74. Energy efficiency utilizing type printing press (4 types)
75. Ultraviolet rays irradiation apparatus for metal plate
76. Energy efficiency utilizing type bookbinding machine (2 types)
77. Energy efficiency utilizing type photo-engraving apparatus (2 types)
78. Partition type rolling mill
79. Heat recovery type agitator
80. Piston-press type dehydrator
81. Heating medium type heater for perfume distillation
82. Leather vacuum dryer
83. Energy efficiency utilizing type glass melting furnace
84. Energy efficiency utilizing type forging raw material cutter
85. Energy efficiency utilzing foundrysand kneader (2 types)
86. Energy efficiency utilizing type mold moulding machine (3 types)
87. Die casting machine
88. Energy efficiency utilizing die casting machine (3 types)
89. Rotary forging machine
90. Energy efficiency utilizing type shot blasting
91. Energy efficiency utilizing type hydraulic sprue runner cutter
92. Energy efficiency utilizing type foundry sand cooling equipment
93. Energy efficiency utilizing type vacuum annealing furnace
94. Continuous coating vulcanizing equipment
95. Thin film rising type vacuum concentrator
96. Energy efficiency utilizing modling machine (5 types)
97. Fishing boat propulsive shaft power utilizing device
98. Compression crude ore crusher
99. Crawler type working machine facility (3 types)
100. Energy efficiency utilizing type asphalt aggregate dryer
101. Energy efficiency utilizing type gas heating dehydrator
102. Energy efficiency utilizing type cleaning and finishing equipment (3 types)
103. Energy efficiency utilizing type used paper packing machine
104. Energy efficiency utilizing type automatic developing machine
105. Overlap circuit type electric power supply device for light source
106. Energy efficiency utilizing type hothouse for gardening
107. Integrated working equipment for agriculture
108. Continuous manufacturing equipment (2 types)

(4) Certification of specifications, etc. of energy saving equipment

In order to make the preferential tax sytem for investment in energy saving equipment truly effective, it is necessary to widen the scope of users of the system and to simplify examination procedures of the tax authorities.

To that end, it is desirable to install a system where the associations of enterprises which manufacture (install) energy saving equipment, certify, in each case, the

specifications of the equipment involved and the competence of the equipment for application of the preferential tax system.

Of course, in the case of the acquisition of energy saving equipment, the maker usually informs the user of the performance and specifications of the equipment involved by such means as a detailed notice of delivery. Therefore, the user can judge whether the equipment can benefit from the preferential tax system, on the basis of such information. However, a certificate issued by a third-party organization with expert knowledge according to unified rules can command a higher degree of trust.

Such certification system will function as follows:

a. The business organization of makers (industrial association, etc.) issues a prescribed certificate form upon request of the maker.

b. The maker, when selling energy saving equipment covered by the preferential tax system, makes out the "certificate of the specifications of the energy saving equipment" by using the abovementioned form, and submits it to the organization.

c. The organization examines the contents of the certificate and then sends it to the user if no problem is found.

If there is doubt about the contents of the certificate, the organization consults with the government authorities concerned.

d. The user submits the certificate to the tax office together with the tax returns.

The tax office uses the certificate as reference when determining whether the preferential tax system can be applied.

4.2 Financial aids for investment

(1) This aims at alleviating burdens of investment cost of enterprises by financing them for a long-term and at low interest, as well as enhancing economy of the investment.

Under the circumstances of a tight financial market and a high interest level, the role and effects of the abovementioned system would even be greater.

At present, in Thailand, the IFCT conducts financing for energy conservation projects, mostly targeted on enterprises of a medium scale or more. The financing terms are considerably favorable, compared to those of common financial organizations.

Table IV-2

	IFCT	Common Banks
Interest	14.5%	19 ~ 20%
Loan Period	7 ~ 10 yrs.	1 year (short term,
Loan Amount	(2 yrs. left uncalled) 1 million bahts or more	but many extensions)
Loan Ratio	60%	

In the case of Thailand, it seems that funds demand for the energy conservation projects has not come to the fore so far, as stated before, due to shortage of technical staffs, information and mortgages.

In the near future, however, it is obvious that the needs for such low-interest loans will be rapidly heightened, as the above-stated troubles would be cleared, and the energy conservation measures of enterprises would be transferred to the stage centering on equipment investment.

It is now desirable that a financing system attractive enough and easily available for enterprises be arranged, and that the system expands corresponding to the developing state of energy conservation measures in the industrial sector.

(2) The financing system for energy conservation project is adopted in a number of countries under varied conditions. In the case of Japan, the government-affiliated financial organs, like the Japan Development Bank, the Smaller Enterprise Financial Corporation, the People's Finance Corporation, etc., are conducting respectively their low-interest loans for energy conservation projects, which cover the whole range of enterprises from big ones to small-sized private ones. The amount of source funds has also been increased year after year.

The outline of the major systems is shown below:

Financing by the Japan Development Bank

A) Subject enterprises

Enterprises and leasing firms wishing to install the following equipments.

B) Condition for subject equipment

a. To improve the energy use efficiency by 10% or more and to save energy equivalent to 50 kiloliters/year or more of oil.

b. To improve the energy use efficiency by 5% or more and to save energy equivalent to 1,000 kiloliters/year or more of oil.

c. To improve energy use efficiency by 20% or more.

d. To shift daytime power load required for cooling/heating into nighttime by 5% or more.

C) Subject equipment

a. It should be among the following equipment and meet the requirement as given in a or b above.

— Low fuel consumption rate type industrial furnace
— Heat exchanger for air preheating
— Waste heat boiler
— Exhaust gas recycling equipment
— LNG cryogenic utilization equipment
— Heat-pump type heat source unit
— Automatic energy controller
— Other ones that particularly require promotion of installation

b. It should be among the following equipment and meet the requirements as given in a and c above.

— Advanced continuous casting equipment
— Energy saving type low density polyethylene manufacturing equipment
— Low bath ratio dyeing equipment

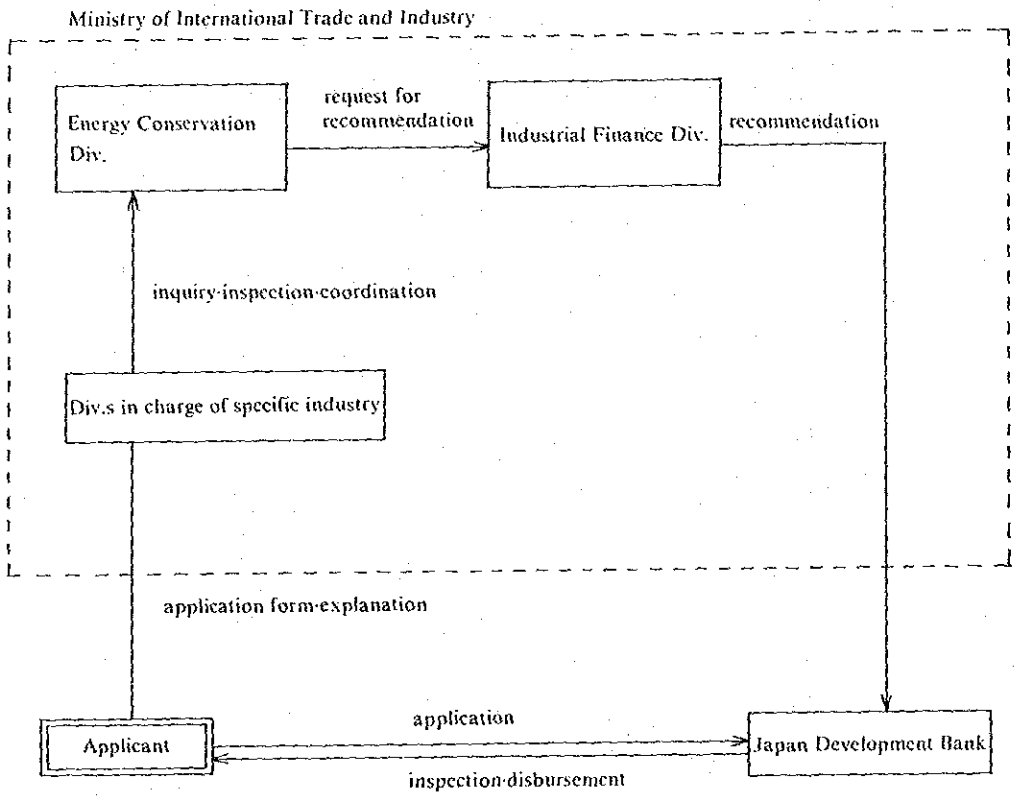
—Falling film evaporator
—High concentration phosphoric acid manufacturing equipment
—High-speed multi yarn stripes reeling equipment
—Ion exchange membrane method electrolytic unit
—Continuous digestion unit
—Pipe reactor type compound fertilizer manufacturing equipment
—Energy saving type business equipment

c. Heat pump type air-conditioning or hot water supplying facility with heat storage tank that meets the requirements as given in c and d above.

D) Financing ratio: Within 40%

E) Interest: 7.6% or 7.9%

F) Financing system



Financing by the Smaller Enterprise Financial Corporation

A) Subject enterprises

Firms with capital of 100 million yen or less, or with less than 300 employees (in the case of manufacturing industries).

B) Subject equipment

For the purpose of promoting energy conservation in medium- and small-size enterprises, a broader range of equipment is covered than the one covered by the Japan Development Bank.

Major equipments are as follows:

a. Equipment with energy conservation effects of 10% or more

①Boiler efficiency enhancing equipment (pure water producton equipment and steam accumulator)

②Automatic combustion control equipment

③Waste heat applying water cooling/heating equipment

Other 14 equipments

b. Equipment with energy conservation effects of 20% or more

①Steam condensate recovery equipment

②Waste heat boiler

③Heat exchanger

Other 101 equipments

C) Loan limit amount: 300 million yen including the common loans

D) Interest: 7.9%, but for the equipment shown under the above B) b paragraph: 7.6%

E) Loan period: Within 10 years

(3) Generally, credits and mortgages are in short supply for smaller enterprises as compared to big enterprises, and there are more than a few cases where the smaller enterprises cannot help suspending investment or retrenching the scale of investment, because they are unable to raise the necessary funds.

In Thailand, too, one of the factors hindering the raising of funds necessary for energy saving investment is supposed to be shortage in mortgages, and, in fact, in the case of financing by IFCT targeted mainly on the enterprises of medium scale or more, it is said that the problematical point is the unavailability of sufficient mortgages.

If a system where public organs offer guarantees to smaller firms is installed, for instance, through the following design (Japanese example), that would serve for the solution of the problem.

Credit Guarantee System for Smaller Enterprises

A) Guarantor—Credit Guarantee Association

This is a juridical person created legally by contribution of the local government aiming at guaranteeing the debts of business funds to be loaned to smaller firms from financial organs.

The debts guaranteed by the Association are automatically subject to insurance of "the Smaller Enterprises Credit Insurance Corporation" (a national organ). In case an accident (irrepayable) takes place in the guaranteed debts, the Association redeems it in place of the debtor and 70-80% of the payment is supplemented by the Insurance Corporation to the Association.

B) Subject of guarantee

It differs by business types, but in the case of manufacturing industry, it deals with firms or individuals of a capital of 100 million yen or less, or of 300 employees or less.

C) Subject funds

Business funds of smaller enterprises (operating fund and facilities fund), which

are promising to be repaid.

D) Guarantee limit amount

¥80 million (but, in the case of energy conservation project fund: 100 million yen).

E) Guarantee rate: 1.0-1.05% year.

(4) In Thailand, since last year, a system has been launched (energy conservation demonstration program) to demonstrate energy conservation technology in industry, by selecting one factory each for every major industry type (by NEA) and loaning it low-interest government funds.

Table IV-3

Year	1983	1984
No./Plant	3 plants	5 plants
Budget	3 mil. bahts	5 mil. bahts
Business type	Paper	Glass industry
	Foodstuffs	Ceramic industry
	Textile	Other industries
Financing amount	0.3-1 million bahts/plant	
Interest	10%	
Term/Repayment	within 5 years	

The financing terms for this project are considerably favorable in comparison with those of the common financing organs in Thailand.

The government intends to analize the effect of investment, by grasping the situation of energy use and equipment operation in the subject factories, and comparing them with those in other factories or those prior to investment, and to publish the results.

Also, viewed in the light of an effective application of the governmental funds, it is believed to be an excellent system.

Hereafter, it is desirable to gradually increase the subject factories and industry types.

Also, it is important to hold a series of inspection tours having inspectors see for themselves equipment and it's operational state at the model plants.

Furthermore, at the stage of the financing scale being expanded, the amount of office work for financing and recovery would increase, and in some cases arrears would occur, so the financing affairs portion of the above project would better be entrusted to a certain financing organ.

4.3 Leasing system for energy conservation-related machiens and equipment

(1) Many instances were witnessed at the factories visited, where equipment and meters relating to energy use were superannuated or defective.

Among others, meters are indispensable to grasp precisely the energy use situation which is the basis for energy management, and no effective progress in energy

conservation can be expected without a perfect arrangement of the meters.

As its countermeasures, a leasing system by the government is proposed hereunder, to promote perfection of meters and/or concise and universal energy saving equipment.

For example, a system is considered, where the government-affiliated organs procure instruments in gross and loan them at a low leasing rate at the request of enterprises.

(2) Usually an enterprise must purchase for itself the necessary equipment for its production activity and use it for business, but in that case, raising of funds will be necessary, and a solidification of funds will be inevitable.

If the necessary equipment is procured by leasing, however, raising and solidification of funds could be made free from consideration.

The following points could be quoted as merits of leasing:

A) Rationalization of office management

Office works like orders placement, signing purchase contracts, funds raising, payment of charge, depreciation, payment of insurance fees, etc., accompanying purchase of equipment, will be unnecessary. Such a rationalization of office works, especially emancipation from the fund raising, will be a big merit to the enterprise.

B) Coping with obsoleteness

By squaring the leasing period with the economic life, a technical innovation can be prepared for, alleviating the risk of obsoleteness.

C) Improvement of cost management

Since the expenditures accompanying the leased equipment are only the lease charge payable monthly at an equal rate, the complicated procedures of depreciation, calculation of loan interest, etc. will be unnecessary and the cost will simply and easily be known.

Also, the leasing charge is invariable all through the contracting period, and the risk due to interest rate fluctuations could be avoided.

D) Fund raising is made easy

As compared with loans from financing organs, the strong and weak points of the leasing system are as folows:

Strong points

- Mortgage is not necessary
- Leasing charge can be accounted for a loss

Weak points

- Apparently more expensive than the loan
- No release from the contract is in principle available within the contracting period

Even in consideration of the weak points, the strong points of the leasing system appear to be attractive to the enterprises.

(3) In Japan, taking note of the above merits of the leasing system, a system is installed to lease (or installment selling) necessary equipment or facilities by the local

governments at favorable terms to the enterprises of smaller scale lacking in funds raising capabilities.

The outline is introduced as follows:

Facilities Loan System for Smaller-Scale Enterprises

The system, in place of the smaller-scale enterprises lacking in fund raising capabilities due to shortage in physical mortgages or lacking in expertise necessary to select the type of facilities, would purchase the facilities in the name of public corporations located in the prefectural administratoin body, and would loan them as installment selling to the smaller-scale enterprises.

A) Loan organs

Juridical persons contributed by the local governments (public corporations or associations).

B) Subject enterprises

Those equipped with all of the following factors:

a. In principle, the number of employees should be less than 20.

b. The average profit for the latest couple of years should be less than 10 million yen.

c. Those who are acknowledged to be developing.

d. Those who are adequately conducting facilities control.

C) Loan facilities

They should not be for replacement but for installation of new, advanced facilities, costing less than 20 million yen in total.

D) Method and terms for loans

a. Period for loans

In principle, 4 (four) years and a half (but in the case of special facilities: 11 years and a half). Those who are granted loans are not able to cancel the contract within the loan terms, except in the case of disaster or other irresistible causes.

b. Security

At the time of signing the loan contract, payment of security corresponding to 10% of the facility's acquisition cost is needed.

The security will be returned at the time of final payment of loan charge.

c. Loan charge

Payable as annual, semi-annual or monthly payments. Moreover, 5% of the unpaid amount from the facilities acquisition cost will be paid as rent. Furthermore, upon completion of payment of the loan charge, the ownership of the loaned facilities will be transferred to those who were granted the loan.

d. Guarantor and damage insurance

In principle, a joint surety is needed. In case physical damage is feared to take place, those who were granted the loan should insure the loaned facilities.

e. Remodelling of the facilities, etc.

In case the loaned facilities are to be remodelled, an approval by the loan organ is needed.

Those who are granted the loan should in principle report annually the application state of the loaned facilities.

4.4 Aids for manufacturers, etc. of the energy saving equipment

(1) The aggressive sales activities by manufacturers and importers of energy saving equipment and materials, as well as of energy-applying facilities, stimulate users' interest and serve for promotion of energy saving equipment investment.

At the same time, it is not to be overlooked that manufacturers and private consultants play the important role of an information channel conveying energy conservation technology in the specific fields towards user enterprises.

From these points of view, it is essential that the government gives aids or incentives to these manufacturers, etc., activating research and development together with the introduction of overseas technologies, and advancing performances of equipment, etc.

Such measures lead also to promotion of domestic industries.

(2) Aids for research and development

Same as for those who invest in energy saving equipment, the following measures would be advisable:

A) Granting of subsidies

This is a sytem where, for exmaple, the government announces concrete themes on the research and development specifically and required to be promoted urgently, like specific energy-saving technology, etc., collects research and development projects from private enterprises, and grants subsidies to the projects acknowledged to be the most adequate.

In this case, results of research and development belong to the enterprise who is granted the subsidies, and the enterprise can freely apply the result in principle, but in some cases, the government may direct publication of the result.

Also, as for specific projects, the government from time to time have them pay to the treasury a portion of profits obtained from the results.

The system has an effect on making the private enterprises bold to start research and development, by supplementing shortage in research and development funds and by alleviating the research and development risks.

B) Tax deduction

The outline of the system is to accelerate research and development of enterprises, by deducting the amount corresponding to a certian share of the increment from the juridical person tax amount, in case an enterprise increased its research and development expenditures in a certain fiscal year.

While the granting of subsidies accompanies the government's intervention to the individual research and development projects of enterprises, the tax deduction is of a simple procedure and brings about a free scries of research and development activities, as well as maintenance and security of top secrets.

In the case of tax deduction however, there is no guarantee of whether the amount obtained by the system could eventually be spent for the purpose of research and development.

C) Special depreciation

This is to admit a special depreciation for newly necessitated machinery equipment, at the stage of commercializing the result of research and development, besides the common depreciation.

Even if the research and development would succeed, large amounts of investments will be required to commercialize the result, or the new technologies and/or new products, and the risks in technology and market exploitation are also great. As a result, the developed new technologies sometimes fall short of commercialization. In order to eliminate such cases, this setup is to open the road to utilize the results of research and development and to advance the technical level of the entire nation, by alleviating the risk in commercializaiton through the special depreciation.

Also, apart from this, there is a system to alleviate research and development costs by admitting an accelerated depreciation of facilities (buildings and machinery equipment) for research and development, at the stage of R & D.

D) Preferential financing

As mentioned above, at the stage of commercializing the results of research and development, private enterprises sometimes can not launch cut into commercialization, due to the large amount of funds and the significant risks which accompany it.

This system is to promote commercialization of new technologies and/or new products, hard to be put within the common financing route, by financing the funds necessitated at the comercializing stage and the funds needed to manufature the prototypes, from the government-affiliated financial organs, at a low interest and for a long term.

(3) Approval of energy saving equipment

It goes without saying that, in order to permeate energy conservation widely in the industrial world, it will be necessary to enhance performances of energy-saving machinery equipment and energy-applying facilities.

This system aims at promoting enhancement of performances and propagation of certain energy-saving equipment, etc., by furnishing them with social credit.

Users like smaller-scale enterprises lacking in sufficient technical knowledge, even if they intend to invest in energy conservation project, can not fully trust on the performances of equipment, etc. enough to accept proposals of manufaturers and importers, and the trade talks fail to go ahead smoothly, resulting sometimes in suspension of the necessary investment project.

In order to eliminate such cases, it is desirable for the government to work out the following measures for the energy-saving equipment, etc. which are especially in need of performances upgrading and expected for a wide-range utilization:

a. To obligate an indication of performances in the government-directed format in the catalogs of manufacturers, etc.

b. To set up an official performance standard, and to call for its fulfillment by manufacturers, etc.

c. To approve the equipment, etc. having fulfilled the above standards, based on the sampling test of the products by official inspection organs or the results of quality control state surveys on plants by itself, and to have them posted with labels (or markings) stating that they are the approved equipment.

By doing so, manufacturers will be given a target to strive for, while users will be able to gain an objective performance guarantee by adopting the approved equipment, thus encouraging them to confidently launch the energy-saving equipment investments.

In order for this system to function effectivley, inspection must be fair and inspection capability (equipment, engineers) must be reinforthed.

Also, an elaborate study is needed prior to enforcement of the system because it accompanies such technical problems as,

a. Possibility of advanced equipment with more excellent performance in energy conservation being developed successively in future.

b. Difficulty in settling judgement criteria for other performances than those in energy conservation.

(4) Commendation of excellent equipments

It will serve for promotion of development and propagation of energy saving equipments that the government recognizes the merit of the manufacturer who has developed the equipments/materials, greatly contributing to effective use of energy at the factories, and commends the manufacturer.

Heretofore, in Thailand, the National Research Institute has been commending the excellent results in the fields of research of science and technology and the Ministry of Industry, too, has been commending the factories and/or individuals who succeeded in obtaining excellent results in the fields of public pollution countermeasures and business management. However, no commendation system is installed yet for the energy saving equipments.

Furthermore, if the equipments awarded are made widely known among the users wishing to invest in energy saving equipments through displays at exhibitions, introduction in magazines, labels posting, etc., the effect of the system would further be heightened.

An outline of the commendation system now executed in Japan is introduced hereunder for reference. This system has been enforced since 1980, and 62 equipments have so far been commended.

Commendation System for Excellent Energy Saving Equipments

A) Purpose

Promotion of dissemination and development of excellent energy saving equipments.

B) Promoter

The Japan Machinery Federation

C) Subject of commendation

a. Subject equipments

Excellent energy saving equipments for use in industry developed and put in practical application approximately within 3 years.

Here the term "equipments" include the following:

— Devices, facilities and systems

— Meters, etc. contributing to energy conservation

— Waste, refuse, methane gas, rice hull, etc.—applying equipment

b. Subject enterprises

Enterprises or enterprise groups which have developed and put to practical use the above equipments,and are recognized to be contributing to promote effective use of energy.

D) Method of screening

a. Selection will be made at a screening committee from among the equipments recommended by the following organizations:

— Mechanical industry-related organizations and institutes

— Energy-related organizations and institutes

— Energy equipments user's organizaitons

— Public testing and research organs

b. Evaluations will be made for each of the following evaluating factors, and the results will be considered synthetically to lead to the final judgement:

— Having originality

— Promoting effective use of energy

— Being excellent in the economic aspect

— Being prospective in a considerable amount of propagation

— Ensuring safety

E) Method of commendation

a. Kind of commendation

The Minister of International Trade and Industry Prize (Reserved only for exceptionally excellent ones)

The President of Japan Machinery Federation Prize

b. Time of commendation

February, every year (Energy Conservation Month)

In addition to the above, the Energy Conservation Center commends the equipments acknowledged to be exceptionally excellent from among those displayed at the Energy Conservation Exhibition held by the Center in February every year.

5. On Establishment of the Energy Conservation Center

5.1 Moves up to foundation

Establishment of an Energy Conservation Center (hereinafter referred to as Center) in the Kingdom of Thailand was quoted as one of the execution plans for energy conservation projects in the industry and transportation sectors within the Fifth National Economic and Social Development Plan. Later, the founding was approved at the Joint Public/Private Sector Consultative Committee chaired by the Prime Minister, and a concrete series of preparations is now being promoted, centering on creation of the founding committee, etc.

Furthermore, prior to the project, the Energy Conservation Center was set up, as a sector of the Energy Economics Division, NEA, in 1981, and substantial activities, like plant diagnoses, information supplies, seminars, demonstrations, started. Thus it substitutes major portions of the above Center's functions, and prepares for a smooth starting operation upon inauguration of the above Center.

5.2 Outline of the Center project

According to the documents of NEA in June, 1983, outline of the Center project runs as follows:

(1) Purpose

a. Establishment of a free organization to execute energy conservation measures of the Government.

b. In order to promote energy conservation, to aid for both government and private sectors.

c. To motivate industrial and other sectors with energy conservation.

(2) Characteristics

In spite of its being under government control, the organization should be independent or semi-independent from the Government, due to the following reasons:

a. Supplies of basic technology could be made by the Government, but the same of high grade technology require well-experienced staff. Such staff are scarce within the Government, and it is difficult to employ many of them as public officials, in terms of wages and personnel control.

b. Some of the operational fields of the Center call for flexibility, but there are many rules and regulations in government and they are subject to restraint.

c. In the case of private organizations, the profit gained could be used as funds for expansion.

(3) Scope of services

a. Plant diagnoses, improvement guidances and consultations.

b. Information supplies to both the government and private sector (printed matter, exhibitions, demonstrations and seminars).

c. Academic study, technical research/foreign technology surveys.

d. Academic consultations for the government sector/advises and reports to the NEA.

e. Public relations for common people.

f. Training of staff in both the official and private sectors.

g. Evaluation and approval of machines and equipment.

(4) Organization and management

a. It is managed by the Management Committee taking responsibility of management and control of the Center.

b. Three departments of Research and Survey Dept., Service Dept. and Administration Dept. are to be installed. Number of employees in ten years after from now will be 42, of which 26 will be engineers.

c. A Steering Committee is to be installed as advisory and supervising organ.

(5) Finance

a. The state grants 40 million bahts as funds, or offers 7 million bahts/year for 10 years as subsidies.

b. The private sector contributes 2 million bahts in 10 years as funds for the fixed assets like facilities.

c. As membership fee revenues 0.6 million bahts/year for the starting year, and 8 million bahts/year for the 10th year, totaling 39 million bahts in 10 years, are slated to be collected from the member firms.

d. The servicing revenues like from diagnostic guidances and others account 0.47 million bahts for the initial year and, gradually increasing annually, 7.5 million bahts in the 10th year, totaling 36.59 million bahts in 10 years.

e. It expects technical and academic subsidies amounting to 70 million bahts from international organs and foreign governments.

f. Under the circumstances, a cash balance of 31.70 million bahts is estimated in 10 years from now.

5.3 Points to pay attention for management of the Center

The conception of founding the Center is decided as shown in the foregoing clause, so the points to pay attention for management of the Center only are covered herewith.

(1) Acquisition of firms' trust

Major services of the Center are to support energy conservation activities of the enterprises indirectly through its supplies of information in various forms. Accordingly, it could never exist unless the firms or enterprises trust it and make use of it positively. Point to acquire confidence or reliance of the enterprises are something like the following:

A) Guarantee of fairness

Activities of the Center are based on justice and neutrality. On the other hand, it is required to pay attention not to leak the confidential matters to others which could be known from the client firms.

In order to guarantee this to others, it will be necessary to oblige staff members or consigned diagnostic instructors of the Center in observation of the office regulations or contracts to keep a secret.

B) Close tieups with firms or enterprises

a. A planning committee will be installed consisting of influential engineers among member firms, thereby collecting needs of firms or enterprises, which will be references in planning new projects. The committee will not deal with surveillance or advices on management like management committee and steering committee, but will discuss the more concrete project details and will propose professional ideas.

b. Offer occasion of technical information exchanges for engineers

It is desirable that, although technical know-hows on manufacturing are the firm's confidential matters, the common portions touching only energy conservation should freely be exchanged information beyond the company's boundary and should be studied. Within the industry of Thailand, no technical committee like the one in Japanese industry is installed, so a study meeting would be created within the Center to assemble engineers deeply interested in energy conservation technology, and to form a workshop of technical exchange for company engineers. The meeting would be pivoting around the above planning committee for the initial stage, and as the number of engineers grows, it will be divided into specific subgroups, gradually digging into specialized research.

c. The Centre should induce eagerly the enterprises to be supporting members, and literatures featuring informations wanted by firms or enterprises should be periodically distributed.

C) Acquisition of appreciation of firms by actual results

It is important to accumulate records of serving greatly for plant energy conservation by contacting the Center and to obtain the high evaluation of enterprises.

a. Capable engineers will be employed as staff members of the Center. The engineers should not only be well-versed in theories but also have experiences of being engaged in services of operation supervisor or facilities construction for plants. Furthermore, after their assignment in the Center, they should be levelled up of their technical know-hows, by training overseas, etc. At the same time, salaries and other remunerations should not be inferior to those of private enterprises, in order not to be scouted off to these private firms easily. This also is related with the maintenance of justice in the clause of (1)A), and it will be necessary to bind them with contracts and others.

b. The number of staffs in the Center is limited, while the technology is of a wide range and specific, respectively, so engineers will be organized from among those who attend the study meeting stated in the above clause B)b, and the engineers are to be advisors for the Center anytime. Also, the consultants, registered on the Government list, and shown in the clause of promotion of facilities introduction, should be applied in practice.

c. University professors who are interested in energy conservation technology should also be organized and they will be advisors for consultation matters on the part of study meetings and firms or enterprises.

d. Information should be piled up as much as possible, and a system to rapidly offer

them at times of need should be arranged. Domestic information will be more persuasive, but introduction of foreign technology would also be important.

D) Chances of conferences between the government and company managers should be supplied jointly with the Association of Thailand Industry and, by frank and candid exchanges of requests and views of both parties, a smooth progress of the government policies will be realized. By so doing, the firms or enterprises would come to recognize that the Center is not the Government itself, but is an organization representing interests of firms or enterprises.

(2) Health of finance

In order that the Center would develop itself in business in a stable manner for a long term, it should maintain a healthy finance. Although the Center obtains partially the Government subsidies, it is to basically manage its business expenses by revenues from services and membership fees. In general, an enterprise tends to willingly pay money for hardware, but is reluctant to spend anything for software. The Center is the first semi-official, semi-private Thai organization based on the revenue from supply of technical information, and it appears to require considerable efforts to render its finance healthy.

A) Security of stable revenues

a. As the biggest revenue for the Center, the membership fee revenue is estimated, coming to 36% of the total revenue in the last fiscal year. In the case of the Japanese Energy Conservation Center, the share of membership fee revenues is 24% of the total revenue, excluding the subsidy. It is known, accordingly, that dependency on the membership fee of the Thai Center is very high. The supporting membership fee for the Japanese Energy Conservation Center is differentiated according to the plant scale as shown below, and the average membership fee per capita comes to some 60,000 Japanese yen, taken from 3/4 of the designated plants.

— Fuel-applying Plants:

Special class — ¥100,000 — Plants consuming fuel (in crude) of 60,000 kl/year or more.

First class — ¥80,000 —	The same of 30,000_60,000 kl/year.
Second class — ¥60,000 —	The same of 3,000–30,000 kl/year.
Third class — ¥40,000 —	The same of 3,000 kl/year or less.

— Power-applying Plants:

Special class — ¥100,000 —	Plants applying the maximum power of 10,000 kW or more.
First class — ¥80,000 —	The same of 5,000–10,000 kW.
Second class — ¥60,000 —	The same of 2,000–5,000 kW.
Third class — ¥40,000 —	The same of 2,000 kW or less.

In the case of Thailand, although the plan says nothing in detail, if the membership fee is set at 4,000 Bt/year, the budget expects eventually entries of 2,000 plants. At the present, supposing that there are 2,600–2,700 plants consuming 1,000 kl/year or more of oil or 500 kW or more of power, it would not necessarily be easy to

secure so many members by the free will entry system, though it depends on the growth speed of the number of plants hereafter.

At times of membership canvassing, the merit of being a member is often talked about.

In order to increase the number of members, basically, evaluation of service will be an important factor, as was stated in the above clause (1)C), but at the same time, it will be necessary to feature privilege of receiving periodicals and reduction of participation fee to the Center projects.

b. Energy conservation is an effective measure for cost-down for an enterprise, but the problem is that the enterprise who does not know or has no interest in the fact does not intend to seek information positively.

As a result, such a policy in which the Government strongly advises the enterprises to undergo plant diagnoses every 3 years, and — that engineers in charge of energy control attend the Center's seminars every year and exchange views by briefing instances, etc., is considered. These projects could be a policy welcome by enterprises, by supplying useful information to the enterprises, and by recommending persons selected from among the diagnosed firms and seminar participants to the state commendation candidates.

If these projects could be carried out by the Center charging fee, the Center could secure stable revenues.

On the other hand, the Korean Energy Management Corporation is also conducting boiler inspections. In the case of the Kingdom of Thailand, the task is carried out by the Ministry of Industry. Though talking over with M.O.I. will be required for following the pattern, but undertaking the supplementary job would be an effective method for the Center to secure a certain amount of profit, since it is business consignable to private organization.

B) Supression of the fixed expenses

At the initial stage of the Center's inauguration, it will be required to take care particularly that the fixed expenses not be excessive. In order that it is better that permanent employees should be compressed as less as possible, the Center staff would mostly deal with planning and control of projects, and execution mostly be consigned to outside agents. This coincides with the principle quoted in the clause (1)C).

For example, concerning research, the Center's committee would examine their themes, schedules, budgets, etc., the execution would be consigned to institutes or laboratories, universities or colleges, or private enterprises, according to the themes, and would control the progress.

Regarding the diagnostic guidance, it should also partially be executed by adding outside engineers.

Seminars and training should be scheduled annually arranging with the relevant organs, and a portion should be consigned to organs equipped with rooms for holding seminars and experienced to manage. The attendance cards, however, should uniformly be issued by the Center.

In the meantime, execution know-how should be accumulated, and the share of its proper execution should gradually be increased as the Center's management grows up.

C) Diversification of business

According to the Center project booklet, the service revenues come totally from diagnostic guidances. The number of factories starts from 31 a year, growing gradually up to 250 a year, and finally it is estimated to total some 1,400 factories after 10 years.

However, if it is not for such a powerful advice of the Government as stated in the clause (2)A)b, it would be dangerous to expect too much from diagnostic projects.

In the case of Japan, the number of factories willing to under-go charged diagnoses is extremely small, due to the following reasons:

a. Big enterprises are full of engineers, needing no outside guidance.

b. For the smaller-scale enterprises, the Energy Conservation Center and the local autonomous governments conduct diagnoses free of charge with state subsidies.

c. Equipment manufacturers of furnaces, etc. conduct diagnoses free of charge and offer estimate for improvement work as their sales campaign to obtain orders.

Although the situation in Thailand differs from that in Japan, it will require considerable amount of canvassing effort to seek for payment against software services like diagnoses. Also, competing enterprises could come to the fore, if such services could be found to make money.

Furthermore, after permeation of common measures like condensate recovery, it is now assumed to transfer to specific energy conservation measures by industries or factories. It must be remembered that in such a case correspondencing capacity of the Center proper engineers tends to be limited. Accordingly, needed are:

a. To positively conduct campaigns, showing instances of previous effective diagnostic guidances.

b. As energy conservation advances at enterprises, engineers should be trained to cope with higher grade diagnoses.

c. To extend projects like seminars and training, publication, etc., separately from diagnostic guidances.

D) Business coordinations with other organs

Most of the projects like seminars, etc. which the Center is about to hold are executed by the government and foreign organs free of charge, and, in the case of the Center, they should be charged to manage their expenses. If it goes as it is now, the pursuit of the Center's projects will also be hampered. So as was stated in the clause (2)B), business coordinations should be carried out with these organs to make rule that the budgets of nations and other foreign assistances related with these projects come to the Center directly.

E) Others

Adoption or not of advice at the time of diagnostic guidances, and their practices, are the responsibility of the enterprises, and it is required to clarify that, even if the result proves to be no good, the responsibility will not affect the diagnostic instructors.

Moreover, with the diagnostic projects, there is a possibility of producing accidents (physical accidents of diagnostic instructors or plant facilities damage due to faults of diagnostic instructors), and it is necessary to care for insurance coverage on these accidents or damages.

5.4 Outline of the Japanese Energy Conservation Center (Reference)

(1) Established: October, 1978

(2) Foundation Fund: 500 million Japanese yen

(3) Organization and personnel: (See the Chart below)

(4) Organization of Headquarters

— Administration Dept. = coordinations, basic policy of business operations, personnel, salaries, welfare, supporting members, commendation, etc.

— Public Relations Dept. = Lecture meeting, exhibitions, posters and pamphlets.

— Education and Training Dept. = Energy manager training, seminars and symposiums.

— Publication Dept. = Publication of "Energy Conservation" magazine, books, periodicals, and "Energy Conservation Pocketbook".

— Technical Dept. = Preparation of practice guidepost based on standard for judgement, examination and certification regarding taxation, approval of energy conservation equipment, service consigned of energy conservation technology, energy diagnostic guidance, and consultations over energy control technology.

— Research Dept. = Collection of information on energy conservation, analyses and supplies of the same, perusal service of books, materials and others, surveys consigned of energy conservation.

— International Cooperation Dept. = Promotion of energy conservation overseas, participation in the IEA's meetings, dispatching and accepting overseas inspection missions

— Examination Dept. = National Examination for energy managers, course of lectures for qualifying energy managers.

(5) Budget (FY 1984)

(Unit in thousands of Yen)

(Revenue) Account	Budget	(Expenditure) Account	Budget
Fund Interest	(37,740)	Projects	(385,935)
		Consigned project	75,001
Projects	(549,736)	Other projects	310,934
Consignment	75,001	Subsidized projects	(214,701)
Other projects	474,735	Examination projects	(39,000)
Membership fee	(213,500)	Management	(403,488)
Subsidies	(164,327)	Personnel	275,974
Examination fee	(39,000)	Office work	127,514
Miscellaneous	(44,000)	Reserves	(5,000)
Interest due	42,000		
Miscellaneous takes	2,000		
Total	1,048,303	Total	1,048,124

No. of Staff:

Directors (full-time)	6
Staff at Main Office	29
Staff at Branches	27
Non-regular Staff	4
Total	66

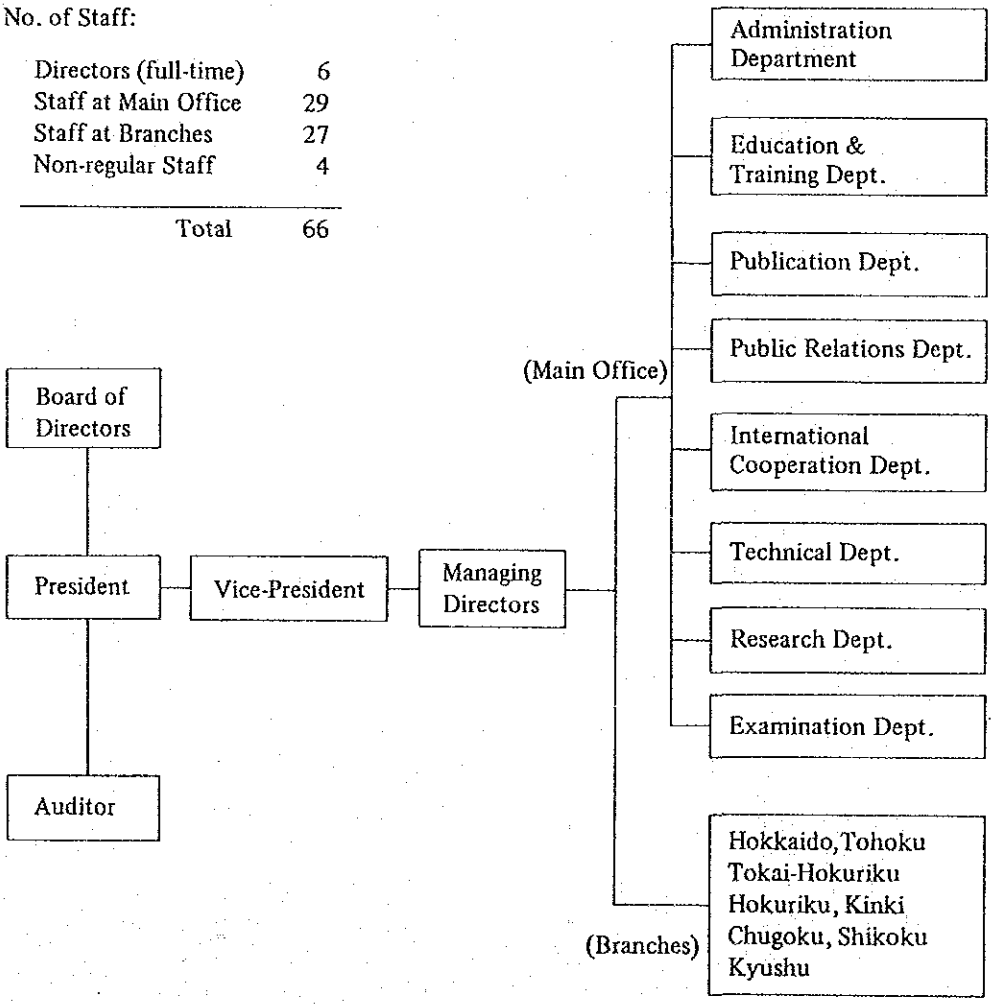


Fig. IV–1 Organization chart

(6) Supplementary explanations

A) The Energy Conservation Center in Japan started operations in 1978, but the services of its Education and Training, Publication, and Technical Departments are mostly inherited from the Thermal Energy Technology Association (dissolved following inaguration of the Energy Conservation Center) in terms of services and personnel. Accordingly, as to the services contributing to profits of the Center, a considerable amount of basis had been secured since its inauguration, and almost all of the supporting members, too, were inherited therefrom to assist the smooth start.

B) Out of 66 permanent staff officers, 25 staff attached to the Center are salaried by the member company respectively. It would be difficult for the Center to cover all of the personnel fee from the profit.

Company dispatching these staff attached to the Center are the energy suppliers or major consumers, like (electric) power, city gas, oil, steelmaking, chemical, paper companies, etc., as well as manufacturers of energy conservation equipment like industrial furnaces and steam traps, etc. All of these enterprises are dispatching their personnel, not for their own firms' interests, but for their standpoint of practically cooperating with the national policy.

C) Subsidies taking some 15% of the revenue of the Center are to be used for non-profit-making projects, like smaller enterprises diagnostic guidances, training and advertisements for general public, etc., and are not contributing directly to the profits of the Center. These subsidies are paid for direct expenses necessitated by the subsidiary projects, and the personnel fee and other indirect expenses of the Center to conduct these projects are not included. In addition, some subsidiary projects are to be covered by the Center for 1/2 to 1/4 of the project expenses. Seen as a whole, therefore, nearly 1/2 of the subsidiary revenue is now compensated from the profit-making sectors of the Center.

6. Conclusion

Same as in the case of energy conservation measures within the enterprises, many common points and similarities are recognized in the energy conservation measures taken by the governments.

All of the items proposed above are already executed in whatever type possible in several countries, and are not new concepts. In fact, some of them are adopted as operation items in the 5th National Economic and Social Development Plan of Thailand.

Problems, however, are that these basic measures are not brought in practice, or even if they are in practice, they are still insufficient in Thailand.

The abovementioned proposals are thought necessary to be rapidly put into practice, but founding the above systems and organs is only the first step to promotion of energy conservation.

Coping with the progress of energy conservation technology and the transition of energy situation, these varied systems should effectively be operated, and it would require many years to take a remarkable energy conservation effect in industrial sectors, thus it must finally be stressed above all on the importance of the government's lasting zeal and concern on energy conservation.

V. Attached Data

Contents

SCOPE OF WORK
FOR
THE STUDY
ON
ENERGY CONSERVATION PROJECT
IN
THE KINGDOM OF THAILAND
AGREED
BETWEEN
NATIONAL ENERGY ADMINISTRATION
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Dated: 25 March, 1982

For Japan International
Cooperation Agency

Junsaku Koizumi
Director, Industry Division
Mining and Industrial Planning
Survey Department
Japan International Cooperation Agency

For National Energy
Administration

Pravit Ruyabhorn
Secretary-General
National Energy
Administration

I. BACKGROUND

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan dispactched a preliminary survey team headed by Mr. Junsaku Koizumi from 18 to 27 March, 1982, following the first energy conservation mission in March 1981, through the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation of the Government of Japan, to carry out the preliminary survey for the study on the Energy Conservation Project in the Kingdom of Thailand (hereinafter referred to as "the Study") and to discuss the scope of work of the Study with the National Energy Administration (hereinafter referred to as "NEA").

The Study will be conducted under "the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand"

II. OBJECTIVE OF THE STUDY

The objective of the Study is to contribute to the promotion and strengthening of energy conservation program in the field of manufacturing industry in the Kingdom of Thailand.

III. SCOPE OF THE STUDY

1. The Study is to be conducted from the following points in mind.

   (1) rationalization of fuel combustion

   (2) prevention of heat loss by radiation and conduction

   (3) recovery and reutilization of waste heat

   (4) prevention of electricity loss by resistance, etc.

   (5) rationalization of conversion of electricity into power, heat, etc.

2. Items to be covered by the Study

   (1) To collect data and information on current energy situation in the industry sector in Thailand.

   (2) To conduct surveys at various manufacturing factories (hereinafter referred to as "the Factory Surveys").

      (i) Detailed items of the Factory Surveys are attached in Annex I.

      (ii) Names of the factories to be surveyed are attached in Annex II.

   (3) To formulate a draft of standards for rationalization of energy use based on the Factory Surveys (hereinafter referred to as "the Draft of Standards") The Draft of Standards is clarified by type of industry in the field of manufacturing industry.

   (4) To recommend measures (e.g. taxation system, subsidy system, organization, etc.) to promote energy conservation (hereinafter referred to as "the Recommendation of Measures") in the field of manufacturing industry.

3. Phase of the Study

   The Study shall be conducted dividing into following two phases.

Phase I : to cover the above 2.(1) and (2)

Phase II : to cover the above 2.(3) and (4)

The schedule and details of the Study for the Phase II will be agreed upon after the full discussion between the Japanese review team and NEA on the result of the Phase I.

IV. TENTATIVE TIME SCHEDULE OF THE STUDY

As per attached in Annex III.

V. REPORTS

The Japanese study team will prepare the following reports in English and submit them to NEA.

1. Phase I

   (1) Report on the first Factory Surveys (30 copies)

   (2) Report on the Second Factory Surveys (30 copies)

   (3) Report on the third Factory Surveys (30 copies)

   (4) Summary Report on the Study of Phase I (30 copies)

2. Phase II

   (1) Draft Final Report (30 copies)

   (The Draft Final Report contains the Draft of Standards and the Recommendation of Measures.)

   (2) Final Report (50 copies)

VI. UNDERTAKING OF THE GOVERNMENT OF THAILAND

1. To provide the Japanese study team with all relevant data, information, reports and materials necessary for the execution of the Study.

2. To arrange the Japanese study team's visit to the factories to be surveyed and relevant autorities concerned.

3. To exempt the Japanese study team and its members from taxes and duties on the materials, equipments and personal effects brought into the Kingdom of Thailand by the Japanese study team.

4. To exempt the Japanese study team members from income taxes and charges of any kind imposed on or in connection with the staying expenses remitted from abroad.

5. To assign the counterparts to the Japanese study team during the Study period.

6. To provide the Japanese study team with suitable office with necessary office equipments.

7. To provide the Japanese study team with necessary facilities and means for the Study, such as vehicle, etc.

8. To provide the security for the Japanese study team members and to provide them with medical service during the staying period.

VII. UNDERTAKING OF THE GOVERNMENT OF JAPAN

1. To dispatch the study team to Thailand to undertake the Study.

2. To transfer the technology related to the Study for the Thai counterparts through their participation in the Study.

Annex I

Items of the Factory Surveys

Annex II

List of the Factories to be surveyed

MINUTES OF MEETING
ON
SCOPE OF WORK
FOR
THE STUDY
ON
ENERGY CONSERVATION PROJECT
IN
THE KINGDOM OF THAILAND

Dated: 26 March, 1982

For Japan International Cooperation Agency

Junsaku Koizumi
Director, Industry Division
Mining and Industrial Planning
Survey Department
Japan International Cooperation Agency

For National Energy Agency

K. Bejraputra

Kriengkorn Bejraputra
Chief, Energy Policy Section
Regulatory Division
National Energy Administration

MINUTES OF MEETINGS

The Japanese Preliminary Survey Team sent by the Japan International Cooperation Agency (JICA) and the National Energy Administration (NEA) had a series of discussions for a period of 5 days (March 19 - March 25 th) on "the Scope of Work for the Study on Energy Conservation Project in the Kingdom of Thailand" (the Scope of Work) signed on March 26th, 1982 at NEA.

In that connection, the following are the main subjects mutually discussed and understood.

I-1 NEA strongly requested to be donated:-
(1) necessary instruments for the Factory Surveys as mentioned in the Terms of Reference, and
(2) training materials.

I-2 Japanese Preliminary Survey Team (Team) stated that Team was not in a position to comment on the above matters, however, promised to convey NEA's request to the Government of Japan.

II-1 NEA strongly requested training of several counterparts of the Study in Japan.

II-2 Team promised to convey NEA's request to the Government of Japan even though Team was not in a position to comment.

III-1 NEA proposed to add more detail items to the III-2-(3) and III-2-(4) of "the Scope of Work".

III-2 Team agreed that detail scope of the Study for phase II (III-2-(3) and III-2-(4) of "the Scope of Work") could be discussed when the Japanese review team visited Thailand as mentioned in "the Scope of Work".

IV Team explained that concept of the Factory Surveys was as follows:

(1) to grasp the current energy use,
(2) to extract the problems, and
(3) to recommend the counter-measures against the problems at the factories.

V-1 Team requested NEA to the necessary arrangements so that effective cooperation to the Japanese Study Team could be secured at factories concerned.

V-2 NEA agreed to take necessary arrangements such as issuing to the factories concerned letters with purposes of the Japanese Study Team's visit in order to obtain permission of the survey at factories and other necessary measures.

MINUTES OF MEETING

ON

THE REPORT OF FACTORY DIAGNOSES

AND

CONTENTS OF PHASE II STUDY

FOR

ENERGY CONSERVATION PROJECT

IN

THE KINGDOM OF THAILAND

Date : 26 Jan. 1984
Place : Bangkok

For Japan International
Cooperation Agency

Mitsuo Iguchi
Team Leader
Energy Conservation Project
Japan International Cooperation
Agency

For National Energy
Administration

Dr. Itthi Bijayendrayodhin
Director
Energy Economics Division
National Energy Administration

JICA dispatched a Team from 18th to 27th January 1984 in accordance with "The Scope of Work for the Study on Energy Conservation Project in the Kingdom of Thailand" (hereinafter referred to as "the S/W") signed on 26th March, 1982.

The team had meeting with NEA during its stay in Bangkok on the Reports of Factory Diagnoses and on the contents of the Phase II Study.

The points confirmed by both parties (attendants is shown in Annex III in the meeting are as follows:

I. The Factory Diagnoses under "the S/W-Phase I" was completed, NEA acknowledged the contents of 1st - 3rd Reports and their Summary Report, and received the Reports above.

II. "The Draft of Standards" and "The Recommendation of Measures" in "the S/W-Phase II" will be prepared according to Annex I and II. However, the word of "Standards" in "The Draft of Standards" will be revised to "Guidelines" in consideration of the contents.

III. The schedule of Phase II will be as follows:

(1) To dispatch 7-member Study Team for collection of information for 18 days in March.

(2) To dispatch 3-member "Draft Final Report Presentation Team" in October.

(3) To submit the Final Report in December.

Annex I

Outline of "the Draft of Standards"

Chapter of Metal Industry (Example)

1. Introduction
   Subject
   Character

   Content

2. Characteristics of energy use in metal industry

2.1. Major manufacturing process and equipment
2.2. State of energy use

3. How to develop energy management

3.1. Clarification of management policy
3.2. System with participation by all employees
   Committee/organization
   Improvement suggestion system
   Small group activities
   Education
3.3. Control through operation data
3.4. Leveling-up of factory management
   Production control
   Quality control
   Equipment control
   Preparation of operation standards

4. Rationalization in use of heat energy

4.1. Basic items

4.1.1. Burner control
4.1.2. Combustion calculation
- Fuel
- Air ratio
- Exhaust gas loss

4.1.3. Heat release calculation
- Heat release from flat surface
- Heat release from pipe surface
- Character of insulation material/refractory material
- Economical thickness of insulation

4.1.4. Boiler
4.1.5. Steam utilization
- Nature of steam
- Piping
- Trap
- Condensate recovery
- Flash steam

4.2. Furnace of heavy oil burning type
4.2.1. Characteristic factor chart
4.2.2. Burner
4.2.3. Hot charge
4.2.4. Improved heat conduction in furnace
4.2.5. Heat insulation
4.2.6. Waste heat recovery
4.2.7. Target for improvement
4.3. Lead bath furnace/zinc bath furnace
4.4. Casting process

5. Rationalization in use of electric energy

5.1. Basic items
5.1.1. Electric power charge system
5.1.2. Power factor
5.1.3. Peak demand

5.1.4. Transformer
- Kind/ characteristics
- Installation (capacity,location,connection)
- Operation
- Maintenance

5.1.5. Electric motor
- Kind/characteristics
- Characteristics change by load
- Operation
- Conduction belt

5.1.6. Lighting
- Illuminance
- Light source
- Fitting
- Operation

5.1.7. Fluid transportation
- Necessary power
- Power conservation
- Rotation control

5.2. Resistance furnace

5.3. Arc furnace

5.4. Induction melter

5.5. Frequency converter

5.6. Machine process

6. Points to be attended to in case of revision of standards

Outline of " the Recommendation of Measures "

Views After Field Study	Necessary Action	Concrete Countermeasures	Measures by Government	Measures by Others
1. The management have not sufficiently grasped concrete management method for energy conservation promotion. Although the management's concern with energy conservation and their recognition of the necessity are high, they are not able to connect to effective action.	Motivation of the management and the managers to energy conservation.	(1) Promotion of enlightenment activity		
		o Conventions announcing successful cases		o
		o Seminars and lecture meetings		o
		o Study visits to domestic and overseas excellent factories		o
		o Printed media such as pamphlets		o
		(2) Commendations		
		o Commendation of excellent factories	o	
		o Commendation of excellent cases	o	
		(3) Obligation of recording and reporting the state of energy use Factories using energy more than a specified amount are subject to this obligation by law, regulations,etc.	o	
2. Energy management technology of the enterprises is generally not sufficient. o Shortage of technical staff o Insufficient knowledge of energy management technology and of scientific management method o The system of participation including all employees is not established	Fostering technical staff, and repletion of education of technical staff and general employees.	(1) Repletion of various training courses,etc.		
		o Training courses and seminars		o
		o Correspondence course		o
		o Conventions announcing successful cases		o
		(2) Factory diagnosis and guidance Circuit diagnosis and guidance of factories by mobile teams		o
		(3) Technology exchange study meeting Exchange of experience and information, and mutual study by groups organized in each kind of industry		o
		(4) Promotion of technology development	o	
		(5) Commendation of excellent engineers	o	
		(6) Creation of State qualification system for energy manager	o	

Views After Field Study	Necessary Action	Concrete Countermeasures	Measures by Government	Measures by Others
3. The management's volition for investment is not keen. Some of the equipment is superannuated.	Arrangement of the conditions for energy saving equipment investment.	(1) Setting up taxation system favorable to energy saving investment		
		o Exemption from or reduction of custom duties on imported energy saving equipment	o	
		o Accelerated depreciation, and tax reduction on energy saving investment	o	
		o Reduction of fixed assets tax	o	
		(2) Setting up low-interest loan system for energy saving investment	o	
		(3) Fostering domestic manufacturers of energy saving equipment, maintenance companies, and consultants	o	
		(4) Energy saving equipment exhibitions		o
		(5) Commendation of excellent equipment	o	
		(6) Creation of leasing system of energy measuring instruments		o
		(7) Subsidy to model factories	o	
4. Generally, exchange of energy technology information is insufficient. Also, central body for energy conservation promotion is not organized.	Repletion and strengthening of promotion activities such as comprehensive enlightenment and collection/distribution of information.	(1) Establishment of non-governmental organ specifically for the promotion of energy conservation	o	o

Annex III.

List of Attendant Members

(Japanese Side)

1)	Team Leader Mitsuo Iguchi	Managing Director The Energy Conservation Center, Japan
2)	Yoshito Yoshimura	Chief, Technology Section, Energy Conservation Policy Division, Natural Resources and Energy Agency, Ministry of International Trade and Industry
3)	Shinya Nakai	Deputy Head, Industry Division, Mining & Industrial Planning and Survey Department, Japan International Cooperation Agency
4)	Teruo Nakagawa	Manager, International Cooperation Department, The Energy Conservation Center, Japan
5)	Toshio Sugimoto	Registered Diagnoser, The Energy Conservation Center, Japan

(Thai side)

1. Itthi Bijayendrayodhin

   Director, Energy Economics Division

   National Energy Administration

2. Pravit Teetakeaw

   Chief Energy Conservation Center

   National Energy Administration

3. Mingsak Tangtrakul

   Head,Energy Audit (Heat) Section

   Energy Conservation Center

   National Energy Administration

4. Pramoul Chanpong

   Head, Energy Audit (Electricity) Section

   Energy Conservation Center

   National Energy Administration

Survey Team Members

First Survey

Part		Name
Leader		Mr. Masakazu Uc
Deputy Leader		Mr. Mitsuo Iguchi
Ceramics · Glass Group	Heat	Mr. Mazumi Ito
	Heat	Mr. Yoshio Ohno
	Power	Mr. Toshio Sugimoto
Paper Group	Heat	Mr. Akira Koizumi
	Heat	Mr. Kaoru Nakao
	Power	Mr. Kenichi Kurita

Second Survey

Part		Name
Team Leader		Mr. Mitsuo Iguchi
Textile Group	Heat	Mr. Kaoru Nakao
	Heat	Mr. Yoshio Ohno
	Power	Mr. Motoki Matsuo
Metal Group	Heat	Mr. Teruo Nakagawa
	Heat	Mr. Toshio Noda
	Power	Mr. Kenichi Kurita

Third Survey

Part		Name
Team Leader		Mr. Mitsuo Iguchi
Chemical · Plastic Group	Heat	Mr. Hiroo Igarashi
	Heat	Mr. Hiroshi Murata
	Power	Mr. Kenichi Kurita
Food Group	Heat	Mr. Akira Koizumi
	Heat	Mr. Shiroo Honda
	Power	Mr. Yuuji Kaneko

Fourth Survey

Part	Name
Leader	Mr. Takashi Niikura
Deputy Leader	Mr. Mitsuo Iguchi
Heat	Mr. Hiroo Igarashi
Power	Mr. Yuuji Fukuma
Laws · Administration	Mr. Tadashi Ohshiro
Laws · Administration	Mr. Kiichi Takahashi
Laws · Administration	Mr. Isamu Nakamura

Survey Counterparts

(1) First Survey

Part	Name	Organization
Ceramics· Glass Group	Mr. Pramoul Chanpong	NEA
	Mr. Danai Egkamol	NEA
	Mr. Supachok Kusolsong	NEA
	Mr. Banphot Diskul	NEA
	Mr. Derake Wuthichok	MOI
Paper Group	Mr. Mingsak Tangtrakul	NEA
	Mr. Supon Khwankongrai	NEA
	Mr. Adisai Pornchai	NEA
	Mr. Tummasak Suwanathep	NEA
	Mr. Tawathai Titivudtiwong	MOI

(2) Second Survey

Part	Name	Organization
Textile Group	Mr. Danai Egkamol	NEA
	Mr. Pinyo Tonthumas	NEA
	Mr. Banphot Diskul	NEA
	Mr. Thongdee Benjamongkon	NEA
	Mr. Umporn Koonchonrat	NEA
	Mr. Derake Wuthichok	MOI
Metal Group	Mr. Supachok Kusolsong	NEA
	Mr. Supon Khwankongrai	NEA
	Mr. Thumasak Suwanadhep	NEA
	Mr. Chadcharachai Teeraslip	NEA
	Mr. Tawatchai Titivudtiwong	MOI

(3) Third Survey

Part	Name	Organization
Chemical · Plastic Group	Mr. Danai Egkamol	NEA
	Mr. Pinyo Tonthumas	NEA
	Mr. Pichai Nitinon	NEA
	Mr. Boonyong Juengthanawiwat	NEA
	Mr. Nattavut Suanin	NEA
	Mr. Derake Wuthichok	MOI
	Mr. Thumasak Suwanadhep	NEA
	Mr. Wicha Thongsuk	NEA
	Mr. Somkid Aoluknua	NEA
Food Group	Mr. Supachok Kusolsong	NEA
	Mr. Supon Khwankongrai	NEA
	Mr. Somjet Junsawang	NEA
	Mr. Sakon Bhutachart	NEA
	Mr. Tawatchai Titivuatiwong	MOI
	Mr. Surapong Bhiraleus	MOI
	Mr. Sirichai Savangmongkol	MOI
	Mr. Banphot Diskul	NEA
	Mr. Umporn Koonchonrat	NEA
	Mr. Buranachai Cutchon	NEA

The Names of the Diagnosed Factories

First Survey (19 factories)

Name of factory	Product
(Ceramic/Glass)	
Bangkok Glass Industry	Glass bottle
Samutprakan Glass Industry	"
Thai Neutrarn Glass Industry	Cup, Ashtray
Asia Glass Industry	Cup, Glass
Union Mosaic Industry	Tile
Thailand Tile and Pottery	"
Super Fibre Cement	Slate
APA Industry	Injection ampul, Tube
Siam Insulator	High-tension insulator
Armitage Shanks (Bangkok)	Sanitary Ware
(Paper)	
Hiang Seng Fibre Container	Paper
Thai Develop Paper	"
Card Board (Thailand)	"
V. Sang Thai Paper Faotory	"
Industry Krungthai	"
Arkanae Paper Industry	"
New Century Paper	"
Central Paper Industry	"
Sang-Ngam Industry	Corrugated cardboard

Second Survey (18 factories)

Name of factory	Product
(Textile)	
The Thai Durable Textile Co., Ltd.	Spinning, Cloth weaving
Union Thread Industries Co., Ltd.	"
The Thai Textile Co., Ltd.	"
The Phiphatanakit Textile Co., Ltd.	"
Siam Synthetic Weaving Co., Ltd.	"
Thai Warp Knitting Co., Ltd.	"
Hantex Corporation Ltd.	Nylon polymerization, spinning
Toray Nylon Thai Ltd.	"
The Bangkok Nylon Co., Ltd.	Socks
(Metal)	
Bangkok Steel Industry Co., Ltd.	Steel bar for concrete
Sahaviriya Metal Industries Co., Ltd.	"
Union Metal Co., Ltd.	"
Thai Special Wire Co., Ltd.	PC wire
Sinthani Industry Co., Ltd.	Wire rods
Thai Malleable Iron and Steel Co., Ltd.	Castings
Thai Special Steel Co., Ltd.	"
BIS Asia Equipment Industry Co., Ltd.	Tractor parts
Kang Yong Manufacturing Co., Ltd.	Nail, Screw, Bolt, Nut

Third Survey (18 factories)

Name of factory	Product
(Plastic/Chemical)	
Thai Bones Industry Co., Ltd.	Ossein
Citric Acid Industry Co., Ltd.	Citric acid
Custom-pack Co., Ltd.	Plastic container
Thai Industrial Gases Ltd.	Liquid oxygen, Nytrogen
Siam Union Sahamitr Co., Ltd.	Soap, Margarine, Glycerine, Vegetable Oil
Siam Chemical Co., Ltd.	Sulfuric acid, Nytrous oxide, Alum, Sulfur roll
Thai Chemical Corporation Ltd.	Formalin, Plasticizer, Adhesive
Thai Silicate Co., Ltd.	Sodium silicate
The Bangkok Chemical Industrial Co., Ltd.	Sulfuric acid, Cupric sulfate, ferrous sulfate, Alum, Sulfur powder, Sulfur roll
(Food)	
Sang Som Co., Ltd.	Whisky
United Grains Co., Ltd.	Grain storage
Thai Castor Oil Industries Co., Ltd.	Vegetable oil
Thanakorn Vegetable Oil Products Co., Ltd.	Vegetable oil
The Unicord Investment (Thailand) Co., Ltd.	Canned sea-food
Thai Union Manufacturing Co., Ltd.	"
Union Seri Co., Ltd.	"
Star Feedmill Co., Ltd.	Feed
Central Food Products Co., Ltd.	"

Survey Schedule

First Survey				
From	Aug.	15,	1982	
To	Sept.	18,	1982	35 days
Second Survey				
From	Jan.	9,	1983	
To	Feb.	12,	1983	35 days
Third Survey				
From	June	26,	1983	
To	July	30,	1983	35 days
Fourth Survey				
From	Mar.	4,	1984	
To	Mar.	21,	1984	18 days

Standards for the Rationalization of Energy Use in Industry

Notification No. 467
of
the Ministry of International Trade and Industry,
promulgated on 27 October, 1979

Notification No. 559
of
the Ministry of International,Trade and Industry,
amended on 26 December, 1979

The Natural Resources and Energy Agency
The Ministry of International Trade and Industry

1. Objective

These standards are promulgated to promote the appropriate and effective rationalization of energy-use in industrial facilities. These standards provide guidelines for businesses to rationalize as far as possible both technically and economically the use of energy.

2. Rationalization of Fuel Combustion

2.1 Fuel Combustion Control Standards

(1) In combustion control a control standard for air ratio shall be set for each type of fuel combustion facility (hereinafter referred to as "combustion facility") and fuel used.

(2) Businesses shall set the above standards taking into consideration the values of standard air ratios given in Table-1, and shall exert efforts to lower the air ratios by observing the set standards.

2.2 Fuel Combustion Measurement and Recording

For each combustion facility, the rate of fuel supplied, temperature, and oxygen content of exhaust gas, and other items necessary to determine combustion conditions, shall be measured and recorded.

2.3 Maintenance and Inspection of Combustion Facilities

Maintenance and inspection shall be performed to keep combustion facility in good conditions.

2.4 Improvement Measurers for Fuel Combustion

(1) If different combustion facilities are used for heating, the combustion load of each facility shall be regulated to attain the highest heat efficiency overall (heat efficiency: ratio of the quantity of heat supplied).

(2) Burners shall be suited to the type of combustion facility and fuel, and also shall allow adjustment of fuel and air ratio to follow variations in combustion conditions.

(3) Draft systems shall allow regulation of draft and pressure combustion chamber.

(4) Combustion control systems shall be provided so that air ratio can be maintained at the specified standard air ratio.

(5) In cases where the heat requirement varies widely, a heat storage system shall be installed, that can minimize variations and also improve heat efficiency of the combustion facility.

3. Rationalizaiton of Heating, Cooling and Heat Transfer

3.1 Heating, Cooling and Heat Transfer Control Standards

(1) Heating, cooling and heat transfer (hereinafter referred to as "heating, etc.") shall be controlled based in standards set for the temperatures of materials being heated or cooled, for the temperature, pressure and flow rate of heat media for heating, etc., such as steam, and for other items relevant to heating etc.

(2) Air-conditioning shall be controlled based on standards for air-conditioning temperatures, rate of ventilation, etc., which are to be set in accordance with structure of the building, the arrangement of equipment and the types of work to be done in the building.

3.2 Measurement and Recording for Heating, Cooling and Heat Transfer

(1) The temperature of materials to be heated or cooled, the temperature, pressure and flow rate of heat media for heating, etc., such as steam, and other items relevant to heat transfer conditions shall be measured and recorded.

(2) In each air-conditioned section, the temperature, humidity and other items relevant to the air condition shall be measured and recorded.

3.3 Maintenance and Inspection of Facilities for Heating, Cooling, and Heat Transfer

(1) Heat transfer surfaces and other parts concerned with heat transfer of boilers, industrial furnaces, heat exchangers, etc., shall be kept free of soot and dust, scale or other deposits, in order to prevent lowering of heat transfer efficiency.

(2) The quality of boiler feed water shall be controlled to prevent fouling of heat transfer piping with deposited scale or sludge.

(3) Air-conditioning facilities shall be kept in good conditions by removing substances that may cause clogging of filters, frosting of heat exchangers, or deposition of scale condenser surfaces.

3.4 Improvement Measures for Heating, Cooling and Heat Transfer

(1) For heating, drying and heat exchanging facilities etc., using heat media such as steam, the temperature, pressure and flow rates of such media for heating or cooling, and the temperature, pressure and flow rates of such media actually being supplied shall be reviewed in order to avoid oversupply of heat.

(2) In industrial furnaces for heating or heat treatment, the heat pattern (change in temperature of materials being heated with the passage of time) shall be modified to suit the structure of the facility, properties of materials to be heated, types of processes installed before and after the heating or heat treating step, in order to improve the heat efficiency of these facilities.

(3) In facilities for heating, etc., the amount of materials to be heated or cooled, shall be controlled so as to avoid excessively large or small loading.

If a variety of facilities are used for heating etc., the loading of individual facilities shall be regulated to attain the highest heat efficiency overall.

(5) In a process where heating is repeated, efforts shall be exerted to shorten the time interval between consecutive heating steps.

(6) Facilities for intermittent heating, etc., shall be operated as intensively as possible.

(7) The properties and shape of refractories in industrial furnaces shall be modified so as to improve the radiation rate.

(8) The properties and shape of heat transfer surfaces, facilities for heating, etc., shall be modified so as to improve the heat transfer rate.

(9) Materials with high thermal conductivity shall be used for heat exchange equipment in facilities for heating, etc.

(10) The heat capacity of the body, frame and jigs of each industrial furnace, and trucks, etc., that transport heated materials, shall be decreased.

(11) Materials shall be directly heated by the use of direct-firing burners, submerged combustion, etc., where possible.

(12) Overall heat efficiency shall be improved by heat utilization in cascade processes which by an increase in the number of a multiple-effect evaporators, multiplication of distillation towers, addition of heat exchangers, modification of heat exchanger arrangement and combination of high- and low-temperature industrial furnaces.

3.5 Introduction of Facilities for Heating, Cooling and Heat Transfer

(1) Heat efficiency equipment shall be installed in selecting a boiler, industrial furnace, or heating or drying facility using a heat medium such as steam.

(2) In a process that requires repetition of heating, a continuous or single step type process or the reduction or partial elimination of the process shall be required.

4. Prevention of Heat Loss by Radiation and Conduction

4.1 Insulation Standards

(1) Insulation of piping carrying a heat medium or of other types of equipment, and equipment for heating, etc., (hereinafter referred to as a "heat-using facility") shall be made in accordance with the "Practice Standard for Thermal Insulation Work" JIS (Japanese Industrial Standards) A9501.

(2) If an industrial furnace is constructed from the floor, insulation work shall be done to improve the insulation characteristics of the furnace wall taking into consideration the standard temperature at the outside surface of the furnace wall (see Table-2). For an industrial furnace to be put to service with a combustion chamber temperature of 500° C or higher, either intermittently or for a total service time not exceeding 12 hours per day, the standard temperature at the outside surface of the furnace wall (see Table-2) shall be met provided that if it is not met at least 50% of total area of the inside wall, excluding the floor, of such a furnace shall be constructed of insulation materials having a bulk density of 1.3 or less.

4.2 Measurement and Recording for Control of Heat Loss

Heat balance analysis shall be conducted for main facilities, and results thereof recorded, clarify the conditions associated with heat loss.

4.3 Maintenance and Inspection of Heat-Using Facilities

(1) Heat-using facilities shall be maintained and inspected so as to prevent leakage of heat media caused by any fault.

(2) Maintenance and inspection of insulated sections of heat-using facilities shall be performed so as to prevent heat loss by radiation.

(3) Maintenance and inspection of steam traps shall be performed so as to prevent loss of steam by leakage as a result of a malfunction.

4.4 Improvement of Heat Loss Prevention

(1) Heat insulation characteristics of heat-using facilities shall be improved by appropriate measures, such as increasing the thickness of insulation materials, fitting insulation materials with low thermal conductivity or fitting double insulation layers.

(2) Openings of heat-using facilities shall be reduced in size sealed or provided with double shutters, in order to prevent heat loss by radiation or air flow.

(3) Appropriate measures, such as sealing, shall be taken for rotating parts or joints of heat-using facilities, in order to prevent leakage of heat media.

(4) The routes of piping for conveying heat media shall be rationalized, in order to reduce the heat-radiating surface area.

(5) Open facilities, etc., that use steam or carry high-temperature materials shall be covered, in order to reduce heat loss by radiation or diffusion of heat.

5. Recovery and Reutilization of Waste Heat

5.1 Waste Heat Recovery and Reutilization Standards

(1) Recovery and reutilization of waste heat from exhaust shall be undertaken based on standards for waste gas temperature and recovery rate as set for the for each waste gas discharge facility, etc.

(2) Businesses shall set such standards, taking into consideration the values of standard waste gas temperature and waste heat recovery rate given in Table-3, and shall exert efforts to lower the waste gas temperature or improve the waste heat recovery rate.

(3) The recovery and reutilization of waste heat from steam drain shall be undertaken based on standards set for the rate of recovery with regard to the temperature and amount of steam drain to be recovered.

(4) Recovery and reutilizaiton of sensible heat and cold heat of heated solids, the pressure of gas or liquid, or discarded combustible components shall be undertaken based on standards set for the rate of recovery.

5.2 Waste Heat Measurement and Recording

(1) Temperature and heat quantity of waste heat and the components of heat media losing waste heat and other items relevant to the waste heat conditions shall be measured and recorded.

(2) Methods to recover and reuse waste heat for the discharge conditions that obtain shall be studied.

5.3 Maintenance and Inspection of Waste Heat Recovery Facilities

Waste heat recovery and reuse heat exchangers and boilers, etc., shall be properly maintained, including such operations as removal of deposit on heat transfer surfaces or repairing faulty equipment from which heat media may leak in order to maximize the waste heat recovery rate and efficiency of waste heat utilization.

5.4 Improvement Measures for Waste Heat Recovery and Reuse

(1) For ducts and piping that transfer waste heat from waste heat exhaust facilities to reuse facilities, measures shall be taken to prevent air flow and to keep the temperature of waste heat high by providing insulation material or by other means.

(2) Waste heat recovery facilities shall be designed to maximize the waste heat recovery rate by the utilization of improved properties and shape of heat transfer surfaces or increased heat transfer area.

5.5 Installation of Waste Heat Recovery and Reusing Facilities

Heat exchangers, waste heat boilers, absorption type water coolers or heaters, waste pressure recovery units, or other waste heat recovery facilities, shall be installed taking account of the types of waste heat, the discharge conditions and the overall efficiency, in order to reuse waste heat for preheating combustion air or raw materials, or for generating steam, hot water or electric power.

6. Rationalizing the Conversion of Heat into Power, etc.

6.1 Standards for Control of Combined Heat and Power Generation System (CHP)

(1) The operation of two or more boilers and steam turbines for CHP systems shall be controlled based on standards set to regulate the loading of individual boilers and steam turbines, taking account of minimum acceptable loading of each steam turbine in order to improve overall power generation efficiency (power generation efficiency on the basis of fuel consumption) of the boiler-turbine complex, taking into account the temperature, pressure and amount of steam to be used for other than independent electric power.

(2) If an extraction or back-pressure turbine is used for CHP, a minimum acceptable extraction pressure or back-pressure shall be set, and the pressure of steam for other purposes than electric power generation shall be reduced taking this set value into consideration.

6.2 Measurement and Recording for CHP

(1) The heat efficiency of boilers and steam turbines to be used for CHP shall be measured and recorded.

(2) If an extraction or back-pressure turbine is used at a pressure almost equal to the minimum acceptable extraction pressure or back-pressure, then the service period, inlet pressure, extraction or back-pressure, outlet pressure, steam rate, and so forth, shall be measured and recorded.

6.3 Maintenance and Inspection of CHP systems

Boilers and steam turbines used for CHP shall be maintained and inspected so as to maximize the heat efficiency. If an extraction or back-pressure turbine is used at a pressure almost equal to the minimum acceptable extraction or back-pressure, special attention shall be paid in the maintenance and inspection of blades and impellers.

6.4 Improvement Measures for CHP

For extraction or back-pressure turbines for CHP, if the pressure of steam to be used for other purposes than electric power generation can be reduced, and if it is required that the minimum acceptable extraction or back-pressure be reduced, then the extraction or back-pressure turbine shall be modified.

6.5 Utilization of Excess Steam

If excess steam is available in a plant, it shall be used for power generation or to provide working power, etc., if such use is justifiable from the viewpoint of overall heat efficiency.

7. Preventional of Electricity Loss by Resistance, etc.

7.1 Standards for Control of Electricity Receiving, Transforming and Distribution Facilities

The supply of electricity to a facility that uses electricity (hereinafter referred to as an "electricity-using facility") shall be controlled based on standards for voltage, electric current, power factor, load factor and demand factor of the electricity receiving, transforming or distribution facilities, which are to be set in accordance with the type service conditions and capacity of the electricity-using facilities.

7.2 Measurement and Recording for Electricity Receiving Transforming and Distribution Facilities

The electric power consumption of a plant, and the voltage, electric current power factor, load factor and demand factor of electricity receiving or transforming facilities and main electricity distribution facilities shall be measured and recorded.

7.3 Maintenance and Inspection of Electricity Receiving Transforming and Distribution Facilities

Maintenance and inspection shall be performed to keep electricity receiving, transforming and distribution facilities in proper condition.

7.4 Improvement Measures for the Prevention of Electricity Loss

(1) The demand factor of transformers shall be maintained at a proper level, by adjusting the number of transformers in service and distributing the load appropriately.

(2) Transformer capacity shall be appropriate for the power consumption.

(3) In order to decrease the maximum electric current required by in a plant the operation of electricity-using facilities shall be adjusted to level power consumption.

(4) Distribution losses of electricity shall be reduced by taking proper measures, including improved rearrangement of electricity receiving and transforming facilities, shortening of power supply routes by modification of the distribution systems, or better adjustment of distribution voltage, and so forth.

(5) In order to maintain the power factor at 95% or above at electricity-receiving terminals, the power factor of the facilities (Table-4) excluding those with a capacity not exceeding that listed in the same table, or of the electricity-transforming facilities, shall be improved by installing phase-advancing capacitors or by other appropriate measures.

(6) Phase-advancing capacitors shall be connected or disconnected as appropriate to the operation of the facilities to which they are connected.

(7) If single-phase load is connected to a three-phase power supply, measures shall be taken to prevent a voltage imbalance.

8. Rationalization of Conversion of Electricity into Power, Heat, etc.

8.1 Standards for Control of Electricity-Using Facilities

(1) Consumption of electricity shall be controlled based on standards for voltage, electric current, power factor and demand factor, that are to be set for electricity-using facilities such as electric power applying equipment, electrical heating equipment or illuminating equipment.

(2) The standards for illuminating facilities shall be set in compliance with the "Recommended Levels of Illumination" specified in JIS, Z-9110.

8.2 Measurement and Recording for Electricity-Using Facilities

(1) Voltage, electric current, power factor and demand factor of main electricity-using facilities shall be measured and recorded.

(2) For illumination equipment, luminous intensity at work sites, in addition to the items specified in (1) above, shall be measured and recorded.

8.3 Maintenance and Inspection of Electricity-Using Facilities

(1) Maintenance and inspection shall be performed for electric power equipment, so as to reduce mechanical losses in driven machines (which loads motors), power transmissions and motors.

(2) Maintenance and inspection shall be performed for hydraulic equipment such as pumps, fans, blowers, and compressors, so as to prevent fluid leakage and to reduce resistance in piping that carries fluids.

(3) Maintenance and inspection shall be performed for electrical heating and electrolysis facilities, so as to reduce resistance losses at the joints of wiring or contacts in switches.

(4) For illumination equipment, accesories for illumination appliances such as shades and light sources shall be cleaned, and light sources shall be regularly replaced.

8.4 Improvement Measures for the Conversion of Electricity into Power, Heat, etc.

(1) Electric power equipment not in use shall be stopped, in order to reduce electricity consumption by motor idling, provided that this is justifiable in consideration of the electricity requirement for starting.

(2) When two or more motors are to be run simultaneously, the demand factor for each motor shall be maintained at a proper level, by adjusting the number of motors in service and by distributing the load appropriately.

(3) The capacity and pressure of pumps, fans and blowers shall be adjusted by impeller trimming, etc, based on the review of heat in order to reduce loading on the motor.

(4) If electric power applying equipment is to be subject to widely fluctuating load, a speed control system shall be installed, so as to allow operation in compliance with the load level.

(5) The heat efficiency of induction furnaces shall be improved by modification of the charging method of the materials to be heated.

(6) Electrolysis facilities shall be provided with electrodes of proper shape and characteristics, and improved to give higher electrolysis efficiency by appropriately controlling the span between electrodes, the concentration of the electrolytic solution, etc.

(7) Illumination equipment shall be switched off, when possible, to eliminate excess or unnecessary electricity consumption.

(8) Illumination equipment shall be fitted with switching to allow the level of illumination to be lowered, or with a device that automatically switches off the equipment or adjusts the luminous intensity in response to the level of daylight.

(9) Unnecessarily wide illumination or excessively intense illumination shall be eliminated by using partial illuminating type facilities or rearranging facilities.

8.5 Introduction of Electricity-Using Facilities

(1) The capacity of motors shall be appropriate for the power requirements and operational and service characteristics of the driven machine.

(2) The power requirement, as calculated with the formula given in Table-5, shall be taken as standard for the installation of compressors, pumps or blowers.

(3) Electrical heating equipment shall be selected after careful study of its merits and demerits with those of fuel combustion types.

(4) High-efficiency discharge lamps, such as mercury, sodium or metal halide pumps, shall be selected for illumination.

Table-1 Standard Air Ratio (for Section 2-1 (2))

(1) Boiler

Description		Load Factor (%)	Standard Air Ratio			
			Solid Fuel	Liquid Fuel	Gaseous Fuel	Blast Furnace Gas or Other By Product Gases
For Electric Power Generation		75~100	1.2~1.3	1.05~1.1	1.05~1.1	1.2
Other Purposes	Hourly Steam Production Rate Exceeding 30 tons	75~100	1.2~1.3	1.1~1.2	1.1~1.2	1.3
	Hourly Steam Production Rate Exceeding 10 tons but Not Exceeding 30 tons	75~100	—	1.2~1.3	1.2~1.3	—
	Hourly Steam Production Rate Not Exceeding 10 tons	75~100	—	1.3	1.3	—

Note: Boilers for "electric power generation", are those which are installed by electric power companies to generate electric power, which are defined in Subsection 6 of Section 2 of the Electricity Enterprises Act.

(Remarks)

1. Values of the standard air ratio raised in the Table are to be measured at an outlet of a boiler (or outlet of an economizer, if installed) which is in service at a constant load after turn-around.
2. The load factor of a boiler is the turbine load factor if the boiler is installed for electric power generation and the boiler load factor if it is for other purposes.
3. Values of standard air ratio for solid fuel are determined on the basis of combustion of pulverized bituminous coal with a minimum heating value of 5,000 kcal per kilogram.
4. The values of the standard air ratio given in the Table are applicable to the boilers described below.

   1) Small boilers which are subject to the provisions of Subsection 4 of Section 1 of the Enforcement ordinance of the Industrial Safety and Health Law.

   2) Boilers which are modified after installation to enable them to burn a different fuel.

3) Boilers which use fuel mixed with industrial waste, such as wood chips, bark sludge, black liqueur, waste tires, etc.

4) Boilers that treat toxic gases.

5) Boilers that utilize waste heat.

6) Boilers that use heat media other than water.

7) Natural draft or balanced draft type boilers.

8) Boilers with an annual operating period not exceeding 1,000 hours.

(2) Industrial Furnaces

Description	Standard Air Ratio
Smelting Furnaces for Metal Casting	1.3
Continuous Heating Furnaces for Bloom, Billet and Slab	1.25
Heating Furnaces for Metals Other Than Continuous Furnaces for Bloom, Billet, and Slab	1.3
Continuous Furnaces for Heat-treatment	1.3
Gas Generators and Gas Furnaces	1.4
Oil Furnaces	1.4
Thermal Cracking Furnaces and Reforming Furnaces	1.3
Cement Kilns	1.3
Alumina and Lime Kilns	1.4
Continuous Glass Smelting Furnaces	1.3

(Remarks)

1. Values of the standard air ratio given in the Table are to be measured at an outlet of a furnace in operation at a load approximately equal to the rated load after turn-around or repairs.

2. Values of the standard air ratio raised in the Table are not applicable to the furnaces described below.

1) Furnaces using solid fuels.

2) Furnaces with a rated hourly capacity less than 200,000 kcal.

3) Furnaces that require specific atmospheres for oxidation or reduction.

4) Furnaces that require frequent repetition of opening and closing of covers, or lighting and extinguishing of burners.

5) Furnaces that require dilution air to secure the desired heat pattern or a uniform temperature inside.

6) Furnaces that require an opening, through which a bulk air current flows, for reasons including the structure of the combustion devices.

7) Furnaces not in operation for more than 1,000 hours per annum.

Table 2 Standard Temperature At External Surface of Furnace Wall (for Section 4-1 (2))

Temperature at Combustion Chamber	Standard Temperature at External surface of Furnace Wall (°C)	
(°C)	Ceiling	Side Wall
1,300	140	120
1,100	125	110
900	110	95
700	90	80

(Remarks)

1. Values given in the Table for the standard temperature at the external surface of the furnace wall Table are average values for the total surface (excluding particular sections) during normal operation at an ambient temperature of 20° C.
2. Values given in the Table for the standard temperature at the external surface of the furnace wall are not applicable to the surfaces of the industrial furnaces described below.
   1) Furnaces with a rated hourly capacity of less than 200,000 kcal.
   2) Furnaces which are equipped with a forced cooling system for the external surface.
   3) Rotary kilns.

Table-3 Standard Waste Gas Temperature and Standard Waste Heat Recovery Rate

(for Section 5-1 (2))

(1) Standard Waste Gas Temperature for Boilers

Description		Standard Waste Gas Temperature (°C)			
		Solid Fuel	Liquid Fuel	Gaseous Fuel	Blast Furnace Gas or Other By-Product Gases
Boilers for Electric Power Generation		145	145	110	200
Boilers for Other Purposes	Hourly Steam Production Rate Exceeding 30 tons	200	200	170	200
	Hourly Steam Production Rate Exceeding 10 tons but Not Exceeding 30 tons	—	200	170	—
	Hourly Steam Production Rate Not Exceeding 10 tons	—	320	300	—

Note: Boilers for "electric power generation" are those installed by electric power companies to generate electric power.

(Remarks)

1. Values of the standard waste gas temperature given in the Table denote the temperatures of waste gases at boiler outlets (or outlets of waste heat recovery units, if installed) operated at 100% of the rated load after a turnaround at an ambient temperature of 20° C. The load factor is the turbine load factor if the boiler is installed for electric power generation or the boiler load factor if it is for other purposes.
2. Values of standard waste gas temperatures for solid fuels are determined on the basis of combustion of pulverized bituminous coal with a minimum heating value of 5,000 kcal per kilogram.
3. For a boiler with steam production per hour exceeding 10 tons but not exceeding 30 tons, which was installed before January 1, 1980, and is not provided with an air preheating device, the standard waste gas temperatures have been set at 320 and 300° C for liquid and solid fuels, respectively.
4. The values of the standard waste gas temperature given in the Table are not applicable to the boilers described below.
   1) Small boilers coming under the provisions of Subsection 4 of Section 1 of the Enforcement Ordinance of the Industrial Safety and Health Law.
   2) Boilers which are modified after installation to burn different fuels.
   3) Boilers which use fuel mixed with industrial waste such as wood chips, bark, sludge, black liquour, waste tires, etc.
   4) Boilers that treat toxic gases.
   5) Boilers that utilize waste heat.
   6) Boilers that use heat media other than water.
   7) Natural draft or balanced draft type boilers.

8) Boilers with a steam production rate between 10 and 30 tons per hour operated under a pressure less than 16 kg/cm^2.

9) Boilers not operating for more than 1,000 hours per annum.

(2) Standard Waste Heat Recovery Rate for Industrial Furnaces

Exhaust Gas Temperature (°C)	Classified by Capacity	Standard Waste Heat Recovery Rate (percent)	References	
			Waste Gas Temperature (°C)	Preheated Air Temperature (°C)
500	A, B	20	200	130
600	A, B	20	290	155
700	A	30	300	260
	B	25	330	220
	C	20	370	180
800	A	30	370	300
	B	25	410	250
	C	20	450	205
900	A	35	400	385
	B	25	490	285
	C	20	530	230
1,000	A	40	420	490
	B	30	520	375
	C	25	570	315
Above 1,000	A	40	—	—
	B	30		
	C	25		

Note: 1. "Exhaust gas temperature" is the temperature of the exhaust gas discharged from a furnace outlet of a combustion chamber.

2. Industrial furnaces are classified by capacity into following three groups.

A. Furnaces with an rated hourly capacity of 20 million kcal or more.

B. Furnaces with an rated hourly capacity of 5 million kcal or more, but less than 20 million kcal.

C. Furnaces with an hourly rated capacity of 1 million kcal or more, but less than 5 million kcal.

(Remarks)

1. The values of standard waste heat recovery rate given in the Table denote the recovery rate for the sensible heat of gas discharged from a combustion chamber operated at a load approximately equal to the rated.

2. The values of standard waste heat recovery rate given in the Table are applicable

to continuously operating furnaces installed on or after January 1, 1980.

3. The values of standard waste heat recovery rate given in the Table are not applicable to the industrial furnaces described below.

1) Furnaces with a rated hourly capacity less than 1 million kcal.

2) Furnaces not operating for more than 1,000 hours per annum.

4. The values of waste gas temperature and preheated air temperature given in the Table for reference are those obtained when waste gas heat is recovered at the standard waste heat recovery rate shown in the table and the recovered waste heat is used to preheat combustion air. The values are calculated for the following conditions.

1) Waste-gas temperature drop due to heat by radiation or in other ways from furnace outlets to an inlet of an air preheating heat exchanger: 200°C

2) Fuel: Liquid fuel

3) Ambient temperature: 20°C

4) Air ratio: 1.2

Table-4 Facilities of Which the Power Factor Is to Be Improved (for Section 7-4 (5))

Facility Type	Capacity (Unit: Kilowatt)
Squirrel-Cage Type Induction Motor	100
Wired-Wound Type Induction Motor	100
Crucible Induction Furnace	100
Groove Type Induction Furnace	100
Vacuum Induction Furnace	100
Arc Furnace for Steel-Making	—
Rocking Arc Furnace	—
Flash Butt Welder (excluding portable type)	10
Arc Welder (excluding portable type)	10
Rectifier	10,000

(Remarks)

Explosion-proof type facilities are excluded.

Table-5 Methods to Estimate Power Requirements (for Section 8-5 (2))

(1) Compressor

(a) Power requirements of compressors shall be calculated with the following expression:

$$L = \frac{(a+1)K}{K-1} \cdot \frac{P_s Q_s}{6120} \cdot \left[\left(\frac{P_d}{P_s}\right)^{\frac{k-1}{k(a+1)}} - 1\right] \cdot \frac{\phi}{\eta_c \eta_t}$$

where; L is the power requirement (kilowatt), P_s is the absolute suction air pressure (kg-f/cm^2), P_a is the absolute delivery air pressure (kg-f/cm^2), Q_s is the air flow rate adjusted to suction conditions (m^3/min), a is the number of intercoolers, k is the adiabatic coefficient of the air, η_c is the total adiabatic efficiency of the compressor, η_t is the transmission efficiency, and ϕ is the safety factor.

(b) The values of η_c and η_t are to be specified by the manufacturers.

(c) The values of ϕ are specified in the table below for each type of compressor.

Reciprocating Compressor	Lubricating Type Screw Compressor	Non-Lubricating Type Screw Compressor	Turbo Compressor
1.10	1.10	1.15	1.20

(2) Pump

(a) The power requirements of pumps shall be calculated using the following expression:

$$L = 0.163\ \gamma Q H \cdot \frac{\phi}{\eta_p \eta_t}$$

where; L is the power requirement (kilowatt), γ is the liquid weight per unit volume (kg-f/l), Q is the pumped liquid flow rate (m^3/min), H is the total head (m), η_p is the pump efficiency, η_t is the transmission efficiency, and ϕ is the safety factor.

(b) The values of η_p are to be specified by the manufacturers.

(c) The values of η_t are given in the table below for each transmission type. For a transmission type other than those given in the table below, the value is to be specified by the manufacturer.

Parallel Axis Type One-Stage Gear Speed Reducer with Transmission Power less than 55 kilowatt	Parallel Axis Type One-Stage Gear Speed Reducer with Transmission Power of 55 kilowatt or greater	Constant-Speed Type Hydraulic Coupling with Transmission Power less than 100 kilowatt	Constant-Speed Type Hydraulic Coupling with Transmission Power of 100 kilowatt or greater
0.95	0.96	0.94	0.95

v-Shaped Belt	Flat Belt	Directly Coupled
0.95	0.90	1.00

(d) The values of ϕ are given in the Table below for types and rated capacity of pumps.

Rated Capacity / Pump Type	Less than 18.5 kW	22 kW or more, and 55 kW or less	55 kW or more
Centrifugal Pump	1.25	1.15	1.10
Mixed Flow Pump	1.25	1.15	1.10
Axial Pump	1.30	1.25	1.20

(3) Fan

(a) Power requirements of fans shall be calculated with the following expression:

$$L = \frac{QP}{6120} \cdot \frac{\gamma'}{\gamma} \cdot \frac{\phi}{\eta_f \eta_t} \quad (P \leq 1{,}000 \text{ mmH}_2\text{O})$$

where; L is the power requirement (kilowatt), Q is the air flow rate, adjusted to suction conditions (m^3/min), P is the fan total pressure (mmH_2O), γ is the design estimate of air density (kg-f/l), and γ' is the maximum air density in operation, η_f is the fan total pressure efficiency, η_t is the transmission efficiency and ϕ is the safety factor.

(b) The values of η_f are to be specified by the manufactures.

(c) The values of η_t are given in the table in Sub-section 2-c for each transmission type. For a transmission type other than those given in the table, the value is to be specified by the manufacturer.

(d) The values of ϕ are given in the table below.

Propeller Fan	Disc Fan	Multi-Blade Fan	Turbo Fan	Plate Fan	Aerofoil Fan
1.30	1.50	1.30	1.15	1.25	1.15

Energy Conservation Survey
省エネルギー調査表

1 Name of Factory
工 場 名

2 Location
所 在 地 Tel.

3 Name of Company Officials
会社役員名

President
社 長

Factory Manager
工 場 長

Energy Manager
エネルギー担当者

4 Segment of Industry
業 種

5 Capital
資 本 金 bahts

6 Annual Turnover
年間売上高 bahts

7 Number of Employees
従業員数

8 Number of Engineers
技術者数

Electricity
電 気

Heat
熱

9 Major Products
主要生産物

10 Production Capacity of Major Products
主要生産物の生産能力

Nominal
公 称

Present Condition
現 状

11 Fuel Consumption
燃料消費高

☐	Fuel oil 重　油	kl/y	bahts/y
☐	Diesel oil 軽　油	kl/y	bahts/y
☐	Kerosene 灯　油	kl/y	bahts/y
☐	Gasoline ガソリン	kl/y	bahts/y
☐	LPG 液化石油ガス	t/y	bahts/y
☐	Natural gas 天然ガス	m³/y	bahts/y
☐	Lignite or Brown Coal 亜炭又は褐炭	t/y	bahts/y
☐	Bagasse バガス	t(m³)/y	bahts/y
☐	Charcoal 木　炭	t/y	bahts/y
☐	Firewood 薪	t(m³)/y	bahts/y
☐	Others その他 (　　)	/y	bahts/y

12 Electric Power, 電力

Electricity Consumption 電力消費高 — KWh/y — bahts/y

Contract Demand 契約電力 — KW.

Receiving Voltage 受電電圧 — V

Power Factor 力　率 — %

Power Plant 発電設備 — Have or Not.

Capacity 能　力 — KW or KVA.

13 Water Consumption, 水消費量

Sea Water 海　水 — m³ or t/y

River Water 河　水 — m³ or t/y

Underground Water 地下水 — m³ or t/y

City Water 水道水 — m³ or t/y

14 Boiler, ボイラ

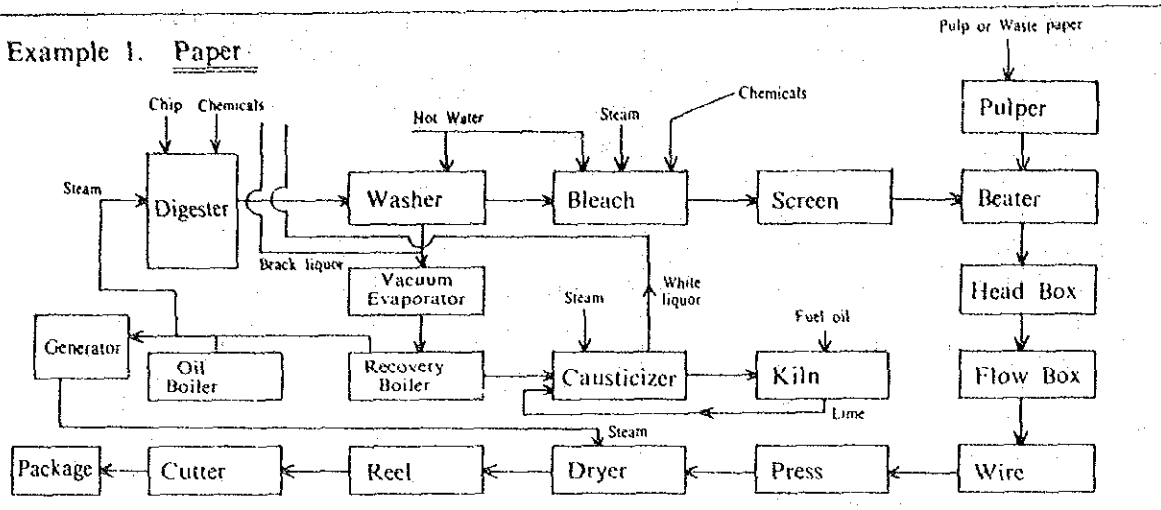
Built(A.D.) 設置(西暦)	Type 型　式	Nominal Capacity 公称能力		Kind of Fuel 燃料の種類	Operating period 運転時間	
		Steam Press. kg/cm²G	Evaporating Volume t/h		hrs/day	days/y

15 Major Facilities Using Energy, エネルギー使用の主要設備

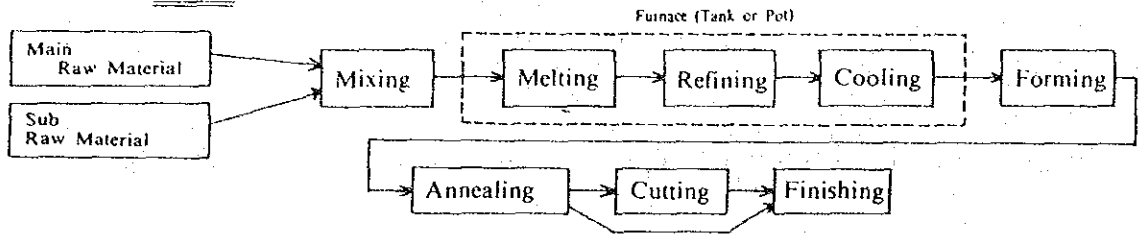
Built(A.D.) 設置(西暦)	Name of Facility 設備名	Products 生産物	Output 生産高		Kind of Energy used 使用エネルギーの種類	Operating period 運転時間	
			Nominal 公称	Present Condition 現状		hrs/day	days/y

16 Flow-chart of Producing Process of Major Products, 主要生産物の生産工程図

Example 1. Paper

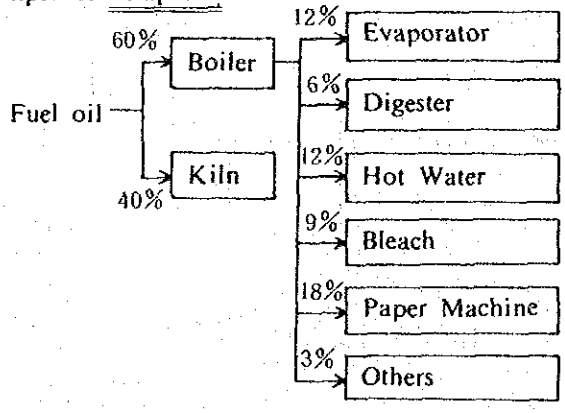


Example 2. Glass

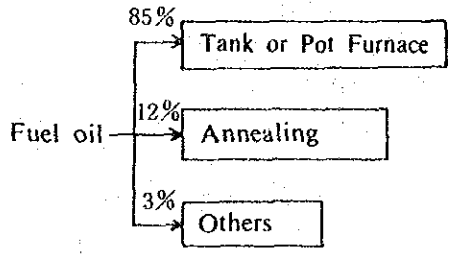


17 Energy Flow-chart, エネルギー流れ図

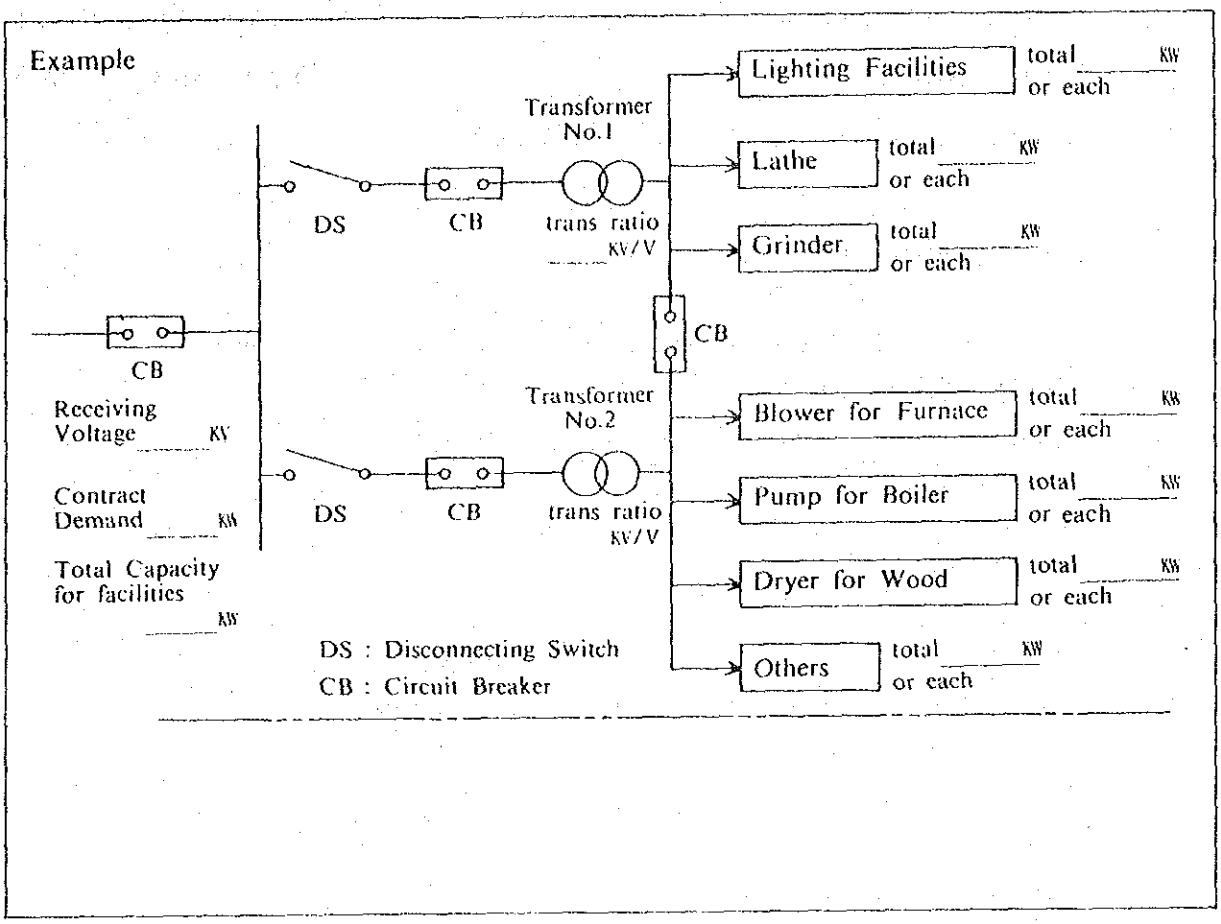
EXample 1. Paper



Example 2. Glass



18 Skeleton Diagram, 単線結線図



19 Plant Layout, 工場配置図

20 In case you have any problem(s) in your course of promotion of energy conservation, please circle the no(s). of applicable item(s) among the following: (Maximum 5 items)

省エネルギー推進上の問題点があれば，下記の該当する項目に丸印を付して下さい。(但し，最高5項目まで)

(1) Prospect of energy price is not clear.
エネルギー価格の見通しが不明。

(2) The proportion of energy cost in the whole cost of enterprise is small.
企業におけるエネルギー費用の割合が小さい。

(3) Increase of energy cost can be covered by raising the prices of products.
エネルギー費用の上昇は製品値上げでカバーできる。

(4) Instability of energy supply. (power stoppage, etc.)
エネルギー供給が不安定（停電など）。

(5) Shortage of engineers.
技術者が不足。

(6) Difficulty in obtaining good energy conservation equipments.
省エネルギー機器のよいものが手に入り難い。

(7) Information such as active cases is not easy to obtain.
実施例のような情報が入りにくい。

(8) System of research and development is not sufficient.
研究開発体制が不十分。

(9) Shortage of fund for facility improvement.
設備改善の資金が不足。

(10) The facilities are superannuated.
設備が老朽化している。

(11) Employees' consciousness is low.
従業員の意識が低い。

(12) No personnel is available who can educate the employees.
従業員教育をできる人がいない。

(13) Shortage of measuring equipments.
計量設備が不足している。

(14) No time to analyze energy consumption rate.
原単位解析を行う時間がない。

(15) Shortage of information on government's measures.
政府施策の情報が不足。

(16) Shortage of government's subsidiary measures.
政府の助成策が不足。

(17) Others
その他。

Check List

1 Energy Management

2 Heat

2-1 Furnace, Kiln, Dryer

2-2 Steam Consuming Equipment

2-3 Boiler

2-4 Steam Piping, Condensate Recovery

1 Energy Management （エネルギー管理）

1	Company's Energy Conservation Policy	企業の省エネルギー方針	
	Setting up Target	目標設定	Set up　　not set up
	Numerical Value of Target	目標値	_____ % improve to _____ base
	Completion Deadline	達成期限	by _____
	Investment for Energy Conservation	省エネルギー投資	
	Investment Scale	投資額	1981 _____ Bts 1982 _____ Bts 1983 Plan _____ Bts
	Judgement for Investment	投資基準	Pay Back Time, within _____ Yrs
2	Check on Energy Consumption	エネルギー消費量管理	
	Measurement of Consumption	消費量計測	

	Electric Power		Fuel	
	Times/		Times/	
Factory Total 工場計	done	not done	done	not done
By Major Process 主要工程別	done	not done	done	not done
By Major Facility 主要設備別	done	not done	done	not done

Data Analysis	データ解析	
Grasp of Energy Consumpt's. rate	原単位把握	done　not done
Preparation of Control Chart	管理図作成	done　not done
Analysis of Variance	変動要因分析	done　not done
Cost Control	原価管理	
Energy Cost Accounting	エネルギー原価計算	Monthly,　Times/y,　not done
Energy Cost Distribution by Process	工程別配分	done　not done
Accounting of Heat Balance	熱勘定	done　not done

Diagnoser	

Date		Factory	

3	Organization Planning and Promotion Committee Frequency of Holding Committee Chairman Project Team Consultant Contract	組　織 企画・推進 委 員 会 開催頻度 委 員 長 プロジェクトチーム コンサルタント契約	 Section held _____ Times/y _____ made made		 Person in Charge not held not made not made
4	System Improvement Proposition System Achievement Commendation System Inspection, Audit	制　度 改善提案制度 実績表彰制度 視察，診断	 is is done		 isn't isn't not done
5	Education of Employees Seminar Observation Meeting	従業員教育 研 修 会 見 学 会	 held held	Times/y Times/y	 not held not held
6	Campaign to Employees Appeal from Factory Manager Poster, etc.	従業員への呼びかけ 工場長の呼びかけ ポスター 等	 done done		 not done not done
7	Activities in the Business Circles	業界の活動	Practised		not practised

2-1 Furnace, Kiln, Dryer

1	Part	工　程				
2	Name of Equipment	設備名				
3	Use	用　途				
4	Charge	被加熱物				
5	No. of Furnace	番　号				
6	Type	型　式				
7	Maker	メーカー				
8	Time built	設置時期				
9	Outer Dimension Length or Dia. Width Height	外法寸法 長さ・径 巾 高				
10	Design Capacity	設備能力				
11	Usage Continuous Batch h/Day h/month	使用状況 連　続 非連続				
12	Induced Draft Fan Forced Draft Fan	吸込み送風機 押込み送風機	___ m^3/h __ mmAq __ kW ___ __ __			
13	Improvement done	改造実績				

Diagnoser		Date	Factory

14	Fuel Name Lower Heating Value Specific Gravity Moisture	燃　料 名　前 発熱量（低位） 比　重 水　分	Kcal/kg. ℓ.m^3N					
15	Average Consumption	燃料使用量（平均）	/h					
16	Oil Storage Tank Contents Volume Temp. Insulation	油　貯　蔵 タンク　油　種 容　量 温　度 保　温	 m^3 °C mm					
17	Fuel Receiving Measuring Volume Temp. Sp.grav. Analysis	受　入　れ 計　量 温度測定 比重　〃 分　析	 done not done done not done done not done done not done					
18	Oil Leak	油　洩　れ	good not good					
19	Steam Pressure Temp.	スチーム 圧　力 温　度	 kg/cm^2G °C					
20	Electricity Elect. Heater Infra Red Lamp	電　力 電　熱 赤外ランプ	 ＿＿＿kW ＿＿＿＿＿V ＿＿＿kW ＿＿＿＿＿V					

	No. of Equipment	設　備　名	
21	Combustion		
	Burner	バーナー	Pressure jet, Low pr.air atomizing, Steam or air atomizing, Rotary, Intermixing, Interior atomizing, Semi mixing
	Burner Tile	バーナータイル	Good ____ not good ____
	Cleaning of Burner tip	バーナー手入	____ times/y
	Flame Color	火焔色	good ____ not good ____
	Length	長さ	good ____ not good ____
	Sparks	花火	good ____ not good ____
	Blow off	吹きとび	good ____ not good ____
	Color of Smoke	煙の色	good ____ not good ____
	Air/fuel ratio	空気比	Factory Data ____ Measured ____
	Automatic Controller	制御装置	____ exist ____ not exist
	Fuel Consumption	燃料量	____ kg.ℓ.m^3/h
	Fuel Temp.	油温	____ °C (at Burner, after Heater)
	Air Temp.	燃焼空気温度	
	Primary Air flow	一次空気量	
	Secondary Air flow	二次空気量	
	Atomizing press.	噴霧圧	

	Quantity of Burners					
Zone	Preheating		Heating		Soaking	
Burner Type	axial	Side	axial	Side	axial	Side
Upper Zone						
Lower Zone						

$$m = \frac{0.21}{0.21 - (O_2)}$$

	No. of Equipment	設備番号	
22	Furnace Pressure	炉圧	_____ mmAq (Measuring Point _____ mmH)
	Pressure Control	炉圧制御	done not done
	Movement of Damper	タンパー作動	good not good
	Air Sucking	空気吸込	
	from Wall	炉壁	good not good
	Burner Side	バーナーまわり	good not good
	Door	出入口	good not good
	Truck	台車シール	good not good
	State of Stack, Gas duct	煙突, 煙道の状態	good not good
	Cooling Air	冷却空気	_____ m^3/min.
23	Heating	加熱	
	Furnace Temp.	炉温	_____ °C
	Charging Temp.	装入温度	_____ °C
	Extracting Temp.	抽出温度	_____ °C
	Temp. measurement	温度測定	Thermocouple( ), Resistance Thermometer, Optical Pyrometer, Radiation thermometer, Seger cone
	Temp. Controller	温度制御装置	exist not exist
	Burner Setting	バーナー取付	good not good
	Arrangement of Charge (Furnace Load Factor)	装入方法	good not good, Truck Speed _____
	Seal		
24	Size of Charge	材料寸法	
	Heat Utilization of previous process, Hot Charge	ホットチャージ	done not done

	Preheating Zone	Heating Zone	Soaking Zone
Set	°C	°C	°C
Actual	°C	°C	°C

	No. of Equipment	設 備 番 号				
25	Drying	乾 燥				
	Air Temp.	風 温	_____ °C			
	Air Flow	風 量	_____ m^3/h			
	Moisture of Charge	装入物水分				
	Inlet	入 口	_____ %			
	Outlet	出 口	_____ %			
26	Insulation	断 熱	Preheating Zone	Heating Zone	Soaking Zone	
	Structure of Wall	壁面構成				
	Refractory Brick	耐 火 材				
	Insulating Zone	断 熱 材				
	Outer Wall	外 壁				
	Color of Wall Surface	壁 の 色				
	Temp. of Wall Surface	壁面温度				
	Side Wall	側 面	°C	°C	°C	
	Roof, Crown	上 面	°C	°C	°C	
	Heat Flux		$kcal/m^2h$			
	Insulation of Skid	スキッド断熱	good	not good		
	Weight Reduction of truck, conveyor, etc.	台車・コンベア等の軽量化	done	not done		

	No. of Equipment	設備番号				
27	Waste Heat Recovery	廃熱回収				
	Name of Recovery Equipment	回収設備名				
	Type	型式				
	High Temp. Fluid	高温流体				
	Low Temp. Fluid	低温流体				
	Heat Recovered	回収熱量				
	Flow	流量				
	Temp. Rising (Falling)	温度上昇(低下)				
	Specific Heat	比熱				
	Temp. of Waste gas	排ガス温度				
	Furnace Outlet	炉出口	_____ °C			
	After Heat Recovery	廃熱回収後	_____ °C			
	Clearing of Heating Surface	伝熱面掃除	_____ Times/y			
	Preheating Zone in Furnace	炉の予熱帯	exist	not exist		
	Air Leak in Heat Recovery Equip.	廃熱回収設備の空気洩れ	found	not found		
	Cooling Water flow	冷却水量				
	Water Inlet temp.	〃 入口温度				
	Water Outlet temp.	〃 出口温度				

	No. of Equipment	設備番号	
28	Operational Management	操業管理	
	Operation Standard	作業標準	made not made
	Heating Curve	昇温曲線	exist not exist
	Recording	記録	good not good
	Maintenance	保全整備	good not good
	Period	周期	_____ ly
	Record	記録	good not good
29	Current Performance	実績	
	Output (or Input)	処理量	_____ t/h
	Fuel Consumption	燃料量	_____ ℓ.kg.m^3/h
	Heat Efficiency	熱効率	_____ %
	Loss with Waste Gas	排ガス損失	_____ Kcal/h _____ %
	Loss with Coolant	冷却水損失	_____ Kcal/h _____ %
	Loss through Wall	放熱損失	_____ Kcal/h _____ %

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2-2 Steam Consuming Equipment (蒸気使用設備)

1	Part	工　　程	
2	Use	用　　途	
3	Name of Equipment	設　備　名	
4	No. of Equip.	番　　号	
5	Type	型　　式	
6	Maker	メ　ー　カ　ー	
7	Time built	設 置 時 期	
8	Dimension	寸　　法	ℓ _____ mm x w _____ mm x h _____ mm, d _____ mm x h _____ mm
9	Heating surface area	伝 熱 面 積	m^2
10	Volume	容　　量	
11	Capacity	能　　力	
12	Subject of heating	被 加 熱 体	
13	Heat source	熱　　源	Steam: kg/cm^{2}G, °C t/h, Hot water °C, t/h
14	Quantity of Treatment	処　理　量	
15	Operating condition	操 業 条 件	
	Temp.	温　　度	°C
	Press.	圧　　力	kg/cm^{2}G
16	Insulation	断　　熱	mm good, not good
	Surface Temp.	表 面 温 度	°C heat flux Kcal/m^{2}h

Diagnoser		Date	Factory

17	Cleaning for heating surface	伝熱面の掃除	done not done
18	Instruments	計装	Temp. Press. Flow. Other:
19	Auxiliary Equip.	附属設備	
	Heat Recovery	熱回収	exist not exist type
	High Temp. Fluid	高温流体	specific heat
	Low Temp. Fluid	低温流体	specific heat
	Temp. rising (falling)	温度上昇（降下）	
	Flow	流量	m^3/h
	Condensate recovery	ドレン回収	done not done, open system, closed system
	Rate of Recovery	回収率	%

2-3 Boiler （ボイラ）

1	Part	工　　程	
2	Use	用　　途	
3	No. of Boiler	番　　号	
4	Type	型　　式	Water tube boiler（水管） Flue tube boiler（炉筒） Once-through boiler（貫流） Hot-water boiler （温水） Other（その他）
5	Rated evaporation	定格蒸気量	t/h
6	Manufacture date	製造年月日	
7	Steam pressure	圧　　力	Rated （定格）　kg/cm2G, Normal （常用）　kg/cm2G
8	Heating surface area	伝熱面積	m^2
9	Auxiliary Equip.	附属設備	Superheater （過熱器）　m^2, Reheater （再熱器）　m^2 Economizer （節炭器）　m^2, Air heater （空気予熱器）　m^2
10	Fuel Name Lower Calorific Value Specific gravity	燃　　料 名　　前 発熱量（低位） 比　　重	Kcal/kg,ℓ,m^3N
11	Usage Continuous Batch	使用状況 連　　続 非連続	h/d,　d/m,　h/y,

Diagnoser		Date		Factory	

	Item	項　　目	Unit 単位	Nominal 定　　格	Actual 実　　績	Remarks 備　　考
12	Oil Tank	油　タ　ン　ク	——			
	Volume	容　　量	m^3			
	Temp.	油　　温	°C			
	Insulation	保　　温	mm			
	Leak	洩　　れ	——			good, not good
13	Boiler	ボ　イ　ラ	——			
	Steam Pressure	蒸気圧力	kg/cm^2G			
	Steam Temp.	蒸気温度	°C			
	Feed water flow rate	給　　水 給水量	m^3/h			
	" Temp.	温　　度	°C			
	" Meter	流量計				Type
	Blow off flow rate	ブ　ロ　ー　量	m^3/d			Continuous, Intermittance, Heat recovery
	Boiler water	缶　　水	——			
	pH	ピィエッチ				
	Conductivity	電気伝導率	μS/cm			
14	Feed Water	給　　水	——			
	pH	ピィエッチ				
	Conductivity	電気伝導率	μS/cm			
	Preparation method	処　理　法	——			
	Testing time	検査頻度	——			
	Cl^- content	クロール濃度	ppm			

	Item	項　　目	Unit 単 位	Nominal 定　格	Actual 実　績	Remarks 備　考
15	Combustion	燃　焼	———			
	Fuel	燃　料				
	Consumption	使 用 量	ℓ.kg.m^3/h			
	Temp.	温　度	°C			
	Meter	計　器	———			exist, not exist
	Burner	バーナー				Oil burner
	Type	型　式	———			Low press, air atomizing （低圧噴霧式） Steam or air atomizing（高圧噴霧式） Press. jet type （油圧式） Rotary（回転式） Gas burner Intermixing type （内部混合式） Injector atomizer （外部混合式） Semi-mixing （半混合式）
	Capacity	容　量	ℓ.kg.m^3/h			
	Burner tile	バーナータイル	———			good, not good
	Clinker	クリンカー	———			found, not found
	Air ratio	空 気 比	———			Measuring point （場処）
	Insulation	断　熱	mm			good, not good　surface temp. heat flux.
	Sucking air	侵入空気	———			good, not good
16	Color of smoke	煙 の 色	———			good, not good
17	Air heater	空気予熱器	———			exist, not exist
	Air temp.	空気温度	———			
	Inlet	入　口	°C			
	Outlet	出　口	°C			

	Item	項　目	Unit 単位	Nominal 定　格	Actual 実　績	Remarks 備　考
	O_2 % Inlet	入口	%			
	Outlet	出口	%			
	Waste gas temp.	排ガス温度	———			
	Inlet	入口	°C			
	Outlet	出口	°C			
18	Economizer	エコノマイザー	———			exist, not exist
	Waste gas temp.	排ガス温度	———			
	Inlet	入口	°C			
	Outlet	出口	°C			
	Feed water temp.	給水温度	———			
	Inlet	入口	°C			
	Outlet	出口	°C			
19	Automatic Controller	自動制御	———			exist, not exist
	Subject	対象	———			Steam press. air ratio
	System	方式	———			
	Operation	作動	———			good, not good
20	Steam accumulator	スチームアキュムレーター	———			exist, not exist
	Capacity	容積	m^3			
	Pressure	圧力	kg/cm^2G			
22	Evaporation ratio	蒸発倍数	Kg/kg,ℓ			
	Boiler efficiency	ボイラ効率	%			Hn base, Hl base
	Loss with waste gas	排ガス損失	Kcal/h			

	Item	項　　目	Unit 項 目	Nominal 定　格	Actual 実　績	Remarks 備
23	Soot blow	スートブロー	/d			
	Service a burner	バーナー手入	/m			
	Removal of scale	スケール除去	———			
	Air heater	空気予熱器	/y			
	Economizer	エコノマイザー	"			
	Gas duct	煙　　道	"			
	Stack	煙　　突	"			
	Cleaning burner tip	バーナチップ手入	/m			

2-4 Steam Piping, Condensate Recovery (蒸気管, ドレン回収)

Steam Piping Insulation Leakage	蒸気配管 保温 漏洩				
Recovery of Flashed Steam Cylinder Hood	フラッシュ蒸気の利用 シリンダー上のフード	exist, not exist 有 無			
Condensate Recovery Flow Rate System	ドレン回収 発生量 回収率 回収方式	 m^3/h % open, closed			
Steam Trap Type No. of Unit Present Condition	スチームトラップ 形式 数量 作動状況	 good, not good			
Flow Sheet Steam Condensate	フローシート 蒸気 ドレン				

Diagnoser		Date	Factory

Equipment List

No.	equipment	type
1	Portable Doppler Flowmeter	PD3
2	Hotwire Anemometer	V-02-A700
3	Heat Insulation Tester	MH2
4	Oxygen Meter	OX61 (6232)
5	Pocket Thermometers	2542
6	Thermopetter	#400
7	Portable Radiation Thermometer	IR-HP2
8	Pocket Conductivity Meter	SC51
9	Pocket PH Meter	PH51
10	Working Efficiency Check Meter	ECM-IR
11	Lux-Meter	ANA-999
12	Clip-on AC Power Meter	2433
13	Clamp-on Power Hi Tester	3136
14	Integrator	3141
15	Digital Printer	3142
16	Micro Hi Corder	8202
17	Volt Slider	S-260
18	Multitester	3009
19	Digital Hygrometer	2577