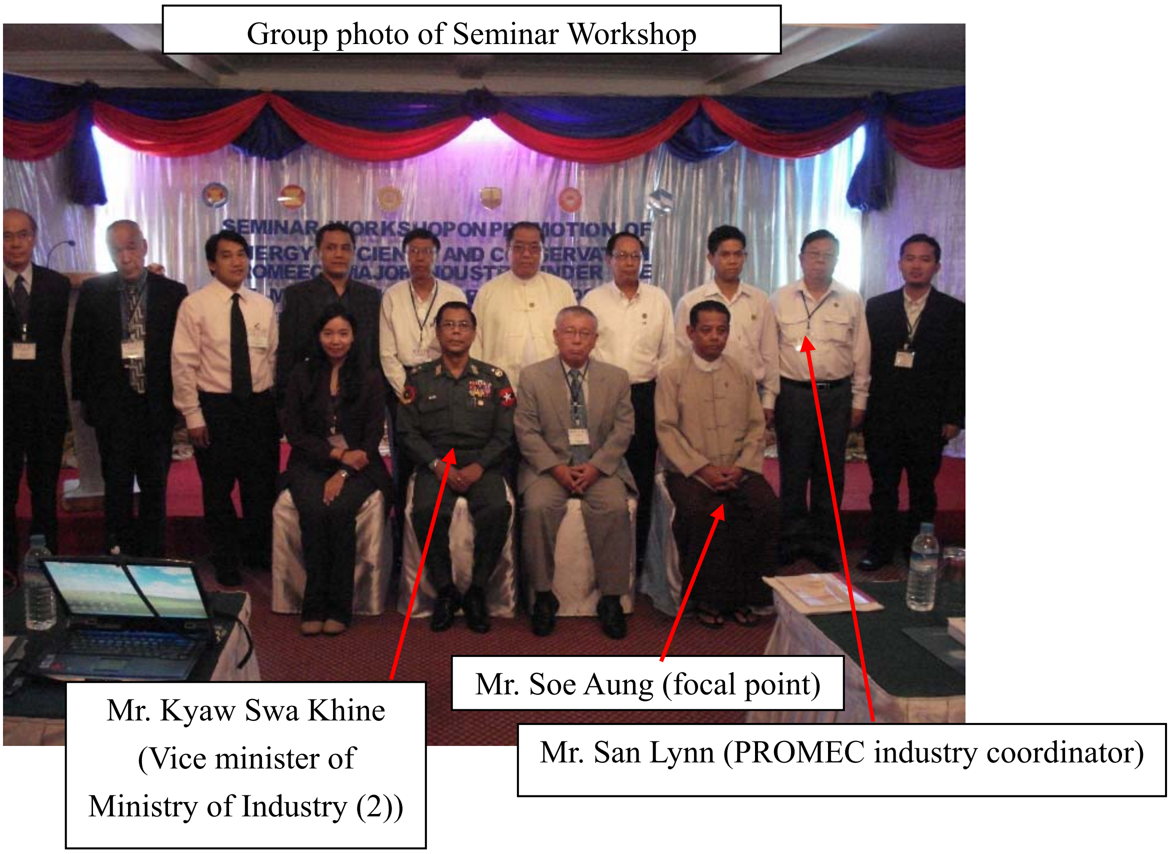


LED Visiting Guidance

Mr. San Lynn (front, fifth from the left)
Mr. Myo Myint (former president, front, third from the left)

Visiting Guidance at Nibban

Mr. San Lynn (eights from the left)
Mr. Aye Ko (assist. manager of manufacturing, 13th from the left)



Attachment II

1. Recommendations for the Myanmar Automobile Factory (1)
2. Results of OJT audit presented by Mr. Thaw Oo
3. Examination of energy conservation and thermal aspects of efficiency measures
4. Examination of energy efficiency and conservation in the field of electricity

III. Brunei Darussalam

1. Activity Overview

In the International Infrastructure Development Project for Efficient Use of Energy, which is the project contracted by METI, officials visited Brunei from October 19 to October 27 to implement the Energy efficiency and conservation Promotion Project for Major Industries in ASEAN Countries. They implemented OJT audits at an oil refinery, follow-up guidance at a cement factory, and seminar workshop to exchange information with the people in industries in Brunei and officials of ASEAN countries. A total of 25 people participated in OJT audits, including delegates from the Prime Minister's Office (PMO), Department of Electrical Services (DES), Institut Teknologi Brunei (ITB), Brunei Shell Petroleum (BSP, factory where the audit was conducted), Brunei LNG (BLNG), and five engineers of ECCJ/ACE. A seminar workshop was held in the Kiulap Plaza Hotel and successfully conducted with 41 participants, many of whom were government officials. The delegates visited Universiti Brunei Darussalam (UBD) and Institut Teknologi Brunei (ITB) in between local activities and exchanged information about training on factory audit technologies.

Delegates: Mr. Taichiro Kawase, Mr. Kokichi Takeda, and Mr. Hidetaka Urakubo,
Technical Experts of Technology Cooperation Department, ECCJ

Activity schedule: Oct. 19 – Oct. 22 OJT audits (Brunei Shell Petroleum factory (abbreviation: BSP))
Oct. 24 seminar workshop (at Kiulap Plaza Hotel)
Oct. 26-27 Follow-up guidance (Butra Heidelberg Cement (abbreviation: BHC))
Oct. 27 Wrap-up meeting (at PMO)

2. OJT audit (BSP oil refinery)

(1) Participants: 25 people
PMO, Energy Division: Mr. Ahmad Mohammad (Head of EE&C, focal point)
Mr. Lim Cheng Guan (Head of N&RE), Mr. Hakeem Basir, Ms. Dina, and others
PMO, Dept of Electric Service: Mr. Muhud Amir (electrical engineer), and others
Institut Teknologi Brunei: Mr. Kamarulzamaad (Assistant Estate Manager)
Mr. Hairol (mechanical engineer), Mr. Ahmad Syamaizar (mechanical engineer),

Mr. Lim Pang Jen
Brunei Shell Petroleum: Mr. Yahya Mohammad (Refinery Manager)
Brunei LNG: Engineer: Mr. Azian (business analyst), Mr. Hussin Elim (Operations Manager), Ms. Nurul Hassanol (technologist), and others
ACE 2 officials (Ms. Maureen Balamiento, Mr. Ivan Ismed)
ECCJ 3 officials (Mr. Urakubo, Mr. Takeda, Mr. Kawase)

(2) Factory overview

Establishment: This factory started its operation in 1983 as an oil refinery of the Royal Dutch Shell Group.
Location: Located 80 km west of the capital city, Bandar Seri Begawan.
Crude oil: Oil is supplied from oil fields in two areas in the east and the west off the coast of Brunei. Some oil is also produced on land in the Seria area.
Major facilities: Crude oil distillation unit (CDU)/12,000 BPSD, Naphtha reformer /5,000 BPSD
Technological support: Shell Headquarters (Shell Global Service)
Products: Gasoline, jet fuel, kerosene, diesel, heavy oil, Products other than heavy oil are shipped for domestic consumption
Employees: 84, Shell LNG is in charge of driving

(3) Audit overview

1) Participants of the auditing team
A total of 25 people participated in the audit from the Brunei side, including the Prime Minister’s Office (PMO), Department of Electrical Services (DES), Institut Teknologi Brunei(ITB), Brunei LNG (BLNG), Brunei Shell Petroleum (BSP, factory where the audit was conducted), and five engineers from ECCJ/ACE. Mr. Hakeem Basir of PMO was assigned as the Brunei team leader. Since the oil refining process is complicated and advanced, the OJT audit was conducted in a style in which ECCJ experts conducted the audit and explained the main points to the Brunei team when necessary.

2) Confirmation of the purpose of PROMEEC project
We confirmed that the purpose of this project is to nurture people who are involved in auditing technologies of industrial facilities rather than a technological service that addresses specific problems. We also confirmed that the target facilities of energy

efficiency and conservation audit are limited to utility systems and peripheral facilities and equipment of manufacturing lines, for example heat recovery systems, dryers, and freezers, whereas the core components of manufacturing processes are not included.

3) Requests of the factory to the auditing team

The refinery manager requested guidance on three categories (improvement of oil processing capacity, securing reformer field, and efficiency improvement of oil refining operation). All these categories are either production capacity improvement of the factory or activities to reduce production costs. We explained that they were not relevant to energy conservation or efficiency and gained the understanding of the factory side.

4) Procedure of the audit

・Interview with the factory side

About the overview of the facilities in the factory, status of energy efficiency and conservation activities, safety assurance during audit, preparation of measuring instruments, etc.

・Confirmation of the responses in the previously sent survey sheet
・Introduction of energy efficiency and conservation activities in oil refineries in Japan
・On-site inspection with engineers and discussion when necessary
・Primary report of auditing findings (to factory executives on the final day of the audit)
・Secondary report (Japanese language report is issued in March next year)

5) Problems identified in the on-site inspection

An on-site inspection as conducted in a walkthrough style under the initiatives of ECCJ experts. The inspection first confirmed the process flow, collected historical data from the DCS (process controlling computer), and interviewed operators in the control room. Then, they inspected individual facilities at actual worksites. The team only inspected the periphery of the CDU furnace, since it was in the extremely busy period before the regular inspection, which started the following week. It was also impossible to obtain the regular operation data on the reformer because the audit was on the same day as catalyst regeneration. Thus, the inspection only included simple appearance inspections of furnace and hot oils.

(a) Maintenance of CDU furnace

This is a 36-year-old cylindrical furnace. Visible deterioration of the facility was beginning to appear. For example, the tube of the air pre-heater was perforated and air was leaking; thus, the blank was used to separate the cool airside of the air pre-heater. The tube will be replaced in this regular maintenance. Findings of the inspection that focused on maintenance are as follows.

- There was damage to the wire that operates the damper from the ground. Thus, the damper was left fully opened, and it was impossible to control the pressure (draft) inside the furnace. With this condition, the combustion chamber pressure was perhaps considerably lower than the atmospheric pressure, and a large amount of air was sucked in.
- In addition, the draft gauge was not functioning due to some problems, and the draft was unreadable. Although it does not impede operation, the furnace continues to waste energy. Urgent repair is required. An emergency measure is to install a hand-made inclined manometer. We recommend the factory look into it.
- According to the DCS data, there was an abnormality in the temperature of waste gas that flows in the air heater part (AH part). That is, while the temperature was 360 °C in the upstream section of the AH part, the temperature was 326 °C in the downstream section. Since the cool air is blocked in the AH part as mentioned above, it is certain that the temperature difference did not originate in the AH part. Some kind of air leak may be occurring in the AH part.
- Possible causes of air leaks include (1) damage to the joint between the AH part and breeching part or between the AH part and convention part, (2) damage to the blank that separates the AH part, and (3) damage to the joint at the cool air header and the main unit of the AH. The factory should immediately inspect these parts and repair any damage. The energy conservation effect from blocking air leaks is about 2%.
- If an inspection identified the possible cause (1) as the cause of air leaks, it is necessary to explore why the joints in the AH parts are damaged. The AH part of this furnace employs a so-called hot wall system, meaning that insulation is placed outside of the furnace. Also, the upstream convection and downstream breeching part uses a cold wall, meaning the insulation is placed inside the furnace. Therefore, the structure of this furnace is vulnerable to thermal stress from the difference in thermal expansion at the joint parts. This is the most likely the cause of the damage.
- As a cause of the perforation in the tube, the factory should investigate the possibility of sulfuric acid dew point corrosion, which is caused by the sulfur in the fuel. The method to estimate the sulfuric acid dew point is attached. We encourage the factory to refer to it. The method to estimate a dew point is provided in the correlation chart

of the amount of sulfur in fuel oil (percentage of the amount) and the dew point of sulfuric acid. Thus, when gas is burned as fuel, the factory must be sure to convert it to the amount of sulfur in the fuel oil conversion.

・Based on the above examinations, if the perforation is found to be caused by sulfuric acid corrosion, tubes will be perforated again even when replaced by a new one. In such cases, the surface temperature of the tube needs to be increased above the dew point of sulfuric acid. API ST 560 provides three examples of measures to deal with this problem. See Attachment III-2 for details.

(b) Quality management of CDU intermediate products

Quality specifications are specifically designated to individual oil products. JIS standards are used in Japan. In order to prevent the production of non-standard products, oil refineries operate under stricter quality regulations than standards; in other words, they operate more safely than designated standards. Moreover, when the operating conditions become more strenuous to improve quality, energy consumption increases and shortens the service life of the facilities. The energy consumption increases exponentially rather than proportionally.

The key to energy efficiency and conservation in oil refineries is to avoid producing products with excessively high quality. As a prerequisite, accurate identification of the relationship between operation conditions and quality is necessary. DCS has been installed in BSP, and the past data are accumulated as DCS archives. Quality data tested in a laboratory are also accumulated. We attempted to investigate the relationship between the flash point of kerosene intermediate products and the consumption of stripping steam at this point, but we were unable to do so. Thus, as shown in the attachment, we gave a lecture about increased energy use due to the pursuit of excessively high quality and a management method to avoid excessive quality. This management method is applicable to many other quality specifications, such as octane number, the first drop point in distillation, the final point of distillation, RVP vapor pressure, and the cetane number.

(c) Energy efficiency and conservation audit of electric energy

Energy efficiency and conservation measures in oil refineries mainly target steam power systems and process motors. They specifically target cases in which expectations in the design and actual operation conditions differ. The largest motor in this oil refinery is the recycle gas compressor of the reformer. Since the audit happened to be conducted during catalyst regeneration, we were unable to verify the conditions of normal operation of this compressor. Although we might be able to check the conditions using DCS data, we were unable to do so due to the time schedule.

Instead, we collected data on the combustion air fan for the CDU furnace that was in operation and the data around the periphery of the SCOT crude oil transporting pump. We collected data on the pressures and motor currents at the front and back of the fan and pump and observed the pipe resistance (especially the aperture of the damper, control valve and pressure loss at the filer). Findings of data analysis are described below. See Attachment III-4 for details. The minute aspects that we noticed in this factory include the fact that the outdoor lights of the plant were turned on even during daytime, and the lights in the pump motor switch room were turned on even when no one was in the room. These lights should be turned off unless there is a safety reason to leave them on.

(c)-1 Combustion air fan for the CDU furnace

The fan we inspected in this visit is currently operating by narrowing the damper on the suction side; thus, there is a room to explore ways to improve energy efficiency. Using measurement data and assumptions, we calculated the amount of energy to be conserved.

Items to be inspected and examined	Outcomes of inspection measurement and calculated amount of energy to be conserved
Facility specifications	Specifications of the fan: Unknown, Motor: 11 kW
Measurement of the current condition	Electricity input: 6.23 kW (shaft power conversion 5.6 kW), aperture of the suction damper: 75%
Energy conservation perspective	Energy conservation from collecting the pressure loss at the suction damper
Energy conservation method (example)	Reduction of rotation speed using an inverter

Calculation outcomes	Main assumption or precondition	Fan shaft power curve: assume 30% of the rating during shut-off operation and 80% during rated wind volume operation. Resistance curve: Hypothesize that the curve goes through the origin and intercepts with the performance curve during rated wind volume operation. (Required pressure in front of the burner and furnace pressure are unknown. There is no performance curve, either. Since the purpose is to show a calculation example, the fixed pressure is omitted in this calculation to keep it simple.)
	Calculation outcome	Margin of rotation speed reduction in the current wind volume: 48% of the rated rotation speed. Shaft power during reduced rotation speed: 0.97 kW (input electricity conversion 1.62 kW)
	Amount of electricity conservation	4.6 kW (this is simply a reference value, since the fixed pressure is not included in this calculation.)

(c)-2 SCOT crude oil transporting pump

The verification of the present electric current indicated that the load factor of the motor was low (22% to 47%), and the load factor for the power required for the pump specification was also low (51% to 69%). Identification of the cause of the low load factor will be left to the future investigations, and energy efficiency and conservation measures are decided depending on the causes. Efficiency improvement from reducing the capacity of the pump is calculated below.

Items to be inspected and examined	Outcomes of inspection measurement and calculated amount of energy to be conserved
Facility specifications	Pump: 3 units, the specifications of the pumps are described in the context. Motor: 30 kW
Measurement of the current condition	Input electricity: 9.2, 7.8, 15.7 kW (shaft power conversion: 7.8, 6.6, 14.1 kW)
Energy conservation method (cause – measure)	(i) Increased pipe pressure loss from clogged pipe: Clean the pipe (ii) Lowered pump performance: Dissemble the pump for inspection and maintenance or replace the pump (iii) Mistake in selecting pump specifications: Reduce the pump capacity (iv) Flow rate reduction control: Reduce pump rotation speed
Energy conservation method (example)	Efficiency improvement by reducing the pump capacity

Calculation outcomes	Main assumption or precondition	Pump flow rate/shaft power property: Assume that 100 % flow rate operation is the calculation shaft power (100%), and hypothesize that the shaft power during shut-down operation is in the linear equation of 40% of it.
	Estimate	Improved pump efficiency: Pump #1 0.4→0.83, pump #2 0.22→0.83, and pump #3 0.55→0.83. The motor efficiency also improves.
	Amount of electricity conservation	#1: 5.1, #2: 5.9, and #3: 5.6 kW (55, 76, and 36% decrease from the current operation, respectively)

In addition, during the process of the examination, we identified that excessive values were selected in the rated specifications (reasonable values are 15 or 22 kW) for the pump motors #1 and #2 and in the discharge pressure for the pump #3 were excessive.

6) Introduction of successful energy efficiency and conservation measures in Japanese oil refineries

Many energy efficiency and conservation measures in oil refineries are reported every year in the National Convention on Excellent Energy Conservation Efforts. *Petrotech*, the monthly magazine published by the Japan Petroleum Institute also introduces many efforts. We specifically provided energy efficiency and conservation measures involving CDU and reformers that BSP has. See Attachment III-3 for details.

7) Preparation of measuring instruments

The factory provided a clamp style power meter as a measuring instrument. ECCJ also provided a contact thermometer. We utilized all instruments and successfully obtained a substantial amount of data. We used the thermometer to measure the wall temperature of the furnace. The power meter is an important measuring instrument to measure motor loads of fan pumps in factories of textiles and food. However, since the inspection was in an oil refinery, we did not use the power meter in this inspection to eliminate any risk of accident. Highly recommended measuring instruments in ordinary factories include power monitor, thermometer and oxygen meter to analyze combustion gas and the hot wire anemometer or vane anemometer to measure the amount of air that goes through a fan. That is because these are essential measuring instruments to analyze combustion management and inverter control, which is frequently implemented in energy efficiency and conservation efforts.

8) Data analysis and brief report

We reported problems with clarified examination outcomes that we obtained so far from the factory audit as a flash report on the final day of the audit to factory executives and the auditing team. We will bring the data back to Japan, which will be analyzed in detail and summarized in the final report (in Japanese) in March of next year. See Attachment III-1 for details of the flash report. ECCJ experts presented the flash report in the seminar workshop.

9) Status of energy management

This oil refinery has implemented little energy management so to speak when we visited. Estimating from the interview, the operators are running the factory from the manufacturing perspectives rather than energy conservation perspectives. Thus, we provided the following advice:

・Establish an energy management system

Organize an energy efficiency and conservation promotion committee, which requires strong support from factory executives.

Appoint energy leaders to individual facilities.

Promote employment education, especially worker education. Request competent authorities to provide advice.

・Facility maintenance

Further improve management with special attention to prolong service lives of devices, such as furnace, pneumatic system, and hydraulic machines.

・Measurement and records

Conduct monitoring and recording of energy consumption data. Make the maximum use of DCS data for it.

(4) Remarks

1) Unfortunately, the factory has made little progress in the status of energy efficiency and conservation. In particular, the concept of energy management is yet to be promulgated. Oil refineries usually implement sufficient management, but we found there was still large room for improvement in this oil refinery. We pointed out many no-cost or low-cost energy efficiency and conservation measures in this OJT audit. We encourage the factory to immediately implement them.

2) Although this oil refinery has accumulated much DCS data, they do not seem to be utilizing the data for energy efficiency and conservation. We fully understand that the factory only has 84 employees, and engineers are busy with manufacturing. People in the factory seemed too busy to develop knowledge on energy efficiency and conservation. BSP is a member of the Shell Group and can receive technical services from Shell headquarters. We recommended that they actively receive assistance from Shell headquarters. The oil refinery manager was nodding to this advice.

3) Mr. Ahmad Mohamad of the PROMEEC focal point and the staff of Energy Division, Prime Minister's Office, did a great job preparing for our visit. Thanks to their efforts, we were able to collect much data, although the factory was busy immediately before the regular repair. Many engineers from the Energy Division, Prime Minister's Office, and Institut Teknologi Brunei joined the local team. Although ECCJ experts took initiatives in the audit, the participants were at least able to check the auditing procedures that they had learned in the lecture. Also, we suppose that they efficiently learned the meaning of energy management and no-cost or low-cost energy efficiency and conservation measures as they looked at actual examples.

3. Visiting Guidance (the Butra Heidelberg Cement (BHC))

(1) Circumstances
We conducted the OJT audit in 2000 and the first follow-up investigation in 2005 in BHC. This is the second follow-up investigation.

(2) Date, time, and participants
October 26, at BHC
Sixteen participants (eleven from the Brunei side, including four from PMO, five from ITB, and two from BHC)

(3) BHC

1) Overview
BHC is the 100% subsidiary company of Heidelberg in Germany, the largest cement manufacturing company in the world. It started operation in 1996. It imports clinker and

secondary materials, manufactures Portland cement in the crusher plant, and ship products mainly to domestic customers. The manufacturing capacity is 500,000 tons a year. However, actual manufacturing in recent years has been less than 200,000 tons a year; the company has been experiencing a low operation rate since the export to Malaysia stopped. The number of employees is fewer than 60 people, and two-thirds of them are Bruneian. The Technology Center of Heidelberg in Singapore provides technological assistance to BHC. The factory is located adjacent to port facilities in the Muara area, the east part of Bandar Seri Begawan.

2) Manufacturing process

Receive raw materials (Jetty) → belt conveyor → material silo (clinker, plaster) → weigh feeder → ball mill → classifier → product silo (cement) → shipping (bulk, large sack, small sack)

3) Hearing

- Mr. Thontowi Djauhari, the factory manager, explained the activities they had implemented since the last follow-up investigation. We then conducted hearing an interview regarding the responses from BHC on the survey sheet that we had sent before our visit. The implementation status of the guidance that we provided before is as follows:
- BHC added a dryer to the pneumatic facility and increased the aridity of compressed air. As a result, the clogging of the filter cloth in the bag filter was reduced, which drastically decreased the amount of compressed air used for hammering.
- In order to improve the crushing efficiency of the ball mill, BHC installed a cement grinding aid loading machine. They are currently conducting tests to obtain optimal amount to be added. At this point, they are feeling the effects of adding cement grinding aid.
- Replacing the power receiving transformer with a smaller one improved the demand factor from 64% to 84%. They asked us to teach them methods to evaluate the effects of improvement.
- BHC installed a power factor compensation capacitor in the power receiving transformer, which improved the power factor from 0.88 to 0.95. They asked us to teach them methods to calculate the effects of energy conservation from power factor compensation.
- BHC is currently using a van compressor (rotary vane type) to transport crushed

cement to the product silo, but its energy efficiency is low (2.5 kWh/t-cement). They wish to replace this system with a mechanical type (0.5-1.0 kWh/t-cement), but they said they cannot maintain profitability from this change. We recommended that they ask the Embassy of Japan in Brunei if they can use JBIC or Japan's other low-interest financing systems.

・BHC has not utilized the operation data accumulated in DCS. They only have two so-called engineers including the factory manager, and they are too busy to deal with the data in DCS.

・They have not worked on repairing the leakage of compressed air. They asked us to teach them how to identify the amount of leakage.

4) Outcomes of walkthrough and details of guidance

・Technological aspects of energy management were implemented under the initiatives of the factory manager who is also an engineer as described above; the management was well done. Meanwhile, we found some improvements to be made in regards to the participation of employees in energy efficiency and conservation activities. For the time being, we recommended that they start with (1) obtaining the support of the PMO and implementing education to promulgate energy conservation, (2) utilizing DCS data, printing out basic unit and energy indices, and having employees monitor them, and (3) posting campaign posters to eliminate wasteful energy use, such as diligent practice to turn off lights.

・We found the possibility of energy conservation in the low-load fan as an energy conservation measure which has not been identified in the past follow-ups. Candidate machines include bag filter fans and dust collection fans. We collected the data on the damper aperture, the rated current of the motor, and the actual current during operation.

・Two cylindrical cooling towers are installed to supply cold water for machinery. We measured the temperatures at the entrance/exit of cold water, as well as the dry-bulb temperature and wet-bulb temperature of the ambient air. As a result, we found a possibility that the amount of cool water circulation was larger than the amount required in the process.

・We provided simple explanations on methods to measure compressed air leakage, methods to calculate energy conservation effects from power factor compensation, and methods to calculate the effect of energy conservation from reducing the size of transformers.

(4) Remarks

- BHC is a small company with the operation rate of about 40%, and the number of employees is only about 60 people. In this company, the factory manager, who is also an engineer, was making great efforts and implementing many energy conservation measures despite the small size of the factory.
- Measures that succeeded in Japan tend to be associated with long payback time and difficult to implement in this factory due to the small size. Assistance, such as JBIC's low-interest financial assistance, are necessary for such factories.
- The measures implemented in BHC are worth registering in the technical directory (TD), the energy management tool. Examples of such measures include the reduced size of the transformer and the installation of a compressed air dryer. We requested ACE and focal point that they register them in TD.
- From the perspective of technological measures, the efforts of BHC can become a model of energy efficiency and conservation activities for small-scale factories. We see the possibility of applying for ASEAN Energy Awards. Nonetheless, it is desirable to apply after strengthening the efforts in energy management aspects. Examples of desirable measures include participations of employees in energy conservation activities and energy data monitoring.

4. Seminar workshop

(1) Date, time, and location

October 24, 2009 08:30-16:30

Kiulap Plaza Hotel, Bandar Seri Begawan, Brunei Darussalam

(2) Participants: 41 people

Prime Minister's Office :

Mr. Ahmad Mohamad, Energy Division, Head of EE&C unit (Focal Point)

Mr. Lim Cheng Guan, Energy Division, Head of N&R Energy unit

Dept of Electric Power Service : Mr. Amir (electrical engineer) and others

Institut Teknologi Brunei : Mr. Kamarulzamaad(Assistant Estate Manager)

Mr. Hairol (mechanical engineer), Mr. Ahmad Syamaizar (mechanical engineer)

Brunei LNG : Mr. Azian (business analyst)

Brunei Shell Petroleum : Mr. Yahya Mohammad (Refinery Manager)

Mr. Hussin Elim (Operation Manager)

Ms. Nurul Hassanol (technologist) and others

Butra Heidelberg Cement, 2 people: Mr.

ASEAN (speaker): 2 people

Mr. Jun Ronaldo, DOE, The Philippines

Mr. Than Tun Aung, Deputy Director, Myanmar Engineering Society

ACE: 2 people

Ms. Maureen Balamiento, Mr. Ivan Ismed

ECCJ: 3 people

Mr. Urakubo, Mr. Takeda, Mr. Kawase

(3) Presentation overview

Session 1: Policy and Initiatives on EE&C in Major Industries

1) Updates of ASEAN Energy Efficiency (EE&C) Activities

Mr. Ivan Ismed explained ACE's activity overview based on the following contents.

- APAEC Program 2004-2009
- ASEAN-Japan cooperation (SOME-METI, PROMEEC, and multi-country training)

- ASEAN Best Practice Competition (energy conservation division)
- ASEAN + 3 Energy efficiency and conservation/Renewable Energy Forum
- Other cooperative programs with EAS-ECTF, UNEP, ASEAN Foundation, ADB, and CDC

Of these topics, he explained the APAEC Program 2004-2009 in detail: this program includes six program areas, and energy efficiency and conservation are implemented in program area 4; the purpose is to strengthen the cooperation of the ASEAN region through the capability establishment of energy efficiency and conservation organizations, the involvement of the private sector, and the expansion of the market for energy saving devices; and this program intends to implement activities in six categories in order to achieve its goals.
(Information sharing and networking, ASEAN energy standard and labeling, participation of the private sector, capability building, training of ESCO companies, and energy efficiency and conservation in the transport sector)
As main activities in the program area 4, she then introduced PROMEEC activities based on circumstances of leading to Phase 1, Phase 2, and Phase 3, as well as outcomes and future perspectives.

2) EE&C Activities in Brunei Darussalam

Mr. Ahmad Mohamad of the PMO Energy Division explained the organizations involved in energy efficiency and conservation in Brunei and recent energy efficiency and conservation activities:

- Division of Energy efficiency and conservation, Department of Energy, Ministry of Energy is in charge of energy efficiency and conservation.
- Three E’s (Energy security, economic competitiveness, and environmental protection) as the meaning of energy efficiency and conservation
- Participation in ASEAN + 6, APEC
- Establishment of EE&C committee (2007)
- Improvement of activity and power generation efficiency in the industry sector and energy management of street lights.
- Activities in the consumer and commercial sector: time regulations of air conditioners in the governmental buildings, employment of building energy conservation standards, promotion of energy efficiency lighting, eco-labeling on consumer electronics, and promotion of CFL.

- Activities in the transport sector: smart driving, active use of public transportations, and promotion of bicycle use
- Energy day activities, promulgations

Energy consumption in Brunei is 12% in the industry sector, 52% in the transport sector, and 36% in the consumer and commercial sector. The ratio of the industry sector is large. The focus of energy efficiency and conservation activities are on transport and consumer sectors.

3) Japan’s Energy Conservation Policy & Measures for Industrial Sector

Mr. Taichiro Kawase of the Energy Conservation Center, Japan explained Japan’s energy efficiency and conservation policies and policies in the industry sector based on the following five perspectives:

- Changes in the basic unit of energy in individual industries in Japan
- Legal measures and energy efficiency and conservation measures in the industry sector of Japan
- Spontaneous activities of private companies and organizations in the industry sector (using the oil manufacturing industry as an example)
- Roles of the Energy Conservation Center and activity overview
- Introduction of successful cases of PROMEEC industry activities in ASEAN countries (uing the food industry as an example)

Session 2: EE&C Best Practices in Industries

4) Best Practices for EE&C of Cement and Oil Refining Industries in Myanmar

Mr. Than Tun Aung of Myanmar Engineering Society reported energy efficiency and conservation measures in Myanmar and the outcomes of the energy efficiency and conservation audit in the cement factory and oil refinery.

- Assigned organizations in the energy sector

  Oil and gas: Ministry of Energy (PROMEEC focal point)

  Electricity: Ministry of Energy (1) (hydropower), Ministry of Energy (2) (thermal and transmission)

  Coal: Ministry of Mines

  Biomass: Ministry of Forestry, Ministry of Agriculture and Irrigation

・Past energy efficiency and conservation activities

UNDP/ADB Project (1991, energy audit, etc.)

UNESCAP Seminar (three sessions, energy efficiency and conservation)

PROMEEC Project (several sessions, audit, seminar)

・Energy efficiency and conservation audit at the cement factory and oil refinery

It was a report on the OJT audit conducted in the PROMEEC Industry Project in 2006. We estimate that the energy efficiency and conservation measures suggested in the OJT audit have not been implemented at this point.

5) Best Practices for EE&C of Cement Industry in the Philippines

Mr. Ronaldo Parreno of Department of Energy, the Philippines reported on the energy efficiency and conservation activities in the Philippines.

- There are 20 factories in the Philippines, and the manufacturing capacity is 100,000 to 500,000 tons a year. Semi-dry process is employed in some factories, but most of them use dry processes. Twelve factories are located in the Luzon area.
- Major activities that the cement industry has worked on since the 1980s include the fuel conversion from heavy oil to coal and the rehabilitation of financial structures and facilities.

・Rehabilitation of facilities

Conversion from direct to indirect firing system

Improvement of existing facility (dust recovery)

Rehabilitation of small capacity kilns to achieve rated output

Conversion of semi-dry process to dry process

Installation of pre-calciner to increase plant capacity

Rehabilitation of clinker cooler to increase kiln capacity

・Recently implemented major energy conversion and efficiency measures

Use of vertical roller mill at raw mill

Installation of 5-stage new suspension pre-heater (NSP)

Replacement of DC motors by variable speed drive instead of damper control

Gas conditioning tower efficiency improvement

Use of high efficiency fans and motors at clinker cooler

Repair vacuum leaks at kiln hood door

Installation of online oxygen analyzer at calciner exhaust to improve leak management

Rice husk facility to use as alternative fuel resource

・Energy efficiency and conservation measures that are currently being considered
Waste heat recovery from kiln exhaust gas and clinker cooler exhaust gas
Waste hot gas utilization for dryer
Install VSD motor and controller for Kiln exhaust gas fan
Install high efficiency separator at finishing mill
Replace pre-heater fan to high efficiency fan

6) Best Practices in Japanese Oil Refining Industry

Mr. Taichiro Kawase of the Energy Conservation Center, Japan, reported energy efficiency and conservation measures in Japan's oil refineries and two examples.

- There are several factors that affect energy consumption in the operation of oil refineries. He explained how these factors affect the operation:
  Property of crude oil (light/heavy, high/low sulfur content, etc.)
  Product components and required quality (the focus is on gasoline or middle distillates, and high octane or low octane, etc.)
  Facility components (hydro-skimming type, decomposition type, or lubricant manufacturing, etc.)
  Freedom of facility operation (a few large facilities or many small facilities)
  Degree of completion in process technology and techniques (latest technologies or old technologies, and abundance in experience, etc.)
  Aging of facility performance (deterioration in performance from corrosion and contamination)
  Environmental restrictions

- Linear programming is employed as the optimal tool for oil refinery operation.
- Complexity factor method is employed to evaluate energy efficiency of an oil refinery.
- Petroleum Industry in Japan is implementing spontaneous action plans on measures to prevent global warming.
- Energy conservation measures that have been employed in oil refineries in the past were categorized and introduced as steps 1, 2, and 3.
- Two examples of energy conservation measures.
  Optimal operation of oil refinery steam power system through a predictive control method

Implementation of energy conservation in oil refineries through small-group activities based on Energy Conservation Act

7) Best Practices in Japan (electrical energy)

Mr. Kokichi Takeda of the Energy Conservation Center, Japan, reported the following cases in regards to energy efficiency and conservation measures in electric energy:

・Reduction of peak electricity by improving off-site area operation
・Reduction of aeration blower power of activated sludge facilities
・Reduction of the number of pumps in pure water systems in boiler rooms
・Replacing boiler combustion air fan with high-efficiency fans
・Reduction of electricity use by employing an infinitely variable capacity control system in a large reciprocal pneumatic system in desulfurization facilities

8) Results of OJT Audit in Brunei Shell Refinery

Three experts of the Energy Conservation Center reported the outcomes of the OJT audit conducted in Brunei Shell Petroleum refinery. Major parts of the suggested measures involve CDU furnace, reformer furnace, and oil transport pump. See Attachment III-1 for details. The team leader of Brunei was planned to present the outcomes of the OJT audit in the original plan, but due to the complexity of the process, the presenter was switched to ECCJ experts.

Session 3: Workshop on Energy Management Tools

9) Heat balance of fired heater

Mr. Hidetaka Urakubo of the Energy Conservation Center, Japan, gave a lecture on heat balance. This lecture aimed to build up fundamental knowledge to make the full use of energy management tools. Industrial furnace used in many factories was selected as an example to demonstrate heat balance. The time allowed for this lecture was short, and only a lecture was given in this session, but we will make improvements so that a calculation exercise can be included in the future. Heat balance calculation homework was assigned as a new attempt. While the submission of the homework was not mandatory, the procedure to submit answers to ECCJ and how the ECCJ experts would correct and return them were presented.

10) Updating of TDs, IHDBs, EMHBs and Cyber Search

Ms. Maureen Balamiento of ASEAN Centre for Energy (ACE) explained the purposes, production method, format, and entry example of four types of ASEAN energy management tools, Technical Directory, In-house Database, Energy Management Handbook, and Cyber Search System.

11) IHDBs for cement industry and food industry

Mr. Taichiro Kawase of the Energy Conservation Center (ECCJ), Japan explained the overview and issued instructions on how to fill out the entry format of in-house database (IHDB) for cement factories and food factories. The characteristic feature of the IHDB as an energy management assistance tool to be used in factories is that it includes manufacturing data, energy data, and equipment data in addition to important operation parameters and energy efficiency indices. These features supply reference information to divisions within a factory for efficient energy operation. Based on the perspective of promulgating them to the ASEAN countries, we requested the participants to actively employ them in cement factories and food factories in Brunei.

Before shifting to full-scale employment of these tools, the following implementation procedure is presented as a reference to identify problems in the trial employment of IHDB:

a. Select participating factories in each industry (about two companies in one industry)
b. Produce an organization chart for the test employment of IHDB (clarification of role assignment)
c. Determine data to be entered in IHDB (be careful not to include too a substantial amount of data)
d. Start data collection and accumulation (each participating factory is to individually implement this procedure)
e. Progress management of test employment (focal point is to implement this procedure)
f. Follow-up (report in the next inception workshop)
g. Create a roadmap (create a mid- to long-term plan with ACE)

12) EE&C capacity building activities in Brunei Darussalam

Mr. Ahmad Mohamad of Energy Division, PMO, explained the activities of energy conservation promulgation and human resources development that the Brunei government is especially focused on in the recent days. In terms of promulgation, they are implementing energy education curriculum and extracurricular activities, such as essays, posters, and skits in elementary, middle, and high schools in cooperation with the Ministry of Education. Meanwhile, universities are promoting establishment of energy clubs as opportunities for students to discuss topics on energy efficiency and conservation.

Concerning human resources development, they have been creating teaching materials for energy management in partnership with ECCJ and already conducted workshops by ECCJ experts. Planned teaching materials include ones for managers and ones for engineers. In addition, they held an energy conservation-auditing workshop for buildings with the cooperation of ITB in this April. They reported that they recognize the supply of technological knowhow is the future issues to deal with, and they are planning to conduct training in Japan with the assistance of ECCJ.

(4) Remarks

1) The total of 41 people participated: 34 people from divisions of PMO, two universities, Brunei Shell Petroleum, Brunei LNG, BHC Cement, etc.; and seven engineers from two ASEAN countries, ACE, and ECCJ. Considering the population of Brunei, the number of participants indicates the strong awareness of the Brunei government toward energy efficiency and conservation issues.

2) The transportation sector and consumer/commercial sector accounts for 88% of the total energy consumption in Brunei. It is natural that the activities of the Brunei government are focused on buildings and automobiles.

3) Mr. Ahmad Mohamad emphasized that future challenge of human resources development is the transfer of technological knowhow. The officials of the Brunei government seem to have good understanding on slogan-like aspects. The problem is that they are not confident with how they will implement them and succeed in energy efficiency and conservation. The assistance of ECCJ should reflect this issue.

4) Engineers and consultants of PMO talked to us about various topics. According to the presentation of Mr. Ahmad Mohamad, Japan's PROMEEC is the only assistance from a foreign donor in the field of energy efficiency and conservation. We felt the expectations of the participants toward this project as opportunities to gain information from foreign countries, as well as toward ECCJ.

5) The staff efficiently operated this session including the preparation of the site, distributing documents, and arranging lunch services. We would like to express our gratitude toward Mr. Ahmad Mohamad of Energy Division, PMO who acted as the industry coordinator of PROMEEC and government officials of Brunei.

5. Wrap-up meeting

(1) Date, time, and location

October 27, 2009, 09:30-12:30, Energy Division, Prime Minister's Office

(2) Participants:

Energy Division, PMO 7 officials

Mr. Alidi Mahmud, Head of Energy Division, PMO

Mr. Ahmad Mohamad, Head of EE&C Unit, Energy Division

Mr. Lim Chen Guan, Head of N&R Energy Unit, Energy Division

Additional 4 staff

ACE/ECCJ: Five officials

(3) Discussions and major findings

1) Activity overview reports by BSP and BHC

Presenters reported activity overviews and energy efficiency and conservation measures implemented in their factories. Mr. Alidi, the head of the Energy Division asked a question about the possibility of technological assistance to the BSP factory. We explained that the purpose of PROMEEC is to develop human resources rather than providing specific technological services. Mr. Alidi seemed to understand.

2) Timing to issue Quick Report

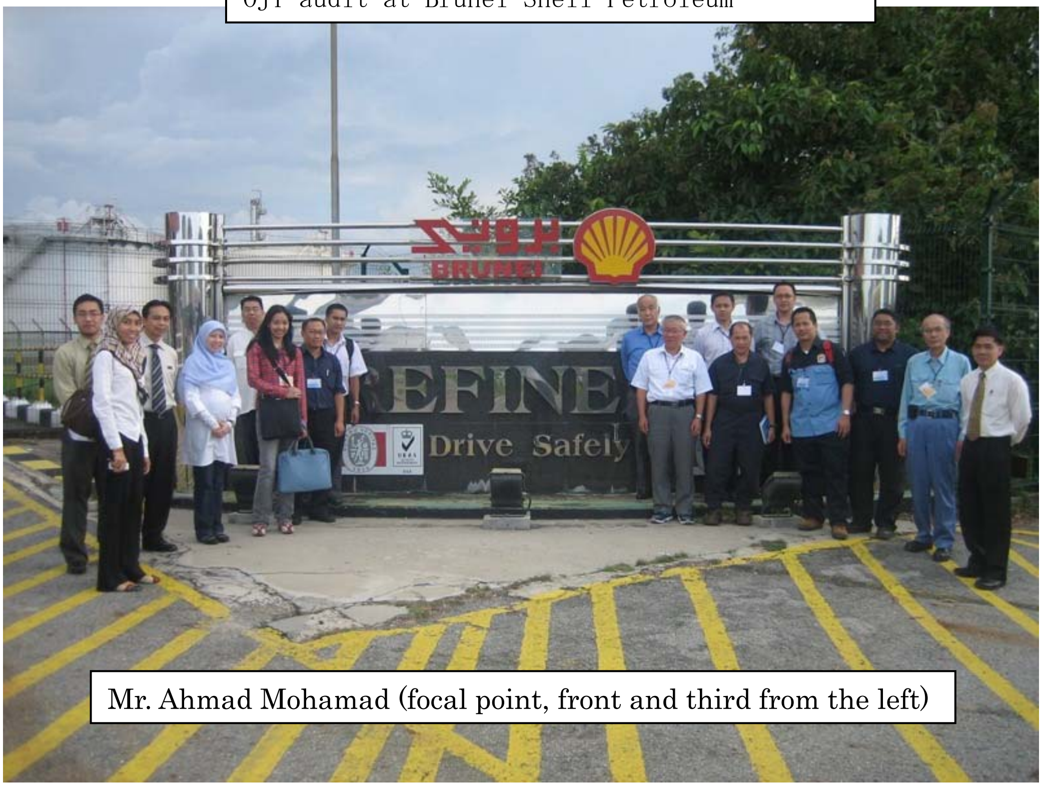
BSP factory requested that we issue the report quickly. BSP factory said they wish to utilize the report as a reference to request a budget. We explained the schedule that we would submit the final report (in Japanese) to METI in March next year. We also responded that we can provide a simple one- to two-page summary which includes the title of energy efficiency and conservation measures, technological details, and degree of costs by the end of January next year.

3) Training on energy efficiency and conservation technologies
We are planning to add technological training to the curriculum of energy management training that started this year. Thus, Mr. Alidi suggested that we cooperate with the training on auditing technology. We suggested him to consult with the ECCJ International Cooperation Headquarters on this matter.
4) Promotion of the test implementation of IHDB
The ECCJ side requested that ACE and focal point cooperate with each other and promote the test employment of IHDB. We specified that the target industries are cement industry and food industry. We also requested them to report the progress of test employments in the post-workshop next year.

5) Entry for ASEAN Energy Award in the industry sector
Since we found that BHC's energy efficiency and conservation activities can be useful in ASEAN countries, we discussed the possibility of entering their efforts in ASEAN Energy Award. We notified that winning the award is possible provided that they achieve employee participation in energy efficiency and conservation measures and conduct energy data monitoring.

END

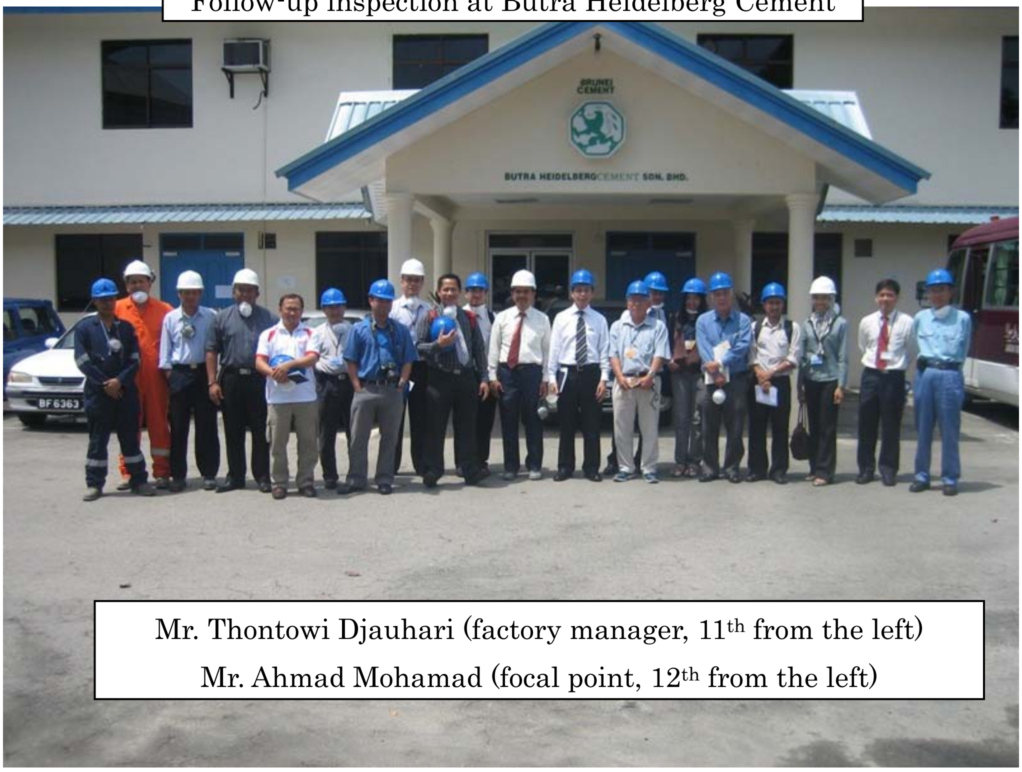
OJT audit at Brunei Shell Petroleum



Mr. Ahmad Mohamad (focal point, front and third from the left)

General view of the crude oil topping plant

Follow-up inspection at Butra Heidelberg Cement



Mr. Thontowi Djauhari (factory manager, 11th from the left)

Mr. Ahmad Mohamad (focal point, 12th from the left)

Group photo at Seminar Workshop

Mr. Ahmad Mohamad (focal point)

Attachment III

1. Recommendations for Brunei Shell Petroleum
2. Examination of energy efficiency and conservation measures in thermal aspects
3. Examination of energy efficiency and conservation measures in electricity aspects

IV. The Philippines

1. Activity Overview

In the International Infrastructure Development Project for Efficient Use of Energy, which is the project contracted by METI, officials visited the Philippines from October 28 to November 6 to implement the Energy efficiency and conservation Promotion Project for Major Industries in ASEAN Countries. They implemented OJT audits at a medical supply factory and seminar workshop to exchange information with the people in industries in the Philippines and officials of ASEAN countries. Twenty-two people participated in the OJT audit and visiting guidance, including four from Amherst Laboratories where the OJT audit was conducted, eleven from the United Laboratories Group, the cooperate parent of Amherst Laboratories, two from the Department of Energy (DOE), and five from ECCJ/ACE. A seminar workshop was successfully held in the convention hall of the Ministry of Energy with the total of 45 participants, including many government officials. Presentations on energy efficiency and conservation examples in four factories including the electric furnace factory in Malaysia and the fiber industry in Indonesia were given in this seminar. We visited ENPAP, which is organized by energy technology service providers between on-site activities and exchanged information on factory auditing technologies.

Delegates: Mr. Taichiro Kawase, Mr. Kokichi Takeda, and Mr. Hidetaka Urakubo, Technical Experts of Technology Cooperation Department, ECCJ

Activity schedule:

October 29 – November 5 OJT audit (Amherst Laboratories)
November 6 seminar workshop (at the convention hall of Department of Energy)

2. OJT audit (Amherst Laboratories)

(3) Participants: 22 people

Amherst Laboratories: Mr. Amado De Leon (engineering manager) and three engineers
United Laboratories Group: Mr. Anthony Arciaga and ten engineers
Department of Energy (DOE): Mr. Marlon Domongo, Mr. Maximino Marquez
ACE: Mr. Zamora, Mr. Junianto

ECCJ: Mr. Urakubo, Mr. Takeda, Mr. Kawase

(2) Factory overview

Operation: Amherst Laboratories belongs in the United Laboratories Group. It is located in the city of Laguna in the southern part of Manila and started solid dosage manufacturing in the Building I in March 2007. Building II was completed in this November, which plans to manufacture liquid dosages. This is the first and only factory with EU GMP certification in the Philippines. It has also obtained ISO 9000, ISO 14000, and Halal certificates. Building management system (BMS) is employed in the factory buildings.

Crude oil and products: Ingredients are imported from foreign companies including Takeda Pharmaceutical Company. Products are shipped for domestic consumption and export (amount is unknown).

Manufacturing facility: Pelletizer machines (wet and dry types), fluidizing dryer, tablet press, coating system, hot air dryer, primary packaging and secondary packaging system, clean room (in compliance with GMP)

Utilities: Air conditioning system (HVAC), pneumatic plant, pure water production system, boiler, and waste water treatment system

Energy consumption (2008): LSFO fuel 203 kL, electricity 7.4×10^6 kWh

Number of employees: 386 people

(3) Auditing overview

1) Participants of the auditing team

Twenty-two people joined the team, including four from Amherst Laboratories, eleven from the group companies of United Laboratories, two from the Department of Energy (DOE), and five from ECCJ/ACE. Mr. De Leon, the technical manager of Amherst Laboratories, was assigned the team leader in the Philippines. The participants were separated into three sub-groups and conducted data collection and analysis. Mr. Aaron Cuaresma, the technical staff of Amherst Laboratories gave a presentation about OJT outcomes in seminar workshop.

2) Confirmation of the purpose of PROMEEC project

We confirmed that the purpose of this project is to nurture people who are involved in auditing technologies of industrial facilities rather than a technological service that addresses specific problems. We also confirmed that target facilities of energy efficiency and conservation audit are limited to utility systems and peripheral facilities and equipment of manufacturing lines, for example heat recovery systems, dryers, and freezers, whereas the core components of manufacturing processes are not included.

3) Requests of the factory to the auditing team

Mr. Limuel Razo, the vice president in charge of factories at United Laboratories expressed the wish to increase energy efficiency and conservation knowledge and skills of engineers and receive knowledge on cost reduction. Mr. De Leon, the technical manager also asked us to teach them the latest energy efficiency and conservation technologies and provide specific suggestions to conserve energy of HVAC

4) Procedure of the audit

・Interview with the factory side

Mr. De Leon explained the overview of factory facilities and energy conservation and their efficiency activities using PPT.

・Confirmation of the responses in the previously sent survey sheet

The explanation of the factory officials using PPT was perfect, and we did not have to confirm their responses on the survey sheet.

・Lectures on technological aspects necessary for audit

We gave a lecture on the overview of energy audits, energy conservation measures of HVAC facilities (chiller, cooling tower), and examples of energy conservation in medical supply factories.

・On-site inspection and discussion

The team leader was the technical manager of the factory, and he answered questions during the inspection. We returned to the classroom and discussed as necessary.

・Primary report

The flash report of auditing findings was reported to the factory executives as the on the final day of the audit.

・Secondary report

Japanese language report will be submitted to METI in March of next year (will be uploaded on the ACE website in June)

5) Findings of the on-site inspection and energy efficiency and conservation possibilities (see Attachment IV-1)

We started the inspection by explaining the purposes at individual facilities to ensure that we provide engineering education that was requested by the factory manager. In the actual setting, it was impossible to explain to more than 20 participants in noisy areas. Thus, we handed out data sheets that list data to be collected to all participants. Also, we explained the meaning of the datasheet in the classroom prior to the on-site inspection. Then, the audit was conducted in a style in which ECCJ experts inspected facilities while participants filled in inspected points in the data sheet. This style succeeded considerably in promulgating the purpose of on-site inspection.

This is a young factory that has been in operation for a little over two years, and the operation rate is still low - about 60%. Organized energy efficiency and conservation promotion activities were also yet to be implemented. Thus, in order to identify opportunities to conserve energy, we conducted the on-site inspection based on the following four classifications.

Category 1: Strengthen energy management system
Category 2: Re-tune operation conditions of facilities to suit the low operation rate
Category 3: Add energy saving equipment
Category 4: Optimize utility supply that integrates solid dosage factory and liquid dosage factory (outside the range of OJT)

<u>(a) Strengthen energy management system</u>

According to the responses in the pre-survey sheet, despite the fact that the factory is implementing a certain level of energy efficiency and conservation activities, it still has some points to be improved: energy manager is not assigned; no energy reduction goal has been set; and the factory has not received an energy audit from a third-party consultant. Thus, we provided the following advice:

・Appoint energy managers

Although the factory has established the energy efficiency and conservation promotion committee, they have not started actual promotion activities because no energy manager has been appointed. They need to appoint managers in individual work areas to turn off lights, stop motors during non-manufacturing periods, clean rooms, remove unnecessary heat sources, and establish a system to request repairs to the facility division when necessary.

・Monitor and record energy consumption data

Implement the following in order to monitor and record data: make maximum use of the data stored in DCS (such as clarifying the relationship between operation data and energy consumption), install an ammeter or a power meter in energy consuming facilities (such as pneumatic system), and purchase portable measuring instruments for energy management (such as a DO meter for activated sludge systems and stethoscope for steam trap management).

・Utilization of building management system (BMS)

This factory is manufacturing products inside a large building with strictly controlled air conditioning. Thus, the factory employs building management system (BMS) for air conditioning management. The information inside the building, such as the temperature and humidity,, as well as the data of service utility systems is inputted in BMS. However, the data is not utilized for energy management. Thus, we instructed them that they should output the energy consumption data as a report so that relevant divisions can share the information for better energy management.

・Pursuit of energy efficient operation using IHDB

An important aspect of energy management is the constant operation of manufacturing facilities and service utilities under optimal conditions; thus, it is important to specify energy efficiency indicators to individual facilities and regularly manage them. Thus, we advised that the factory should regularly collect key process parameters that can be used as energy efficiency indices, store then as a database, discover signs of increased energy consumption, and be prepared to repair when necessary. Such databases are used inside factories and called in-house database (IHDB). In general, the contents of IHDB vary in individual factories, but there are some common aspects in service utilities.

・Roadmap to promote energy efficiency and conservation

Receive assistance from third-party consultants, generally explore possible energy conservation measures, and categorize individual implementation plans of energy conservation measures into short-term, medium-term, and long-term plans. The Energy Conservation Act of Japan demands designated energy management factories to create and submit mid- to long-term plans of energy efficiency and conservation measures. This stipulation aims to prevent businesses from only trying energy conservation measures with short payback time and overlooking greater energy conservation opportunities. That is, the stipulation is grounded on the awareness of the importance of implementing energy conservation measures under mid- to long-term perspectives. We advised the factory to create a mid- to long-term plan.

・Improve skills of engineers

In the process of discussing with engineers who participated in the OJT audit, we felt the importance of improving their knowledge and skills. For example, some engineers did not understand the mechanism of freezers and why freezers require energy. These are essential knowledge to promote energy efficiency and conservation activities. Thus, we advised that the factory utilize third-party technological services, such as energy service providers and consultants to strengthen engineer education on process principles of facilities and auditing technologies.

・Improve workers' awareness toward energy efficiency and conservation

Worker education is also necessary. The goal of worker education is to develop awareness toward energy efficiency and conservation. Efforts, such as turning off lights during lunch breaks require cooperation of workers. Quickly detecting signs of increased energy consumption, such as mechanical malfunctions is also an important energy conservation activity. One of the requirements for small group activities to succeed is an awareness of energy efficiency and conservation.

・Facility maintenance

Based on the perspective of energy efficiency and conservation, major maintenance targets include defective steam traps, damaged insulation, leakage of compressed air, and malfunction in meters. These are often left without being repaired, since they do not affect operations of the factory. The factory needs to create inspection lists and conduct regular inspection and maintenance.

(b) Energy efficiency and conservation in thermal facilities (see Attachment IV-4)

・Inspection of cooling tower performance

Of the factors that affect the energy efficiency of air conditioning system, which accounts for 60% of the energy consumption of this company, the largest factor is the temperature of cooling water. The yardstick to examine the performance of a cooling tower is the temperature (⊿t) between the temperature at the exit and difference of the temperature at the entrance and exit. The temperature at the exit was below 31 °C, and ⊿t was 3 °C to 4 °C, which indicates no trouble in the performance of the cooling tower. The exit temperature was regulated with automatic on/off control of the number of IDF fans. The system was set up so that it is turned on when the temperature gets 31 °C or higher and turned off when it gets below 27 °C. Possible energy conservation include that setting the off-temperature at 29 °C instead of the current 27 °C so that the on-time becomes shorter which consequently reduces the energy use of IDF fans. This is especially effective because the wet bulb temperature gets lower at night along with the exit temperature. Changing the off-temperature setting is effective. When implementing this, be sure to examine the daily variation of the wet-bulb temperature in Manila. Then, gradually increase the off-temperature from 27 °C and check to see if there is any trouble before moving on to the next step.

・Maximization of Steam Condensate Recovery

We found that the drain discharged from the steam trap was released into the gutter without being collected in the boiler room and the steam pipes in Level 2. The discharges should be collected in a boiler feed water tank (the deaerator in this factory). If the trap is far from the tank, the cost of installing collection pipes increases and makes it unprofitable. In such cases, it is necessary to make adjustments, such as grouping several traps.

・Steam trap management

We found malfunctions of the steam traps in the boiler room and Level 2 steam pipes. They increase the lead on the boiler and increases fuel consumption. Defective traps must be dissembled for repair or replaced with a new one. We recommend free-float style traps that are not likely to cause steam leak when replacing traps. Regular inspection is important for early detection of defective traps, and the factory should have a trap inspection list ready for the inspection. Also, the factory should purchase a stethoscope for trap audits to find defective traps. Stethoscopes can be purchased from trap suppliers.

・Insulation of bare part of steam piping and fittings

We found steam pipes and warm water pipes without insulation in the boiler room and Level 2. We also found bare parts in cool water pipes in the Level 2. These parts trigger increased boiler load and air conditioning load, which consequently cause wasteful use of fuel and electricity. The factory should immediately insulate them. Meanwhile, the factory has been operating only for two years at this point, and insulation is not deteriorated yet; however, they will began to deteriorate and insulation performance will decrease as the years in operation become longer. The factory needs to repair them in early stages of deterioration.

・Optimum boiler operation

It is important for boiler operation to keep the exhaust gas temperature low and keep the oxygen concentration in exhaust gas at optimal value. The exhaust gas temperature was 170 °C and the oxygen concentration in exhaust gas more than 6 % at the time of the OJT audit. Estimating from the fuel consumption, the boiler load is about 25%, which is extremely low. Given that, 170 °C and 6% are values with no significant problems. Under low load situation like this, lowering the combustion air volume impedes good air-fuel mixture, which adversely increases imperfect combustion. It is necessary to adjust air volume in order keep red flame without producing black smokes. The ratio of fuel and combustion air is controlled with a linkage mechanism in this boiler. If low load operation persists, the factory needs to adjust the air-fuel ratio in the presence of the boiler supplier. In regards to the exhaust gas temperature, they need to be careful not to cause condensation corrosion from sulfur in the fuel oil. The fuel oil used in this factory is a mixture of heavy oil and light oil, and the sulfur content is 0.9%. The acid dew point is about 150 °C, and the exhaust temperature during operation is nearly 170 °C. The factory should inspect tube corrosion during regular maintenance to prevent economizer tubes from locally reaching below the acid dew point.

・Minimization of heat generation in air conditioned spaces

Heat sources inside an air-conditioned room must be kept to the minimum because they increase the load on air conditioners. Heat sources include equipment that uses steam, ones that use motors, lighting devices, forklifts, workers, and the outdoor air that enters with door movements. We inspected equipment that use steam in this inspection. The fluidized bed dryer was coincidentally not in operation on the day of inspection, and we were unable to check if the surface temperature was high. There was one steam heating kettle, and its steam pipes were not insulated. The jacket surface of the kettle was not insulated, either. Since it is a small kettle with small surface area, we suppose that its impact on the air conditioning load is small. The factory should consider providing insulation if they add more kettles in the future.

・Heat recovery of streams around pure water PHE

Pure water for manufacturing is indirectly sterilized by a steam using a heat exchanger. The sterilized and heated pure water is then cooled by cooling water and sent to a pure water tank. The heat is absorbed by the cooling water in this process, but there is a possibility of recovering this heat for preheating boiler water or raw water for a warm water generator. Although we were unable to explore this point due to the time restriction in this OJT, but this matter should be explored in the future.

(c) Energy efficiency and conservation in electric facilities (see Attachment IV-5)

・Condenser coolant pump

A total of four condenser coolant pumps (18.5 kW) are placed for one chiller system (4 types).

The motor load factor of this pump (two pumps were operating during measurement) is 68% to 70%, and the load factor on shaft power when the pump is operating at specified rating is 71% to 73%. Hypothesizing a flow rate/shaft power curve and convert the above into a flow rate, the actual operating condition is estimated to be about 59% to 61% of the rated flow rate. Based on the comparison between the rating specification and specification required in the end, we recommend the implementation of energy efficiency and conservation measures by reducing excessive specifications, such as impeller cutback. We estimate that the amount of energy to be saved through impeller cutback is approximately 5 kW.

・Inspection of chilled water and condenser pumps

Chilled water is circulating in the sequence of chiller evaporator, secondary pump, processing, (chilled air tank), primary pump, and chiller evaporator. The chilled water tank is not placed in this system, which makes it a closed system. The primary pumps (four units) are operated with the constant speed motor, and secondary pumps (seven units) with variable speed motor with inverters. The frequency of the secondary pump motor was 10-11 Hz in the maintenance inspection, which practically means no rotation. The suction pressure and discharge pressure of the secondary pumps are almost the same, about 6 bar. This means that the entire flow resistance of the chilled water circulation is lower than designed, and the circulation can be made only with the primary pumps. Flow resistance changes in proportion to the square of flow rate. It is probably caused because the amount of chilled water circulation is smaller than designed because of the current low rate operation. Thus, we recommend that the factory stop either primary or secondary pumps. Since the rated headings are 22.8 m for the primary pumps and 27.4 m for the secondary pumps, stop the primary pumps and operate only with secondary pumps. In this case, it is necessary to install bypass pipes to the primary pumps. We estimate that the amount of electricity to be saved with the operation with the secondary pumps will be about 8 kW.

・Reduction of compressed air pressure

The compressed air is used to move actuators, blow surfaces, transport powder, and move micronizer in this factory. The average exhaust pressure is 8.2 bar. Seven bar or lower is sufficient for equipment other than the micronizer. Meanwhile, the micronizer is only used once in three months for about 1.5 days. Thus, it means that energy is wasted for the majority of the time. Thus, possible measures include (1) install a small pneumatic system exclusively for the micronizer, (2) operate at 7 bar or lower during normal operation and increase the discharge pressure setup to 9.2 bar when using the micronizer, or (3) install a (new) booster exclusively for the micronizer. When employing the method (2), it is necessary to check with the pneumatic system supplier whether it is possible to change settings. The electricity conservation ratio when the discharge pressure is lowered from 8.2 bar to 6.2 bar is estimated to be about 14.4%.

・Optimum control of air compressors

Three screw type pneumatic systems are installed in this factory; two are constantly in operation, and the other one is standing by. We measured the load time of the running pneumatic systems and found that one spent 61% of the time in unload and the other one 22% of the time. Also, the load setup pressures and unload setup pressures were almost the same for the two systems. Possible measures to reduce the unload time include (1) replace one of the pneumatic system with a small pneumatic system or (2) replace it with inverter-operated one. The case (2) requires a significant investment, and it is difficult to pay out.

・VSD of aeration blower of activated sludge unit

Three aeration blowers are installed with the activated sludge unit in this factory and supplying air for aeration. They are all operated with constant speed motors. The operation rate of the factory is currently low, and the BOD load is probably lower than the designed value. We found large bubbles in the visual observation during aeration, which indicate the possibility of over-aeration. The factory should measure dissolved oxygen value using a portable dissolved oxygen meter (DO meter), and if it is within the control limits (usually 2-4 ppm), reduce the amount of aeration to reduce the energy consumption of the blower. Three methods to reduce the amount of aeration include (1) reduce the exit valve, (2) change the pulley diameter, and (3) use a motor with a variable speed inverter. in the motor. Although the method (3) is has the largest energy conservation effects, the most viable one is to change the pulley diameter. DO should be measured and controlled every day; thus, we recommend purchasing a portable DO meter (about $ 2,000 USD).

・VSD of miscellaneous rotating machinery

The flow rates in pumps, fans, and blowers driven by constant speed motors are controlled by opening and closing discharge valves. Discharge valves are closed during low flow operation to generate pressure loss and control the flow rate. Energy is lost in proportion to the pressure loss. Then, a variable speed motor is used to minimize the pressure loss at the discharge valve. That is, energy is conserved during low flow operation usually by slowing the motor speed and fully opening the discharge valve. The most frequently used variable speed motor is ones with inverters. The yardsticks to determine whether to use an inverter are (1) when the opening of a discharge valve is less than 50% to 60%, and (2) when the load shows large or frequent fluctuations. The load fluctuation is usually large in air conditioning systems, and factories with lower nighttime load usually install inverters in chilled water pumps, cool water pumps, and AHU/dust collection fans as a common practice. The factory should select an inverter with the lowest price possible when installing one. Manually, rather than automatically controlled inverters without expensive protective circuit will suffice unless malfunction will have great impact on a factory's operation. This factory should consider installing inverters for the following machinery.

Chilled water pump (water circulating in the cooling tower)

Cold water pump (cold water circulation)

Dust collection fan

Water pump (excluding when the pump is on ON/OFF control)

・Cooling tower fan

The cooling tower fan (18.5 kW x 4) is automatically turned on and off by the feed water temperature control, which also selects the number of units to turn on to run energy efficient operation. The motor load factor during the measurement is 66% to 76%. The cooling tower fan is already running in energy efficient operation with the feed water temperature control, and we have no particular recommendation for further energy conservation. However, a possibility to further reduce energy consumption in the operation is to add the capacity control feature to deal with partial loads by using an inverter with one fan in combination with the current control on the number of equipment to turn on.

6) Introduction of successful energy efficiency and conservation measures in medical supply factories in Japan

Many energy efficiency and conservation measures in medical supply factories are reported in National Convention on Excellent Energy Conservation Efforts every year. The representative examples listed below are described in the PPT document. See Attachment IV-3 for details.

- Clean room A/C system in Abbott Japan, Katsuyama Plant
- Cooling water system in Ajinomoto, Kyusyu Plant
- Water supply pumps in Eisai, Tsukuba Laboratory
- Utility facilities in Japan Chemical Research, Kobe Plant
- Lighting fixture in Santen Pharmaceuticals, Noto Plant
- Utility facilities in Otsuka Pharmaceuticals, Tokushima Plant
- Ice-thermal storage system in Eisai, Tsukuba Plant
- A/C system in Pfeizer, Nagoya Plant
- Multi-effect evaporative water distillation unit in Otsuka Pharmaceuticals Tokushima Plant
- Flue gas desulfurization unit in Taiho Pharmaceutical Tokushima Plant
- Spray dried crystallizer in Fuji Pharmaceutical Toyama Plant

7) Preparation of measuring instruments

DOE provided a clamp-on power meter as a measuring instrument. ECCJ also provided a contact thermometer. We utilized all instruments and successfully obtained a substantial amount of data. We used the thermometer to take temperatures around the boiler and the cooling tower. The power meter is an important measuring instrument to measure motor currents of pumps, fans, and compressors. We asked the factory officials to handle the power monitor as a precaution to prevent possible accidents.

In common factories, highly recommended instruments required for measurement include oxygen meter to analyze combustion gas and hot wire anemometer or vane anemometer to measure air volume of fans in addition to power meters and thermometers. These are essential measuring instruments in the evaluation of combustion management and inverter control that is frequently practiced as energy efficiency and conservation measures.

8) Data analysis and brief report

We reported issues to be examined and problems found in the OJT audit as a flash report on the final day of the audit to the factory executives. Mr. Nestor Felicio, the vice president in charge of planning, and Mr. Limuel Razo, the vice president in charge of factories, attended from the parent company, United Laboratories, Inc. Mr. Aaron Cuaresma, the member of the local team, presented this flash report in the seminar workshop. See Attachment IV-4 for the details of this report. We will bring the data back to Japan, which will be analyzed in detail and summarized in the final report (in Japanese) in March next year. The participants engaged in active discussion on this report.

Main questions and answers are described below:

Q. (UniLab) We want to submit a budget request and would like to know how to calculate the cost of installing inverters.

A. (ECCJ) The purpose of this project is to build capacity of auditing technologies rather than technological services. This project explained locations of energy saving potentials. Participants should consult with energy service providers (ESP) for detailed information to calculate specific suggestions and other services. Naturally, you need to pay for such services.

C. (DOE) The purpose of PROMEEC is to increase awareness and to develop the market of EE&C technologies. We would like you to utilize ESP's technological services.

Q. (UniLab) What is the load factor of a pneumatic system that we should target?

A. (ECCJ) First, I would like to explain how to determine a facility capacity at a design phase. In general, a facility capacity is determined by adding two types of safety to the capacity required for normal operation. One of the safety factors is 10% to compensate for insufficient capacity that originates in the lack of design precision, and the other one is 10% to compensate for increased capacity due to market fluctuations. Thus, the capacity of a facility is 20% larger than required for normal operation.

Next, I will describe how to effectively utilize already installed facilities. The efficiency of a facility is maximized when operating at rated capacity, which means 100% load factor. Meanwhile, normal operation uses 80% of the facility capacity, which means that the facility is operating with 80% load factor. Thus, the facility is forced to operate with lower efficiency than when operating with 100% capacity. Since the reduction of efficiency is not very significant when the load factor is 80%, there is no special need to increase it. However, the power required in rotating machines, such as pumps and fans is proportional to the cubes of load factor; thus, if an inverter is used, the required power is decreased to 51.2% (= 0.8^3) when operating with 80% load factor. Thus, inverters are often included in a design phase. The answer to the question is that there is no target load factor for already installed facilities (a type of cryptic dialogue).

Q. (UniLab) Please teach us the mechanism of a temperature regulating steam trap.

A. (ECCJ) Explained the mechanism by comparing temperature regulating type and free floating type.

Q. (UniLab) What is the boiler blow down?

A. (ECCJ) Explained the relationship between water quality and blow down, intermission blow and continuous blow, the effects of conductance meter, TOD standard values, etc.

Q. (UniLab) Why didn't you employ a suction chiller?

A. (UniLab) We used a mechanical chiller because a suction chiller could not satisfy the required temperature of chilled water.

Q. (UniLab) Please explain the energy efficiency and conservation effect of fuel additive.

A. (DOE) Many types of fuel additives are on the market, but we have not confirmed their effects.

(4) Remarks

1) This is the largest and latest factory in the Philippines, and only two years have passed since the start of operations. Naturally, the factory strictly followed the GMP for medical supply manufacturing standards. However, few latest energy saving technologies have been reflected in the design of factory facilities. In fact, the factory was collecting heat of some exhaust air and installed inverters in the AHU blower, but these are not sufficient. Building a new factory was a great opportunity to install energy saving technologies; unfortunately, they missed the opportunity. We heard that a contractor in Manila was in charge of the construction, but we feel that the engineering in the field of medical supply might be underdeveloped.

2) The energy efficiency and conservation management was also very underdeveloped. Although they have organized an energy efficiency and conservation committee, it is questionable how much they are actually conducting. Many engineers did not even know what kind of energy efficiency and conservation technologies were available. Although it was a new factory, the maintenance was not well implemented; we found signs of damages to the insulations and defective traps. We felt that the factory had many things to do including the improvement of the skills of engineers, energy conservation awareness among workers, data monitoring and recording, and the improvement of maintenance.

3) The main factory has installed a BMS based on DCS. The fundamental energy data and important operation data are collected online. The factory needs to utilize the data in their energy management from now on. IHDB is an effective tool to do so. We expect the factory to use IHDB.

4) A liquid dosage factory will be completed next to the current solid dosage factory in November. The new liquid dosage factory will have a different system that is completely separated from the solid dosage factory. Having separate systems is associated with the advantage that troubles in one factory will not affect the other, but also the disadvantage that the service cost will be high. The future issue to be examined is that the factory should minimize the service cost of the entire factory by categorizing the effects on factory operation and share functions between the two factories when possible. Targets include boilers, steam system, compressed air systems, wastewater treatment systems, and water supply systems should be included.

3. Seminar workshop

(1) Date, time, and location

November 6, 2009 08:30-16:30

Conference hall in Ministry of Energy

(2) Participants: 45 people

Dept of Energy (DOE) 9 people

Mr. Roy Kyamko, Senior Undersecretary

Ms. Evelyn Reyes, OIC-Director

Mr. Artemio Habitan, OIC-chief, EE&C division

Group of United Laboratories, Inc. Nine people

Mr. Amado De Leon, Engineering Manager of Amherst Labs

Mr. Anthony Arciaga, AVP-engineering service

Pharmaceutical Industry (ex. United Labs Group) Eight people

Philippines Council for Industry & Energy and Development **(**PCIERO**)** Two people

Energy Service Providers Six people

Hotel Industry Two people

ASEAN (speaker) Two people

Mr. Zul Azri Hamidon, PTM, Malaysia

Mr. Gannet Pontjowinoto, President director of PT EMI, Indonesia

ACE 2 people

Ms. Christopher Zamora, Mr. Junianto M

ECCJ 3 people

Mr. Urakubo, Mr. Takeda, Mr. Kawase

(3) Presentation overview

Session 1: Policy and Initiatives on EE&C in Major Industries

1) Updates of ASEAN Energy Efficiency (EE&C) Activities

Mr. Christopher Zamora explained about the activity overview of ACE based on the following aspects.

・APAEC Program 2004-2009 and 2010-2015

・17 EAEF EE&C Project
・ASEAN-Japan Cooperation (SOME-METI, PROMEEC and multi-country training)
・ASEAN Best Practice Competition (energy conservation section)
・ASEAN＋3 Energy efficiency and conservation/Renewable Energy Forum
・AEMAS (ASEAN Energy Manager Accreditation System)
・Other cooperative program with EAS-ECTF, UNEP, ASEAN foundation, ADB, and CDC

Of these topics, Mr. Zamora explained in detail about the APAEC Program 2004-2009. This program includes six program areas, and energy efficiency and conservation are implemented in program area 4; the purpose is to strengthen the cooperation of the ASEAN region through the capability establishment of energy efficiency and conservation organizations, the involvement of the private sector, and the expansion of the market for energy saving devices; and this program intends to implement activities in six categories in order to achieve its goals.
(Information sharing and networking, ASEAN energy standard and labeling, participation of the private sector, capability building, training of ESCO companies, and energy efficiency and conservation in the transport sector) As main activities in the program area 4, he then introduced PROMEEC activities based on circumstances of leading to Phase 1, Phase 2, and Phase 3, as well as outcomes and future perspectives.
The efforts involving the commercial use of nuclear power will be added to the APAEC Program 2010-2015, which is currently being developed.

2) EE&C Promotion Activities in the Philippines

Mr. Artemio Habitan of the Energy efficiency and conservation Division, DOE, explained the organizations involved in energy efficiency and conservation in the Philippines and recent energy efficiency and conservation activities;
・ The main themes of the activity are to improve energy independence, promote energy efficiency and conservation, and develop alternative and renewable energies.
・ Energy demand: Transport 34.6%, residential 28.5%, industry 25.4%, commercial 10.1%, and agriculture 1.4%
・ Division of Energy efficiency and conservation, Department of Energy, Ministry of Energy is in charge of energy efficiency and conservation.
・ NEECP (National EE&C Program) Select 2004 official logo (ec way of life)
Seven sub-programs (promulgation campaign, consumer electronics S&L, energy

efficiency run, government EM project (GEMP), energy management service/audit, award, voluntary action plan (VAP))

- PEEP Project (Philippine Energy Efficiency Project)

  Goal: Reduce electricity cost by cutting the peak energy

  Fund: US $ 46.5 mil. (ADB loan US $ 31.0 mil, ADB grant US $ 1.5 mil, Gov't US $ 14.0 mil)

  Four sub-projects: Lighting, building and industry super ESCO, promulgation of energy efficiency and conservation in domestic aspects, assistance for energy efficiency and conservation

- Outcome: Reduction of the peak energy 450 MW
- ・CFL supply plan

1st lot (5 mil CFLs, Manila area), 2nd lot (4 mil CFLs, Luzon area), 3rd lot (4 mil CFLs, Visayas area and Mindanao area)

- Project with other countries

ASEAN-PROMEEC, ASEAN BP building, ASEAN EM Award Industry and Building

3) Japan's Energy Conservation Policy & Measures for Industrial Sector

Mr. Taichiro Kawase of the Energy Conservation Center, Japan explained Japan's energy efficiency and conservation policies, policies in the industry sector and the role of the Energy Conservation Center based on the following five perspectives:

- Changes in the basic unit of energy in individual industries in Japan
- Legal measures and energy efficiency and conservation measures in the industry sector of Japan
- Voluntary activities of private companies and organizations in the industry sector (using the medical supply industry as an example)
- Roles of the Energy Conservation Center and activity overview
- Introduction of successful examples of PROMEEC industry projects in other ASEAN countries (using the food industry as an example)

<u>Session 2: EE&C Best Practices in Industries</u>

4) EE&C Best Practices in Malaysia

Malaysia: Mr. Zul Azri Hamidon of Energy Conservation Center (PTM) presented cases of electric furnaces that produce billets and steel bars.

- The operation started in 1961, billet 423 kt per year, steel bar 291 kt per year, energy cost RM 65 million, number of employees 1,060 people, operated for 24 hours a day.
- Manufacturing process: Accept scraps → DC arc furnace → ladle furnace → continuous casting machine → reheating furnace → rolling machine → laying → finished product (steel bar)
- Measures to prevent compressed air leaks from the No. 1 rolling machine: Conduct air leak test and estimate the amount of air leak, identify areas of air leak (air flow when the air is not used, pipes and joints, leave a shut-off valve open, mishandling of air guns)
- Replaced the aged piston pneumatic system with a screw pneumatic system and downsized the two-unit 75 kW operation into one-unit operation.
- Prevention of air infiltration in the reheating furnace: Found air infiltrations from the output door and handling door. Lowered the bottom line of the output door 200 mm. Repaired the inclination of the handling door.
- Installed a VSD in the quenching pump of No. 2 rolling machine: Switched from discharge valve control to inverter control. Installed VSDs in two 160 kW pumps and one 225 kW pump.
- Installed VSDs in the cooling blower of No. 2 rolling machine: Switched from constant speed motor to inverter controlled motor. Installed VSDs in two 37 kW blowers and one 75 kW blower.
- Improvement of power factor: Installed a capacitor bank and improved the power factor from 0.7 to 0.9.

5) EE&C Best Practices in Indonesia

Indonesia: Mr. Gannet Pontjowinoto of PT EMI (PERSERO) explained four cases.

- A case of the integrated fiber factory in Jawa Barat

Manufacturing capacity:	Spinning	: 350 tons per month
	Weaving	: 1.35 million yarns per month
	Dyeing & finishing	: 1.2 million yards per month
	Printing	: 600,000 yards per month

No.	Energy saving potential	Energy saving recommendation	Implementation	energy saved
1	There are leaks in the compressed air distribution pipe	Repair the distribution pipe leakage	Improvement in the compressed air distribution pipe, mainly at the weaving division	46,000 kWh/month
2	Higher discharge pressure due to high pressure drop at the distribution pipe	Shorten the distance between main header to user point so we can reduce the pressure drop	Shorten the distance between the main header to user point, degrading the discharge pressure from 7.6 to 7.2 kg/cm^2	21,670 kWh/month
3	High inlet temperatur reduce the Elliot 320 & 330 compressor efficiency by 6 - 7%	Regular cleaning activity at the compressor's intercooler&aftercooler will improve the efficiency	Regular cleaning activity once every 6 months	9,360 kWh/month
4	Low free air temperature at night and high pressure drop at the condenser side	Raise the air conditioning system temperature setting Optimize the use of low temperature free air to conditioned the production room	Accelerate the use of low temperature free air and conduct regular cleaning of heat transfer equipments	29,600 kWh/month
5	Low performance hot oil and steam boilers	Boiler efficiency improvement & Changing the use of HFO to NG	Improving hot oil and steam boilers performance trough shell&tube cleaning, regular maintenance Repair and adjust the gas burner in the hot oil boilers	828,720 liter of IDO and 508,464 Nm^3 of NG
TOTAL ENERGY SAVING			106,630 kWh, 828,720 liter of IDO and 508,464 Nm^3 of NG	

・Electric furnace factory in Jawa Timur

Manufacturing process: Scrap/Sponge → EAF → LRF →C CM → (Billet) → BRF →Roughing→Intermediate→Finishing→Wire rod

No.	Energy saving potential	Energy saving recommendation	Implementation	energy saved/year
1	High value (242%) of excess air for billet reheating process in Billet Reheating Furnace (BRF)	Reduce the amount of excess air that is needed for billet reheating process from 242% to 92%	Install BAF gas project	1,857,661 liter IDO
2	Heat loss in billets as a result of natural cooling (cooled billets from 600 to 40 °C)	Billets feeding arrangement to reduce the occurrence of heat losses due to waiting time	Setting the billets feeding mechanism	4,994,183 liter IDO
3	Tap to tap time can be reduce in Ladle Reheating Furnace (LRF)	Reduce tap to tap time up to 20 minutes to reduce electrical energy consumption in Ladle Reheating Furnace (LRF)	Reduce tap to tap time	7,175,550 kWh
TOTAL ENERGY SAVING				7,175,550 kWh and 6,851,844 liter of IDO

・Gas treatment plant in Sumatera Selatan

Main facilities: Amine desulfurization unit, stabilizer, propane chiller, GTG power generator

No	DESCRIPTION	SAVING, MMSCFD
NO COST/LOW COST :		
1	Optimize operation of GTG will increase efficiency from 18 % to 23 % that will reduced HP Fuel consumption	0.14
2	Optimized operation of all heater will increase efficiency 5 %	0.10
3	Reducing excess air of (225-H-202) at standby condition will reduce fuel gas consumption	0.08
4	Optimized operation of air cooler by Reducing the number of fan operation at low ambient temperature will reduced electricity consumption	-
MEDIUM/HIGH COST :		
5	Optimize operation of Heater and utilized flare gas can be implemented by installing booster compressor** to compress gas up to 180 psig. This fuel gas can be used for Gas turbine and in turn it will reduce HP Fuel consumption	1
	TOTAL =>	1.36
**Estimated payback period to install the system is 2.42 Years		

・Cement factory in Sumatera Barat

Eight improvement suggestions were made in Greenhouse Gas Emission Reduction at Industries in Asia Pacific program (GERIAP), five of which received follow-up evaluations in Cleaner Production Energy Efficiency Program (PBEE).

No.	Energy saving potential	Recommendation	Implementation	Energy saved annually	CO_2 reduction annually	payback period
1	Compressors in cement mill & cement kiln areas are generally operates on less than 75% of their nominal load	Optimization of compressor work through compressor interconnection	Install interconnection between compressors so	31.1 kW	143.79 ton	less than 4 months
2	Timer setting of air jet pulse filter in the bag house to the optimum operating time	Adjusting the timer settings on the optimum operating time of the air jet pulse filter	Adjust the timer settings	2,178 kWh	1.57 ton	-
3	There are a lot of leaks in the distribution pipe network of compressed air	Optimize the compressors working through compressed air leak repair	Repairing the compressed air leaks in the area of cement mill & kiln	163,800 kWh	118.6 ton	less than a month
4	Vacuum leak in the area of kiln system and raw mill	Optimize the work of induced fans through vacuum leaks repair	Repairing the vaccum leaks in manholes and compensators	2,268,728 kWh	1,643.28 ton	5 months
5	Fans operate far below their nominal load	Optimization of fans work through adjusting the rotation of the fans according to their working load	Variable speed drive installation and fan motor pulley replacement	11,550,000 kWh	8,354.96 ton	18 months
	TOTAL ENERGY SAVING & CO_2 REDUCTION			13,984,706 kWh	10,262.2 ton	

6) Best Practices in Japan (pharmaceutical factory)

Mr. Hidetaka Urakubo of the Energy Conservation Center, Japan, reported two cases from medical supply factories in Japan.

- Energy efficiency and conservation activities involving steam trap management
  Implemented management activities including simple measurement of the amount of drain from traps, performance comparison of four trap manufacturers, decision on optimal traps, and labeling distinguishing marks on steam traps.
- energy efficiency and conservation in the chiller for the clean room air conditioning
  Utilization of free cooling (gain energy conservation effects by taking advantage of the property that the cooling water becomes as cold as the chilled water temperature in winter and stopping the chiller operation), clean-up of the heat exchange tubes of the suction chiller (restore heat exchanging efficiency and reduce LPG combustion), and clean-up the heat exchange tubes of the turbo chiller (restore heat exchanging efficiency and reduce the compressor energy)

7) Best Practices in Japan (electrical energy, pharmaceutical factory)

Mr. Kokichi Takeda of the Energy Conservation Center, Japan, reported the following topics in regards to energy efficiency and conservation in electric energy:

- Energy efficiency and conservation through the accumulation of low-cost measures that conform to ISO 14001
- Reevaluation of factory energy management when transferring manufacturing to overseas
- Use of VSD in water pump (inverter control)
- Reduction of unload time by switching to a small compressor
- Energy conservation in the clean room air conditioning system (heat recovery from exhaust air, modification of temperature and humidity management values during non-manufacturing period, and the reduction of flow rate in lamina-flow facilities in a packing chamber during non-manufacturing period)
- Energy efficiency and conservation in spray dryer freezing system (introduction of inverter control in brine pump and cooling water pump, control the number of refrigeration compressor to operate)
- Energy efficiency and conservation in the lighting in a packaging room (use of high-efficiency lighting and lighting control and division of lighting areas)

8) Results of OJT Energy Audit in Pharmaceutical Factory (Attachment IV-2)

Mr. Aeron Cuaresma, the technical staff of Amherst Laboratories reported the outcome of an OJT audit conducted in this factory. Major points of the suggested measures include the performance evaluation of the cooling tower, energy conservation operation in the chilled water pump, condensate recovery, improvement of steam trap management, insulation of pipes without insulation, minimization of heat sources in air conditioned spaces, reduction of the pressure to send compressed air, and energy conservation of the aeration air blower of the activated sludge system.

Session 3: Workshop on Energy Management Tools

9) Heat Balance Practice of Fired Heater (Attachment IV-3)
Mr. Hidetaka Urakubo of the Energy Conservation Center, Japan gave a lecture about heat balance.
This lecture aimed to build up fundamental knowledge to make the full use of energy management tools. Industrial furnace used in many factories was selected as an example to demonstrate heat balance. The time allowed for this lecture was short, and only a lecture was given in this session, but we will make improvements so that calculation exercise can be included in the future. Heat balance calculation homework was assigned as a new attempt. While the submission of the homework was not mandatory, the procedure to submit answers to ECCJ and how the ECCJ experts would correct and return them were presented.

10) Updating of TDs, IHDBs, EMHBs and Cyber Search

Mr. Junianto M of ASEAN Centre for Energy (ACE) explained purposes, production method, format, and entry example of four types of ASEAN energy management tools: the technical directory, in-house database, energy management handbook, and cyber search system.

11) IHDBs for cement industry and food industry

Mr. Taichiro Kawase of the Energy Conservation Center (ECCJ), Japan explained the overview and provided instructions on how to fill out the entry format of in-house database (IHDB) for cement factories and food factories. The characteristic feature of

IHDB as an energy management assistance tool to be used in factories is that it includes manufacturing data, energy data, and equipment data in addition to important operation parameters and energy efficiency indices. These features supply reference information to divisions within a factory for efficient energy operation. Based on the perspective of promulgating them to the ASEAN countries, we requested the participants to actively employ them in cement factories and food factories in Brunei. The following implementation procedures were presented before moving on to a full-scale employment of IHDB in order to identify problems associated with its test employment:

a. Select participating factories in each industry (about two companies in one industry)
b. Produce an organization chart for the test employment of IHDB (clarification of role assignment)
c. Determine data to be entered in IHDB (be careful not to include too a substantial amount of data)
d. Start data collection and accumulation (each participating factory is to individually implement this procedure)
e. Progress management of test employment (focal point is to implement this procedure)
f. Follow-up (report in the next inception workshop)
g. Create a roadmap (create a mid- to long-term plan with ACE)

(4) Remarks

1) Forty-five people attended from the Ministry of Energy, energy technology service providers, the United Laboratories Group, as well as other medical supply businesses and the hotel industry, which indicated great interest toward energy audit. Unfortunately, we had a small number of participants from industries other than the medical supply industry and universities. We wanted the local officials to encourage participation at least from the officials of the cement industry and steel industry, which were introduced in the seminar workshop.

2) The presentation of the cases in Malaysia and Indonesia involved low cost measures that were extremely practical. The contents should be promulgated among ASEAN countries. We would like to request the cooperation of relevant countries and actions of ACE so that the efforts will be registered in the technical directory.

3) The staff efficiently operated this session including the preparation of the site, distributing documents, and arranging lunch services. We would like to express our gratitude toward Ministry of Energy, the industry coordinator of PROMEEC and government officials of the Philippines.

END

Attachment IV

1. Outcomes of OJT audit (flash report)
2. Results of OJT Energy Audit in Pharmaceutical Factory
3. Heat Balance Practice of Fired Heater
4. Examination of energy efficiency and conservation measures in thermal aspects
5. Examination of energy efficiency and conservation in electric aspects

Amherst Laboratories OJT audit

OJT audit data analysis

Group photo at Seminar Workshop

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