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1　合同評価報告書

JOINT EVALUATION REPORT
ON
JAPANESE TECHNICAL COOPERATION
FOR
THE AUTOMOTIVE FUEL RESEARCH PROJECT
FOR ENVIRONMENTAL IMPROVEMENT
IN THE KINGDOM OF THAILAND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

RESEARCH AND TECHNOLOGY INSTITUTE,
PETROLEUM AUTHORITY OF THAILAND

JUNE 30, 1999
BANGKOK, THE KINGDOM OF THAILAND

MUTUALLY ATTESTED AND SUBMITTED

TO ALL CONCERNED

JUNE 30, 1999

BANGKOK, THE KINGDOM OF THAILAND

Mr. Shigemaro AOKI
Leader
Japanese Evaluation Team
Japan International Cooperation Agency
(JICA)
Japan

Mr. Narong Rattana
Leader
Thai Evaluation Team

The Kingdom of Thailand

CONTENTS

I . INTRODUCTION

1. The Evaluation Teams

The Japanese Evaluation Team (hereinafter referred to as "the Japanese Team") organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Mr. Shigemaro AOKI, visited the Kingdom of Thailand from June 14 to June 30, 1999 for the purpose of evaluating jointly with the Thai Evaluation Team (hereinafter referred to as "the Thai Team") the achievement of the Japanese technical cooperation for "The Automotive Fuel Research Project for Environmental Improvement in the Kingdom of Thailand" (hereinafter referred to as "the Project") on the basis of the Record of Discussions signed on April 11, 1995 (hereinafter referred to as "R/D").

Both teams discussed and studied together the efficiency, effectiveness, impact, relevance, sustainability and future perspective of the Project.

Through careful studies and discussions, both teams summarized their findings and observations as described in this document.

2. Schedule of Joint Evaluation

(June 14 – June 30, 1999)

Date	Schedule
	(Member in charge of Project Analysis and Evaluation)
June 14, 1999 (Mon)	Arrive in Bangkok
June 15, 1999 (Tue)	Interview of Counterparts / Bureau of Fuel Oil
June 16, 1999 (Wed)	Interview of NEPO / Pollution Control Department
June 17, 1999 (Thu)	Interview of Long-term experts
June 18, 1999 (Fri)	Interview of Counterparts
June 19, 1999 (Sat)	Data analysis
June 20, 1999 (Sun)	Data analysis
June 21, 1999 (Mon)	Arrive in Bangkok (Other members of the Japanese Team) Field survey (Member in charge of Project Analysis and Evaluation)
June 22, 1999 (Tue)	Internal Meeting and Discussion with the JICA Thai Office, Courtesy call to the Embassy of Japan and DTEC, Courtesy call and Discussion with the PTT
June 23, 1999 (Wed)	Discussion with the JICA Experts / R&T Institute
June 24, 1999 (Thu)	Interview survey with Counterparts
June 25, 1999 (Fri)	Discussion with the R&T Institute
June 26, 1999 (Sat)	Internal Meeting
June 27, 1999 (Sun)	Internal Meeting
June 28, 1999 (Mon)	Discussion with the Thai Team, Preparation of Joint Evaluation Report (draft) and M/D (draft)
June 29, 1999 (Tue)	Discussion with the Thai Team
June 30, 1999 (Wed)	Joint Evaluation Meeting (Signing of the Joint Evaluation Report and Minutes of Discussions) Report to the Embassy of Japan and the JICA Thai Office Leave Bangkok for Tokyo

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3. Members of Evaluation Teams

3-1. Japanese Side

Mr. Shigemaro AOKI	Leader
Ms. Atsuko SARUHASHI	Technical Cooperation Planning
Mr. Kiyohiro TACHIKI	Fuel and Exhaust Evaluation & Analysis
Mr. Takaoki HARADA	Evaluation Management
Mr. Shigeru KOBAYASHI	Evaluation Analysis

3-2. Thai Side

Mr. Narong Rattana	Thai Director, Thai-German Institute, Ministry of Industry
Ms. Hathairattana Garivait	Environmental Scientist 6, Environmental Research and Training Center, Ministry of Science, Technology and Environment
Ms. Duanghathai Chenchaivitha	Programme Officer Level 6, Monitoring and Evaluation Sub-Division, Planning Division, Department of Technical and Economic Cooperation (DTEC)
Ms. Hataichanok Siriwadhanakul	Programme Officer Level 6, Japan Sub-Division, External Cooperation Division 1, DTEC
Ms. Tanyaporn Lertlaksana	Programme Officer Level 4, Japan Sub-Division, External Cooperation Division 1, DTEC

II. METHODOLOGY OF EVALUATION

1. Method of Evaluation

Both teams agreed to use the Project Design Matrix (PDM) as the basis of evaluation, and evaluated activities by the Evaluation Grid.

2. Aspects for Evaluation

Both teams reviewed all activities and achievement, and evaluated the project based on the following five aspects:

Efficiency

Effectiveness

Impact

Relevance

Sustainability

These aspects represent the most important points to be taken into consideration in connection with decisions on development projects.

3. Information for Evaluation

In order to evaluate past performance, the following materials were used:

(1) The Record of Discussions (R/D), Tentative Schedule of Implementation (TSI), Technical Cooperation Program (TCP), Annual Work Plans, Minutes of Discussions, and other documents agreed to or accepted in the course of implementation of the Project.

(2) The Project Design Matrix (Annex 1)

(3) Input and output data from the Project

(4) Result of series of interviews and questionnaires

Ⅲ. BACKGROUND AND SUMMARY OF THE PROJECT

1. Outline of Project's Background

The automobile market in Thailand has expanded rapidly since the late 1980's following rapid economic development. A quarter of the total number of automobiles is concentrated in Bangkok and the traffic congestion in Bangkok is well known all over the world. In addition, air pollution caused by exhaust emissions from vehicles has worsened remarkably. This air pollution has a bad influence on not only the health of residents but also on social and economic development in Thailand. Therefore, it is necessary to reduce air pollution by introducing prompt countermeasures such as improvement of automotive fuel.

On the other hand, the Government of Japan informed the Government of the Kingdom of Thailand of a new scheme of cooperation aimed at contributing to global environment protection, namely "the offer-based project-type technical cooperation scheme for environmental pollution protection" as a means for taking prompt countermeasures against the above situation. In June 1994, a Project Formulation Team was dispatched by the Government of Japan which discussed with the Thai side this Japanese cooperative plan. In response to this proposal, the Government of the Kingdom of Thailand submitted an official application form for Japanese technical cooperation in October 1994.

The Government of Japan accepted this request and dispatched an Implementation Survey Team to Thailand in April 1995, and made the decision to implement project type technical cooperation for the Automotive Fuel Research Project for Environmental Improvement in the Kingdom of Thailand, which purposed to transfer techniques for designing environmentally-friendly automotive fuel.

2. Chronological Review of the Project

A chronological review of the Project is shown in Annex 2.

3. Objectives of the Project

The objectives of the Project were stipulated in the PDM as follows:

Super Goal:	Environmentally-friendly and technologically-feasible automotive gasoline will be introduced into the Thai market to reduce air pollution.
Overall Goal:	The Government of the Kingdom of Thailand formulates specification of the environmentally-friendly automotive gasoline on the basis of the technical advice and proposal by the Research and Technology Institute (hereinafter referred to as "R&T Institute") of the Petroleum Authority of Thailand (hereinafter referred to as "PTT").
Project Purpose:	R&T Institute of the PTT has the ability to give technical advice and offer proposals on the properties and composition of environmentally-friendly and technologically-feasible automotive gasoline.

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4. Tentative Schedule of Implementation

The Tentative Schedule of Implementation (TSI) is shown in Annex 3.

5. Technical Cooperation Program

The Technical Cooperation Program (TCP) is shown in Annex 4.

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IV. RESULT OF EVALUATION

1. Summary

Efficiency

Construction of the R&T Institute was delayed about one and a half years due to a flood at the construction site and shortage of the labors. This delay in construction influenced the installation of provided equipment and dispatch of short-term experts. However, most of the activities achieved their objectives owing to adjustment of the project schedule in August 1998. Most of the provided equipment was well utilized and maintained. It was considered that most of the input was efficiently converted to output. Even though some subjects have not yet set to work at this stage, necessary technical transfer is expected to be completed by the end of project period.

Effectiveness

Most of the necessary techniques for formulating the composition of environmentally-friendly gasoline were effectively transferred. Since May 1999, the R&T Institute has joined "the Study on Changes in Specification for Gasoline and Diesel Fuels for Thailand" which is organized by National Energy Policy Office (hereinafter referred to as "NEPO"). The R&T Institute is supposed to submit technical information and data to NEPO for formulating specification of environmentally-friendly gasoline. Therefore, it is concluded that project purpose will be achieved during the project period.

Impacts

The R&T Institute is the only institute to implement automotive fuel research in Thailand. It seems that the importance of the R&T Institute will rise rapidly in the automotive and petroleum refining sectors, which will help to raise Thai societies' consciousness of the automotive fuel research. In addition, the Thai nation's awareness of the quality of gasoline has been improved since the Project joined together with the Royal Project.

Relevance

The project purpose, overall goal and super goal followed the policy of the Eighth National Economic and Social Development Plan. The components of the Project are also well designed according the research methodology.

Sustainability

The R&T Institute will continuously implement the project activities through the contract researches. Regarding the budget, maintenance cost and personnel expenses are prepared by PTT, and research budget is obtained through the contract researches at a request of related parties. From the technical view point, the counterparts serve as competent researchers and will transfer the acquired techniques to other researchers and technicians.

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Future perspective

It is thought that the project purpose will be achieved by the end of the project period, and technical information and data will be submitted to NEPO by March 2000. However, emission regulations have been internationally tightened up in recent years.
Consequently, the R&T Institute should acquire planning ability of the research to submit more advanced information.

2. Details

2-1. Efficiency

	Efficiency	Indicator	Constraints
(1) Scale of Cooperation (input)	Japanese side 1) Dispatch of Japanese experts The number of experts, their duration of stay and fields of expertise are considered appropriate and well balanced to the output. Long-term experts: Eight long-term experts of different areas as described in the R/D were dispatched by JICA. They made technology transfer to Thai counterparts according to the TSI and TCP. - Chief Advisor (2) - Coordinator (1) - Chassis Dynamometer System Mechanic (1) - Cooperative Fuel Research (CFR) Engine / Engine Dynamometer Mechanic (2) - General Properties Analyst (2) Short-term experts: 16 short-term experts of different areas were dispatched by JICA in order to transfer technology in each specific area. In addition, two more experts will be dispatched in 1999. - Installation of Chassis Dynamometer (6) - Expert Seminar on Automotive Fuel (1) - Supervise for Installation of Bench Engine System (4) - Effect of Gasoline Components on Exhaust Emission (1) - Gasoline Engine Structure and Exhaust Gas Composition / Fuel Composition (1) - Gasoline Engine Oil and its Additives (1) - Installation of Blow-by Gas Meter for Bench Engine System (1) - Gasoline Composition and Exhaust Gas (1)		
	2) Provision of equipment Equipment equivalent to approx. 370 million yen was provided as part of technical cooperation. Items and quantity of equipment were well balanced to the output. Most of the equipment was well utilized and maintained.	Annex 6	
	3) Counterpart training in Japan Nine counterparts were trained in Japan and two more will be trained in 1999. The subject of training and number of trainees were appropriate. However, some counterparts commented that the training period was short.	Annex 7	
	4) Expenses Total expenses of the Japanese side were approx. 749 million yens. This amount is well balanced to the outputs.	Annex 8	

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	Efficiency	Indicator	Constraints
	Thai side 1) Allocation of counterpart personnel Appropriate number of counterparts was allocated to the Project. All of the counterparts have a sufficient educational background. 2) Building and facilities The Thai side prepared the Building of the R&T Institute. All of the equipment provided by Japan was installed in this building. 3) Provision of equipment The Thai side prepared all of the necessary items such as office supplies. 4) Budget allocation by the Thai side Aggregated expenditure for the Project will reach approx. 39 million Baht by February 2000.	Annex 9 to 12 Annex 13	
(2) Timing of Cooperation	Japanese side 1) Dispatch of Japanese experts Both long-term and short-term experts were dispatched in a timely manner except CFR/Bench engine experts. The first CFR/Bench engine expert could not finish his training schedule due to delay of the Bench engine provision. 2) Provision of equipment Most of the equipment was installed behind schedule. Especially, the bench engine was provided almost one year behind the schedule. This delay of the Bench engine provision had a serious influence on the schedule of the research activities. 3) Counterpart training in Japan Counterpart training was implemented on schedule.		The Bench engine provision was delayed. Installation of most of the equipment was delayed.
	Thai side 1) Allocation of counterpart personnel Counterparts was allocated in a timely manner in general. 2) Building and facilities Construction of the R&T Institute was delayed about one and a half years. 3) Provision of equipment All of the equipment was provided in a timely manner.		Construction of the building was delayed

	Timing of Implementation The construction of the R&T Institute was delayed about one and a half years. The main reasons for the delay are as follows: - The construction activities were delayed because of a flood in Autumn 1995. - The contract constructor couldn't prepare the required manpower and construction materials.		
(3) Supporting System	1) The Joint Coordinating Committee The Joint Coordinating Committee was held in order to assist the project activities. 2) The Technical Advisory Committee in Japan The Technical Advisory Committee was organized in Japan in order to support the Project. The committee met at least four times a year to give technical supports to the Project.		

* Efficiency measures the output of the project – qualitative and quantitative – in relation to the total resource input: in other words, how economically various inputs are converted into outputs.

2-2. Effectiveness

	Effectiveness	Indicator	Constraints
(1) Contribution of Activities to Output	The construction of the R&T Institute was intended to be completed in January 1997. However, the "chassis dynamometer room" was completed in February 1997, the "bench engine room" and the "CFR engine room" were completed in October 1997, and the "analytical equipment room" was completed in December 1997. Therefore, series of provided equipment was installed in each phase. In the end, all of the necessary equipment was installed completely in July 1998. However, most of the project activities were started on the schedule except Bench engine, and carried out in alternative spaces such as temporally analytical laboratory. Due to delay of the Bench engine provision, research schedule of this subject was adjusted. Therefore, series of the experiments has been implemented once in a week although it was scheduled for every two weeks. All of the installed equipment was well maintained in accordance with the maintenance plan. Counterparts have already acquired maintenance techniques and maintain the equipment by themselves. Counterparts also mastered the necessary skills through the On the Job Training.		Delay of the Bench engine provision.

	These facilities, equipment and acquired skills were well utilized and the following research activities were carried out: - The pollutants of exhaust emissions of six car models using 15 kinds of Reformulated gasoline (RFG) composition were analyzed. As a result, RFG compositions for less pollutant exhaust emissions were clarified. These results will be reported to government officials concerned in June 1999. In addition, these results were also contributed to Society of Automotive Engineers (SAE). - Volume and composition of Intake Valve Deposit (IVD) and Combustion Chamber Deposit (CCD) inside the engine were compared with the combination of lubricant oil and detergent additives. The detergent additives that leave less IVD were consequently clarified. These results will be reported to government officials concerned in October 1999. In addition, these results were also contributed to SAE. - The positive and negative influence of RFG composition on car fuel supply components was studied. The report on this study will be prepared and presented to government officials concerned in December 1999. - Technology transfer for measurement of octane number requirement will be done by the end of the project period. - "The study on the effect of RFG composition on engine oil stability" is also being implemented from October 1999 to January 2000.	Annex 14	

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(2) Contribution of Output to the project purpose	Effectiveness	Indicator	Constraints
	Counterparts have acquired the necessary techniques and knowledge for giving technical advice and offering proposals on the properties and composition of environmentally-friendly and technologically-feasible automotive gasoline through the achievement of the outputs. The Government of the Kingdom of Thailand has implemented "the Study on Changes in Specification for Gasoline and Diesel Fuels for Thailand" for drawing up the new fuel specifications since May 1999. The committee for this study was organized under NEPO, and the R&T Institute also joined this committee. The R&T Institute is supposed to submit technical information and data to NEPO for formulating specification of environmentally-friendly gasoline. Therefore, it is concluded that project purpose will be achieved during the project period.		

* Effectiveness is a measure of whether the purpose of the project has been achieved, or how likely it is to be achieved. This then is a question of the degree to which the outputs contribute to achieving the intended purpose. It thus also says something about the content of the project and whether it contributes to development in the expected direction.

2-3. Impact

(1) Contribution to the improvement of the concerned sector	• The R&T Institute is the only institute to implement comprehensive research on the effects of fuel on exhaust emissions in Thailand. Therefore, it receives many research proposals and joint research projects from the government sectors and private companies, and R&T Institute will continue to play an important role on the subject in the oil and automotive industries in Thailand. • The automotive emission problem is related to geographical, technical, social and economic situations in each country, in general. Therefore, the solutions that have been adopted in developed countries can not be effectively applied in Thailand. The R&T Institute is fully equipped with research facilities, well-trained researchers and technicians. In addition, the Project is the first comprehensive automotive emission research in Thailand. Consequently, it is expected that the Project will stimulate and raise consciousness of the oil companies, automobile industries and relevant government sectors on the subject.
(2) Contribution to the improvement of the region	• The Project cooperated with the Royal Project, which purposed to study the effects of Ethanol for additives of automotive fuel. This cooperation made good publicity to improve Thai nation's awareness of the quality of gasoline. Because the opening ceremony of the R&T Institute under the sponsorship of the Royal princess was broadcast on the spot, the R&T Institute and the project activities are well known throughout the country.
(3) Others	• Due to the delay of bench engine installation, training program for the counterparts was modified and additional subjects were prepared . As a result, the counterparts acquired not only maintenance technique but also overhaul technique for the CFR engine.

* The impact is intended and unintended, direct and indirect, positive and negative changes as a result of the project. The starting point of the assessment of the impact is to examine what other effect have come about as a result of the project, besides the direct intended effect of the project (=project purpose). They may be economic, social, technological or environmental effect-locally, regionally or the national level.

2-4. Relevance

(1) Relevance of the project planning	As mentioned in the Eighth National Economic and Social Development Plan, reduction of air pollution is one of the most important subjects in Thailand. Automotive exhaust emission is one of the main causes of air pollution in Bangkok. Therefore, several countermeasures, such as revising the tax system for price reduction of lead-free gasoline and introducing catalytic converter have been taken since the early part of the 1990's. Although these countermeasures were taken, air pollution caused by exhaust emissions has not been improved satisfactorily. Therefore, it is necessary to reduce air pollution by introducing prompt countermeasures such as improvement of automotive fuel. The Project planned to improve the ability of the R&T Institute for making technical advice and offering proposals on the specification for the environmentally-friendly and technologically feasible automotive gasoline. This purpose takes a different approach from other countermeasures and would contribute to reducing toxic substances in the exhaust emissions of automobile. Therefore, it is concluded that the project planning as a whole is relevant.
(2) Relevance of the initial recognition of the needs of the recipient country side	According to the Thai Energy Development Plan, NEPO considers future improvement of quality specifications of gasoline and high speed diesel in order to reduce pollution, e.g., the reduction of sulfur content in gasoline, the increase of the cetane number and decrease of specific gravity in diesel. Although emission from diesel engines is recognized as the most severe automotive emission in Thailand, the improvement of diesel fuel required too complicate research methodology and equipment to be considered as a first comprehensive research project and should be implemented at a later stage when the researchers at the R&T Institute have acquired enough experience from the Project.
(3) Relevance of the cooperation planning (target level ; relationship among the project goals, output, and input; implementation schedule etc.)	A number of similar research projects have been implemented in developed countries, and there is already an established technical method for formulating the specifications of environmentally-friendly automotive gasoline. This project was formulated on the basis of the technical method. Therefore, all technical information which is required to formulate new specifications is able to be acquired through research activities on the subjects of "The effect of RFG composition on exhaust emission", "Octane number requirement", "Effect of detergent additives on gasoline detergency", "Effect of RFG composition on engine oil stability" and "Effect of RFG composition on car fuel supply components". Therefore, it is concluded that the Project was well designed and cooperation planning was relevant as a whole.
(4) Relevance of offer-based environment protection cooperation	The reduction of air pollution is one of the most important subjects in Thailand. Therefore, selection of this subject was certainly pertinent. In addition, a research oriented cooperation which required a long period to accomplish the purpose was timely proposed and effectively implemented using offer-based project-type technical cooperation scheme for environmental pollution protection.

* Relevance means an overall assessment of whether the project is in accordance with both the overall objective, the donor and recipient policy, as well as with local needs and priorities. This is intended to help to clarify whether the project should be continued, reformulated or terminated.

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2-5. Sustainability

(1) Institutional and Managerial Sustainability	The project activities will be continued by the R&T Institute. The R&T Institute carried out contract researches on request by PTT, governmental organization and private sector. One of the main subjects for these contract researches is technical feasibility of the composition of environmentally-friendly gasoline. These research activities will be continuously implemented by the counterparts. Because the need of fuel research is increased, engineers in chemistry, machinery and electricity and technician will be employed in the Engine test department.
(2) Financial Sustainability	The budget of the R&T Institute in 2000 was under preparation when the Japanese Team visited in Thailand. The maintenance cost for facilities and equipment and personnel expenses have been prepared by PTT since the Project started, and these expenses will be prepared by PTT continuously. Regarding the research budget, the R&T Institute obtain it through the contract researches at a request of related parties. One of the funding sources of these contract researches is the Energy Conservation Fund. The total amount of these expenses was 30 million Baht in 1999. It seems that the R&T Institute would be able to arrange the required budget through these contract researches.
(3) Technical Sustainability	Counterparts have already acquired the necessary techniques for implementing the project activities. The R&T Institute has a rotation system of researchers and technicians. The counterparts serve as competent researchers in this rotation system, and transfer the acquired techniques to other researchers and technicians through the seminar and OJT.

* Sustainability is an overall assessment of the extent to which the positive changes achieved as a result of the project can be expected to last after the project has been terminated. In many ways this is a question of the relation between the necessary local resources and how the recipient views the project.

2-6. Future perspective

As mentioned in "2-2 (2)", it is thought that the project purpose will be achieved by the end of the project period, and technical information and data will be submitted to NEPO by March 2000. However, emission regulations have been internationally tightened up in recent years. Consequently, the R&T Institute should acquire planning ability of the research to submit more advanced information.

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V. CONCLUSION

Both the Japanese and Thai Teams discussed and evaluated the efficiency, effectiveness, impact, relevance and sustainability of the Project with PTT officials. Through the careful studies and discussions, both teams concluded that the Project would achieve its purpose during the project period. All of the necessary techniques and methodologies will be acquired by the counterparts through OJT, and various data and information will be accumulated by the end of the Project. Even though there are some subjects that have not completely achieved at this stage, the necessary technical transfer is expected to be completed by the end of the project period.

VI. RECOMMENDATIONS

1. Although the R&T Institute will submit the technical information and data to NEPO, a lot of subjects are still remained to improve the specification of environmentally-friendly gasoline. Currently, the expected role of the R&T Institute is to verify the technical feasibility of proposal of specification that is prepared by the Bureau of Fuel Oil, Ministry of Commerce. Therefore, it is expected that the R&T Institute will attain the position to propose research subjects to the related governmental agencies such as Bureau of Fuel Oil and NEPO, and offers them more technological assistance to formulate the specification of gasoline.
2. Number of the counterparts assigned met an only minimum requirement for the project activities. There were only one researcher assigned for Bench engine/CFR engine group and Chassis Dynamometer group respectively, and one technician was assigned for driver of chassis dynamometer. It imposed a severe burden on these counterparts. It is expected that the R&T Institute implements appropriate training programs for new researchers and technicians.
3. The Government of the Kingdom of Thailand requested a new technical cooperation project that targeted exhaust emissions from diesel engines. However, this requested project also requires some facilities and equipment that were provided by the Project. Therefore, the Japanese Team suggested that the R&T Institute should draw up a plan for facility utilization and a plan for personnel allocation to avoid duplication between the projects.
4. This project is implemented as the offer-based environment protection cooperation. The advantage of this scheme is that it is able to shorten project preparation period. The environmental protection is the international issue, and it is required to take prompt measures. The Japanese Team wishes the Government of the Kingdom of Thailand would utilize this scheme more than ever.

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LIST OF ANNEXES

Annex 1

Project Design Matrix (1/2)

Project title : Automotive Fuel Research Project for Environmental Improvement in the Kingdom of Thailand — Duration : March 1, 1996 to February 29, 2000

Project area : Ayutthaya, Thailand — Target Group :Research and Technology Institute of the Petroleum Authority — Prepared by JICA Evaluation Team on June 14, 1999

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
[Super Goal] Environmentally-friendly and technologically-feasible automotive gasoline will be introduced into the Thai market to reduce air pollution.	• New specific environmentally-friendly automotive gasoline are sold in the Thai market.	• Statistical record of Bureau of Fuel Oil • Production records of fuel refining companies.	• Governmental Policy on prevention of air pollution will not change.
[Overall Goal] The Government of the Kingdom of Thailand formulates specification of the environmentally-friendly automotive gasoline on the basis of the technical advice and proposal by the R&T Institute of the PTT.	• New specification on automotive gasoline for reducing toxic substances in exhaust gas is established by the year 2005	• Specification of automotive gasoline	• Economic situation will not get worse rapidly.
[Project Purpose] R&T Institute of the PTT has the ability to give technical advice and offer proposals on the properties and composition of environmentally-friendly and technologically-feasible automotive gasoline.	• R&T Institute submits technical information and data to Thai Government for drawing up the specification of environmentally-friendly and technologically-feasible automotive gasoline.	• Submitted reports from R&T Institute to Thai Government	• Governmental regulation on the quality of automotive gasoline is strengthened. • Thai refining industry will not oppose to introduce the environmentally-friendly automotive gasoline.
[Output] 0 The management and operation system of the Project will be established. 1 Various measurement and analysis equipment for automotive gasoline and lubricant oil will be installed. 2 Preventive maintenance system for machinery and equipment will be established and effectively utilized. 3 Various technologies concerning measurement, analysis, evaluation and designing of product properties will be acquired by Thai counterparts. 4 Various data on analysis, evaluation and formulation concerning automotive gasoline will be accumulated and effectively utilized.	0 Necessary staffs for the project operation and maintenance are allocated, and duties are assigned to the staffs. 1 Necessary facilities and equipment mentioned in R/D are installed on TCP's schedule. 2 Counterparts can maintain the machinery and equipment by themselves. 3 Counterparts are able to implement measurement, analysis, evaluation and designing of product properties by themselves. 4 The results of study on "The effect of RFG composition on exhaust emission", "Octane number requirement", "Effect of detergent additives", "Effect of RFG composition on engine oil stability" and "Effect of RFG composition on car fuel supply components" are presented to governmental organization concerned.	0 Annual report of the Project 1 Annual report of the Project 2-1 Evaluation by JICA experts 2-2 Maintenance record of equipment 3 Evaluation by JICA experts 4-1 Records of meeting to the related parties 4-2 Number of published technical reports in each field	• Counterparts will be continuously employed as permanent employee. • The industrial / governmental / academic authorities concerned will cooperate to the project activities.

Project Design Matrix (2/2)

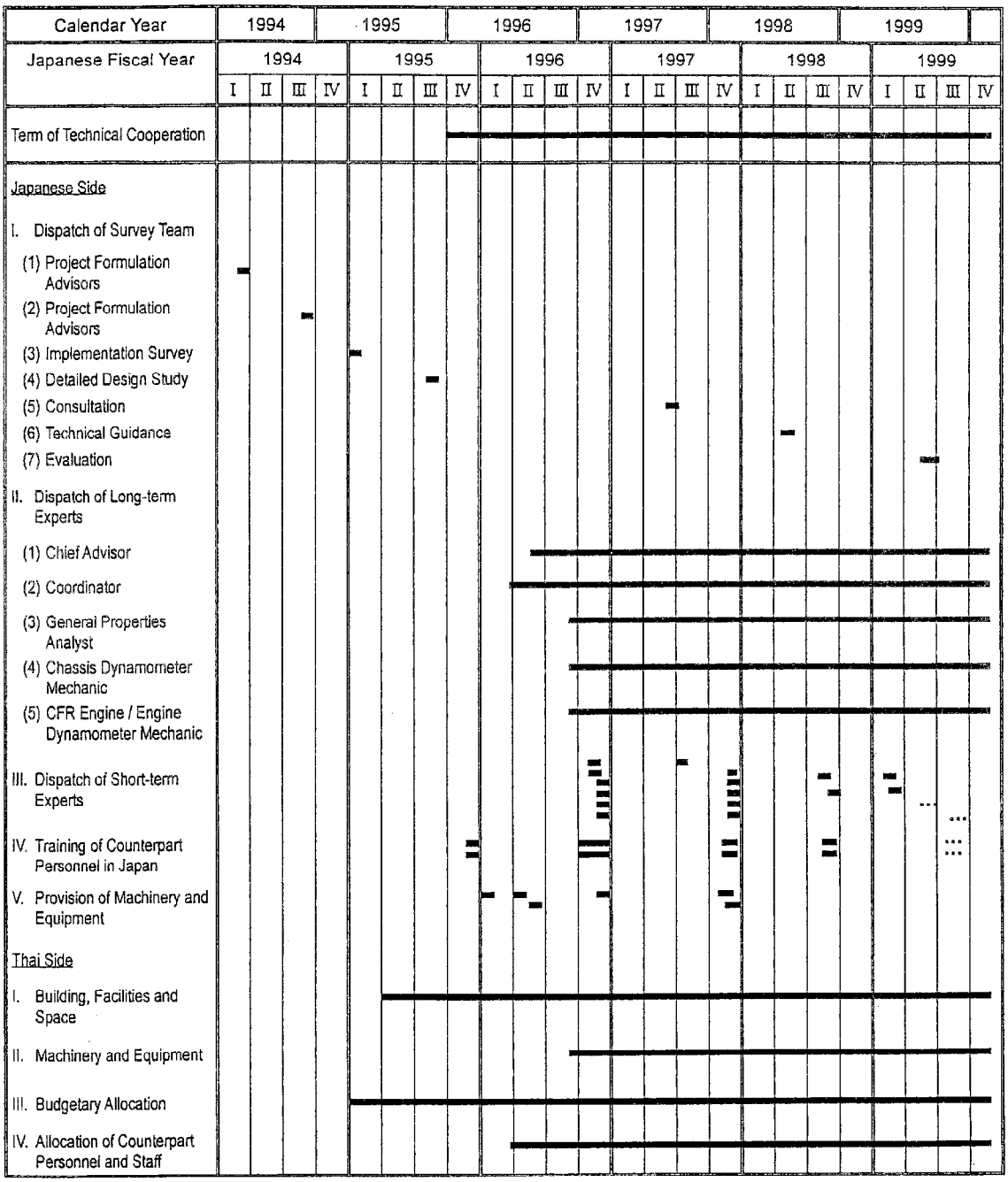
Narrative Summary	Input		Important Assumption
【Activities】 0-1 Allocate staffs. 0-2 Make operation plan of the Project. 0-3 Make and implement budget plan properly. 1-1 Make specification of the machinery and equipment for various measurement and analysis. 1-2 Make layout plans for the machinery and equipment as well as phased plans for installation. 1-3 Provide and purchase the machinery and equipment for various measurement and analysis. 1-4 Transport, install and adjust the machinery and equipment. 1-5 Procure supplementary materials and accessories. 1-6 Prepare supplementary operational manuals for the machinery and equipment. 2-1 Make maintenance plan for the machinery and equipment. 2-2 Make maintenance manuals for the machinery and equipment. 2-3 Implement the maintenance as planned. 3-1 Make training programs for the counterparts in the following techniques ; - operation of the machinery and equipment properly for various measurement and analysis - evaluation of measured and analyzed results - formulation of product properties 3-2 Make training materials. 3-3 Implement the training program. 4-1 Accumulate the measured and analyzed data. 4-2 Make reports on the accumulated data. 4-3 Hold meeting to explain reports to the related parties. 4-4 Prepare for the future proposal on the formulation of environmentally-friendly gasoline based on accumulated data.	Japanese side 1) Dispatch of Experts -Long Term Experts 206.07M/M ① Chief Advisor ② Coordinator ③ Chassis Dynamometer System Mechanic ④ CFR Engine/Engine Dynamometer Mechanic ⑤ General Project Analyst -Short Term Experts 8subjects, 11.93MM 2) Expenses by Japanese Side (X1,000) ¥ 748,732 - Dispatch of Survey Team ¥ 31,873 - Dispatch of Experts ¥ 328,369 - Acceptance of C/P Training ¥ 3,403 - Provision of Machinery & Equipment ¥ 370,436 - Local Budget ¥ 12,067 - Supplementary Local Budget ¥ 2,584 3) Overseas Training 9 staffs, 5.67MM Two more staffs will be trained in 1999.	Thai side 1) Counterparts 19 persons ①Project Manager ②Deputy Project Manager ③Properties Group ④Engine Group ⑤Administrative Group 2) Land and buildings - Research and Technology Institute - Other land, building and facilities necessary for the implementation of the Project 3) Financial Inputs (x 1,000) - Local running cost B 39,378.0	• Machinery and equipment provided by the Japanese side will obtain easy custom clearance.
			【Preconditions】 • Necessity of research activities for preventing air pollution will not be decreased. • PTT will have a strong intention to establish its Research and Technology Institute in order to implement research activities for preventing air pollution. • Construction of the Research and Technology Institute will not be delayed much.

Chronological Review of Project

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
Process of the Project Request : October, 1994 R/D: April 11, 1995 TSI: April 11, 1995 M/D:	Project Formulation Team Request Submission	Project Formulation Team (Phase II) Implementation Survey Team Detailed Design Study Team	The Automotive Fuel Research Project for Environmental Improvement	Consultation Team	Technical Guidance Team	Evaluation Study Team
Project Formulation Team : 5 members June 20, to July 1, 1994	1) Leader 2) Technical Cooperation Planning 3) Fuel Evaluation Technique 4) Exhaust Gas Evaluation Technique 5) Operation & Management					
Project Formulation Team : 4 members December 12, to December 22, 1994		1) Leader 2) Fuel Analysis 3) Practical Experiment 4) Exhaust Gas Evaluation Technique				
Implementation Survey Team : 6 members April 2, to April 13, 1995		1) Leader 2) Technical Cooperation Planning 3) Training Planning 4) Analytical Equipment Planning 5) Engine Equipment Planning 6) Operation & Management				
Detailed Design Study Team : 5 members November 13, to November 24, 1995		1) Leader 2) CDS & Exhaust Gas Evaluation System 3) CDS Planning 4) Exhaust Gas Evaluation System Planning 5) Coordinator				
Consultation Team : 4 members September 28, to October 4, 1997			1) Leader 2) Technical Cooperation Planning 3) Technical Transfer Planning 4) Project Management			
Technical Guidance Team : 2 members August 19, to August 22, 1998				1) Technical Transfer Planning 2) Project Management		
Evaluation Study Team : 5 members June 14, to July 1, 1999		1) Leader 2) Technical Cooperation Planning 3) Fuel and Exhaust Gas Evaluation & Analysis 4) Evaluation Management 5) Evaluation & Analysis				
Dispatching Japanese Experts Long Term Experts: 8 persons (206.07MM)		1 st Dispatching Experts was on June 22, 1996	Input MM/year : **28.27MM** 1. Chief Advisor 2. Coordinator 3. Chassis Dynamometer System Mechanic 4. CFR Engine / Engine Dynamometer Mechanic 5. General Properties Analyst	Input MM/year : **60.00MM** 1. Chief Advisor 2. Coordinator 3. Chassis Dynamometer System Mechanic 4. CFR Engine / Engine Dynamometer Mechanic 5. General Properties Analyst	Input MM/year : **61.97MM** 1. Chief Advisor 2. Coordinator 3. Chassis Dynamometer System Mechanic 4. CFR Engine / Engine Dynamometer Mechanic 5. General Properties Analyst	Input MM/year : **55.83MM** 1. Chief Advisor 2. Coordinator 3. Chassis Dynamometer System Mechanic 4. CFR Engine / Engine Dynamometer Mechanic 5. General Properties Analyst
Short Term : 8subjects(11.93MM)			**1Subjects 6Experts 7.07MM**	**2 Subjects 5 Experts 3.53MM**	**3 Subjects 3 Experts 0.93MM**	**2 Subjects 2 Experts 0.40MM**
Counterparts Overseas Training: 9 trainees 5.67MM		2 persons 1) Automotive Fuel Research for Environmental Improvement 2) Automotive Fuel Research for Environmental Improvement (0.87MM)	2 persons 1) General Property Analysis of Gasoline 2) General Property Analysis of Gasoline (1.87MM)	2 persons 1) The Effect of Gasoline Composition and Additive on Exhaust Emission and IVD 2) The Effect of Gasoline Composition and Additive on Exhaust Emission and IVD (1.13MM)	2 persons 1) General Property Analysis of Gasoline 2) General Property Analysis of Gasoline (1.80MM)	
Expenses by Japanese Side (x1,000)						
1) Dispatch of Survey Team ¥ 31,873	¥ 14,840	¥ 8,137		¥ 2,232	¥ 864	¥ 5,800
2) Dispatch of Experts ¥ 328,369			¥ 66,625	¥ 126,374	¥ 68,170	¥ 67,200
3) Acceptance of C/P Training ¥ 3,403		¥ 555	¥ 844	¥ 584	¥ 850	¥ 570
4) Provision of Machinery and Equipment ¥ 370,436		¥ 19,025	¥ 199,771	¥ 147,973	¥ 3,667	
5) Local Budget ¥ 12,067			¥ 2,429	¥ 3,077	¥ 4,748	¥ 1,813
6) Supplementary Local Budget ¥ 2,584					¥ 2,584	
Others						

Annex 3

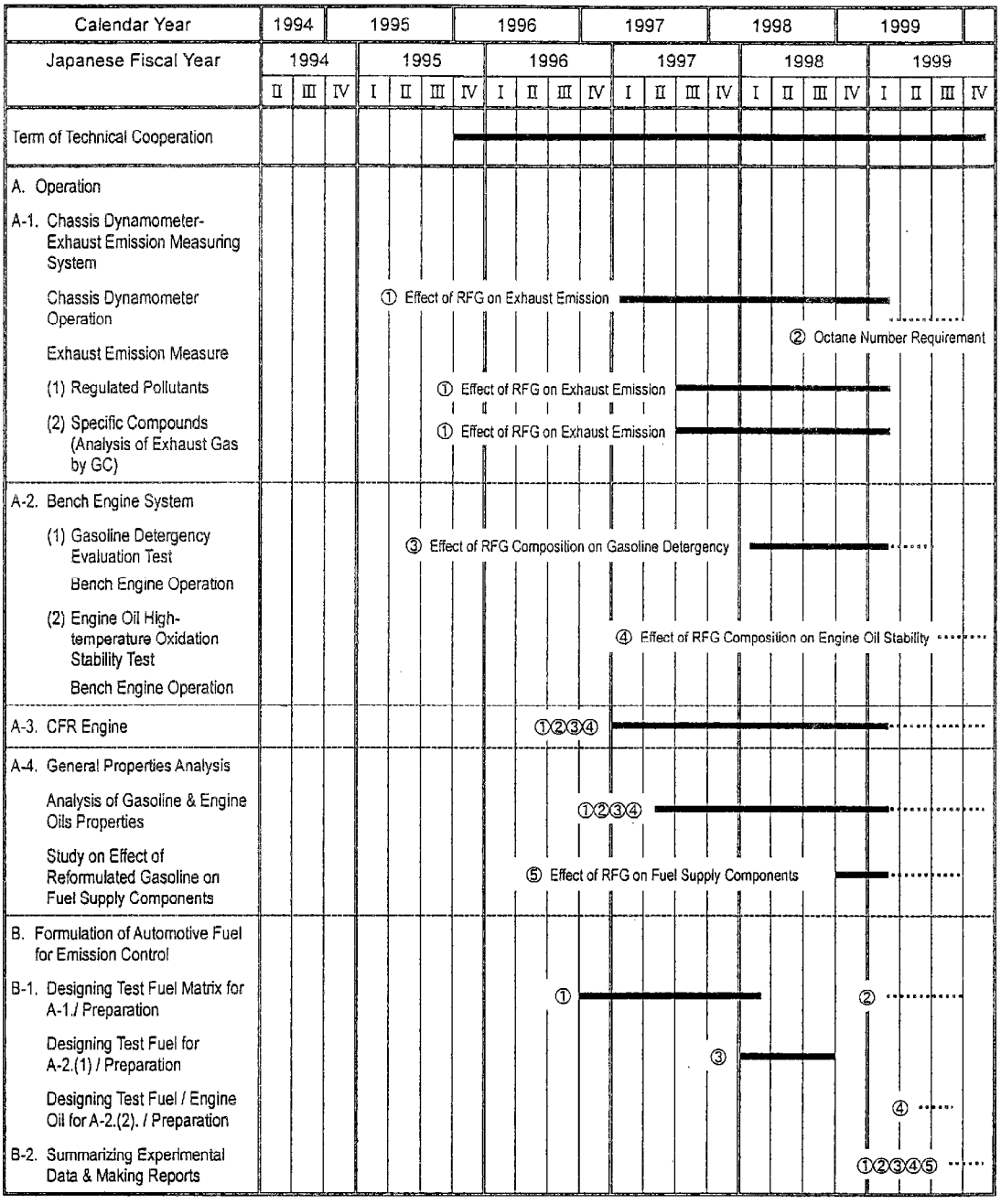
TENTATIVE SCHEDULE OF IMPLEMENTATION (TSI)



Note: 1. Japanese fiscal year starts in April and ends in March.
2. ▬▬ = finished in implementation, ····· = to be implemented

Annex 4

TECHINICAL COOPERATION PROGRAM (TCP)



Note: 1. ①~⑤ indicates each research subject. RFG: Reformulated Gasoline
2. ▬▬ = finished in implementation, ····· = to be implemented

Annex 5

LIST OF JAPANESE EXPERTS

1. LONG-TERM EXPERTS

Chief Advisor	
Dr. Yoji Komatsu	27 August, 1996 to 26 August, 1998
Mr. Yasuo Yamamoto	17 August, 1998 to 29 February, 2000
Coordinator	
Mr. Yoichi Kogure	22 June, 1996 to 29 February, 2000
Chassis Dynamometer System Mechanic	
Mr. Tsuguo Kimura	6 December, 1996 to 29 February, 2000
CFR Engine / Engine Dynamometer Mechanic	
Mr. Kazuo Kakugawa	6 December, 1996 to 5 August, 1998
Mr. Daijiro Hosogai	20 July, 1998 to 29 February, 2000
General Properties Analyst	
Mr. Akio Takase	6 December, 1996 to 5 August, 1998
Mr. Kazuki Fukuda	20 July, 1998 to 29 February, 2000

2. SHORT-TERM EXPERTS

Installation of Chassis Dynamometer	
Mr. Kazutaka Ohashi	2 February, 1997 to 28 February, 1997
Mr. Minoru Motegi	2 February, 1997 to 2 March, 1997
Mr. Masato Sugiyama	29 March, 1997 to 5 May, 1997
Mr. Isao Itoh	5 April, 1997 to 3 May, 1997
Mr. Zenjiro Yoshimura	29 March, 1997 to 5 May, 1997
Mr. Hiroyuki Arima	29 March, 1997 to 28 April, 1997
Expert Seminar on Automotive Fuel (including Diesel Oil)	
Mr. Masabumi Yoshimura	8 October, 1997 to 17 October, 1997

Supervise for Installation of Bench Engine System

Mr. Shigeru Nemoto	2 March, 1998 to 2 April, 1998
Mr. Hiroshi Igarashi	31 March, 1998 to 14 April, 1998
Mr. Masahiro Takahashi	31 March, 1998 to 28 April, 1998
Mr. Yasuyoshi Tsuji	9 April, 1998 to 28 April, 1998

Effect of Gasoline Component on Exhaust Emission

Mr. Toshio Shimizu	5 March, 1998 to 14 March, 1998

Gasoline Engine Structure and Exhaust Gas Composition / Fuel Composition

Mr. Yasunori Takei	November 5, 1998 to November 13, 1998

Gasoline Engine Oil and its Additives

Mr. Yasuhisa Yamada	December 10, 1998 to December 18, 1998

Installation of Blow-by Gas Meter for Bench Engine System

Mr. Hideki Nojiri	May 10, 1999 to May 15, 1999

Gasoline Composition and Exhaust Gas

Mr. Ken-ichiro Saito	May 31, 1999 to June 5, 1999

(Scheduled in FY99 – 1 person for each subject)

Survey Method of Octane Number Requirement	September 1999
Thermal Stability of Engine Oil and Engine Evaluation	November 1999

Annex 6

LIST OF MACHINERY AND EQUIPMENT PROVIDED BY JICA

Fiscal Year	Item	Amount	F*	M*	Installation		
					Delivery	Plan	Result
1995	Automatic Distillation Tester Model: AD-5 (Tanaka Scientific) 1 set	¥2,525,000	B	A	April 1996	Feb. 1997	Jan. 1998
1995	Automatic Vapor Pressure Tester Model: AVP-30D (Tanaka Scientific) 1 set	¥2,507,000	B	A	April 1996	Feb. 1997	Jan. 1998
1995	Oxidation Stability Tester of Gasoline Model: 1B-781 (Tanaka Scientific) 1 set	¥620,000	B	A	April 1996	Feb. 1997	Mar. 1998
1995	Density Specific Gravity Meter Model: DA-300 (Kyoto Electronics) 1 set	¥1,210,000	B	A	April 1996	Feb. 1997	Jan. 1998
1995	Copper Corrosion Testing Apparatus Model: 1A-133 (Tanaka Scientific) 1 set	¥549,000	C	A	April 1996	Feb. 1997	Dec. 1997
1995	Existing Gum Testing Apparatus Model: 1B-612N (Tanaka Scientific) 1 set	¥2,009,000	B	A	April 1996	Feb. 1997	June 1998
1995	Automatic Sulfur Analyzer Model: MCTS-130 (Dohrmann) 1 set	¥6,380,000	B	A	April 1996	Feb. 1997	Jan. 1998
1995	Gasoline Analysis System Model: GAS-90 (Cosmo Trade & Service) 1 set	¥10,000,000	B	A	July 1996	Feb. 1997	Jan. 1998
1995	Gas Chromatography (A) Model: 5890A (Hewlett-Packard) 1 set	¥8,170,050	B	A	Aug. 1996	Feb. 1997	Jan. 1998
1995	Gas Chromatography (C) Model: G1540A (Hewlett-Packard) 1 set	¥4,418,925	A	A	Aug. 1996	Feb. 1997	Jan. 1998
1995	Chassis Dynamometer & Exhaust Emission Measurement System Model: N/A* (Banzai /Best Instrument) 1 system	¥125,000,000	A	A	Jan. 1997	Dec. 1996	Apr. 1997
1996	Kinematic Viscometer Model: 75943-1 (Precision) 1 set	B263,000 (¥1,261,611)	B	A	July 1997	July 1997	Jan. 1998
1996	Apparatuses for Insoluble in Used Lubricating Oils Model: 67318 (Precision) 1 set	B377,000 (¥1,808,469)	C	A	July 1997	July 1997	Jan. 1998
1996	Potentionmetric Titimeter Model: DL25/ST20 (Mettler Toledo) 1 set	B564,600 (¥2,708,386)	B	A	July 1997	July 1997	Jan. 1998
1996	Automatic Flash Point Apparatus Model: ACO-5 (Tanaka Scientific) 1 set	B265,000 (¥1,271,205)	B	A	July 1997	July 1997	Jan. 1998

Fiscal Year	Item	Amount	F*	M*	Installation		
					Delivery	Plan	Result
1996	Trace Nitrogen Analyzer Model: 7000N (Antek) 1 set	B1,130,000 (¥5,420,610)	B	A	July 1997	July 1997	Jan. 1998
1996	Automatic Carbon Residue Apparatus Model: ACR-5 (Tanaka Scientific) 1 set	B193,000 (¥925,821)	B	A	July 1997	July 1997	Jan. 1998
1996	Water Content Analyzer in Liquid petroleum Products Model: 701KF (Metrohm) 1 set	B257,000 (¥1,232,829)	B	A	July 1997	July 1997	Jan. 1998
1996	Strain-Stress Measurement Machine Model: AD4937 (A&D) 1 set	B485,000 (¥2,326,545)	C	A	July 1997	July 1997	Jan. 1998
1996	Rubber Hardness Tester Model: 61-270 (Coesfeld) 1 set	B99,000 (¥474,903)	B	A	July 1997	July 1997	Jan. 1998
1996	CFR Engine Model: 8001 (Waukesha) 1 system	B6,027,023 (¥28,911,627)	C	A	July 1997	July 1997	Nov. 1997
1996	Bench Engine System Model: N/A* (Meidensha) 1 system	¥73,603,500	A	A	Feb. 1998	June 1997	May 1998
1997	Trapping System of Aldehyde in Exhaust Gas Model: N/A* (GL Science) 1 system	B6,700,000 (¥22,739,800)	A	A	June 1998	July 1998	July 1998
1997	High Performance Liquid Chromatography Model: G1312A (Hewlett-Packard) 1 set	B1,854,000 (¥6,292,476)	A	A	June 1998	July 1998	July 1998
1997	Maintenance Parts for Aldehyde Trapping System (10 items)	B704,350 (¥2,390,564)	A	A	June 1998	June 1998	June 1998
1997	Maintenance Parts for Chassis Dynamometer (9 items)	B1,239,100 (¥4,205,505)	B	A	May 1998	May 1998	May 1998
1997	Blow-by Gas Meter for Bench Engine System Model: N/A* (Meidensha) 1 set	¥2,300,000	D	A	April 1999	May 1999	May 1999

Note: N/A*: does not have model name (custom configuration / custom made)

F*: Usage Frequency (A: everytime B: often C: sometimes D: seldom use)

M*: Maintenance (A: very good B: good C: not good D: abandoned)

Annex 7

LIST OF THAI COUNTERPART PERSONNEL TRAINED IN JAPAN

Automotive Fuel Research for Environmental Improvement

Mr. Vijit Tangnoi	4 March, 1996 to 16 March, 1996
Mr. Nirod Akarapanjavit	4 March, 1996 to 16 March, 1996

General Property Analysis of Gasoline

Ms. Arunratt Wuttimongkolchai	2 March, 1997 to 29 March, 1997
Mr. Suttipong Tunyapisetsak	2 March, 1997 to 29 March, 1997

The Effect of Gasoline Composition and Additive on Exhaust Emission and IVD

Mr. Thummarat Thummadetsak	17 February, 1998 to 6 March, 1998
Mr. Wattanapong Khankeaw	17 February, 1998 to 6 March, 1998

General Properties Analysis of Gasoline

Ms. Jiraporn Ansomboon	November 24, 1998 to December 11, 1998
Ms. Nattasuda Sakulpatsith	November 24, 1998 to December 11, 1998
Mr. Mongkol Jampamee	November 24, 1998 to December 11, 1998

(Scheduled in FY99)

Octane Number Requirement and Bench Engine

Mr. Tharapong Pengsakul	October 1999
Mr. Chaiwat Panpaew	October 1999

Annex 8

EXPENSE BY JAPANESE SIDE

Item \ Japanese Fiscal Year	1994	1995	1996	1997	1998	1999	Total
Dispatch of Survey Team	14,840	8,137	0	2,232	864	5,800	31,873
Dispatch of Experts	0	0	66,625	126,374	68,170	67,200	328,369
Acceptance of C/P Training	0	555	844	584	850	570	3,403
Provision of Machinery and Equipment	0	19,025	199,771	147,973	3,667	0	370,436
Local Budget	0	0	2,429	3,077	4,748	1,813	12,067
Supplementary Local Budget	0	0	0	0	2,584	0	2,584
Total	**14,840**	**27,717**	**269,669**	**280,240**	**80,883**	**75,383**	**748,732**

Unit: Thousand Japanese Yen

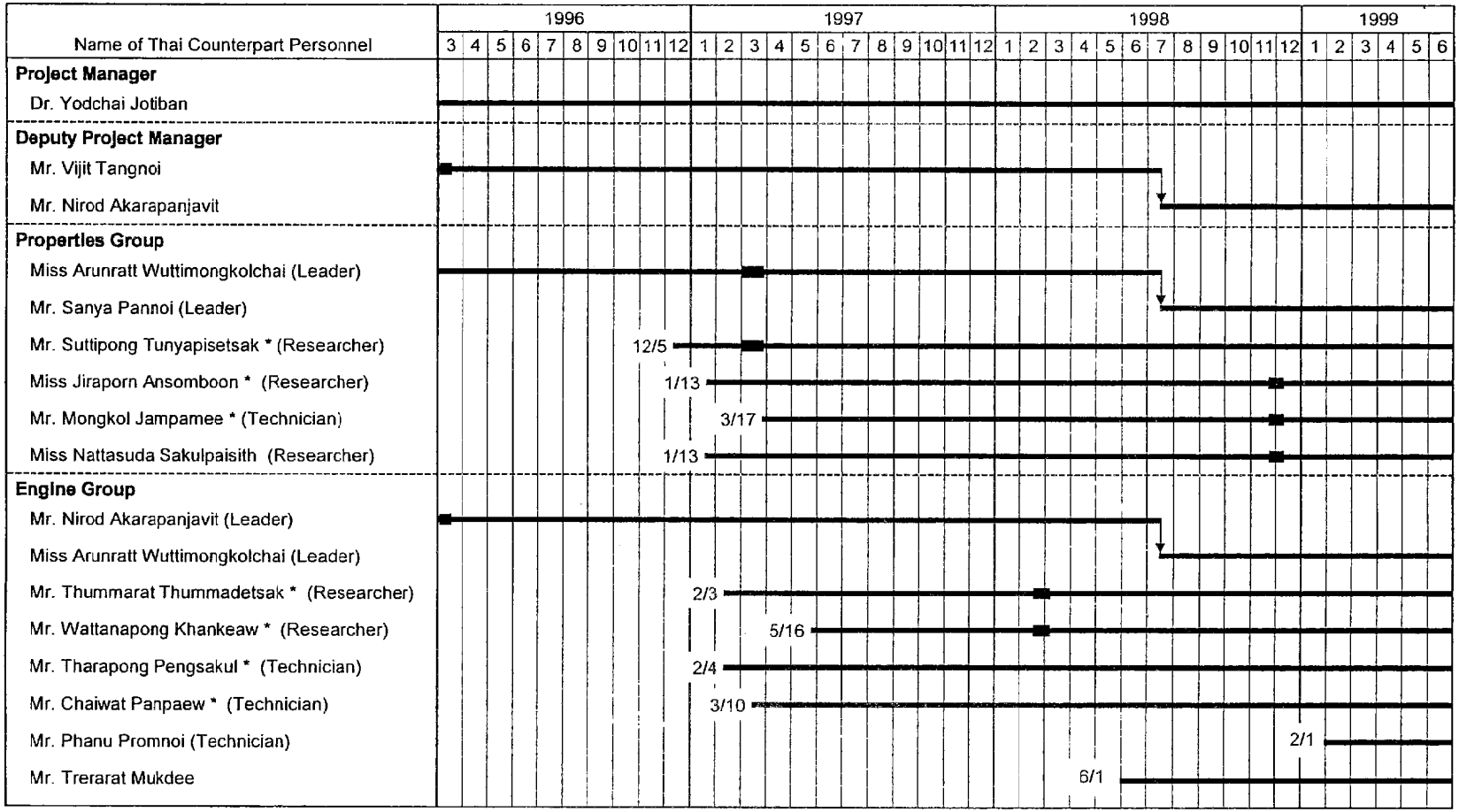
Note: Japanese Fiscal year 1998 and 1999 includes estimation.

Annex 9

LIST OF THAI COUNTERPART PERSONNEL AND ADMINISTRATIVE STAFF

Project Manager	Dr. Yodchai Jotiban
Deputy Project Manager	Mr. Nirod Akarapanjavit
Properties Group	Mr. Sanya Pannoi
	Mr. Suttipong Tunyapisetsak
	Miss Jiraporn Ansomboon
	Mr. Mongkol Jampamee
	Miss Nattasuda Sakulpaisith (Part-time)
Engine Group	Miss Arunratt Wuttimongkolchai
	Mr. Thummarat Thummadetsak
	Mr. Wattanapong Khankeaw
	Mr. Tharapong Pengsakul
	Mr. Chaiwat Panpaew
	Mr. Phanu Promnoi
	Mr. Trerarat Mukdee (Part-time)
Administrative Staff	Miss Ratri Srisaneha
	Mrs. Tippawan Chutiteparak
	Mr. Surachai Yaisoongnern
	Mr. Sampas Chulasukol
	Miss Duangporn Kongsri (Secretary)

Allocation of Thai Counterpart Personnel (1996-1999 Result)

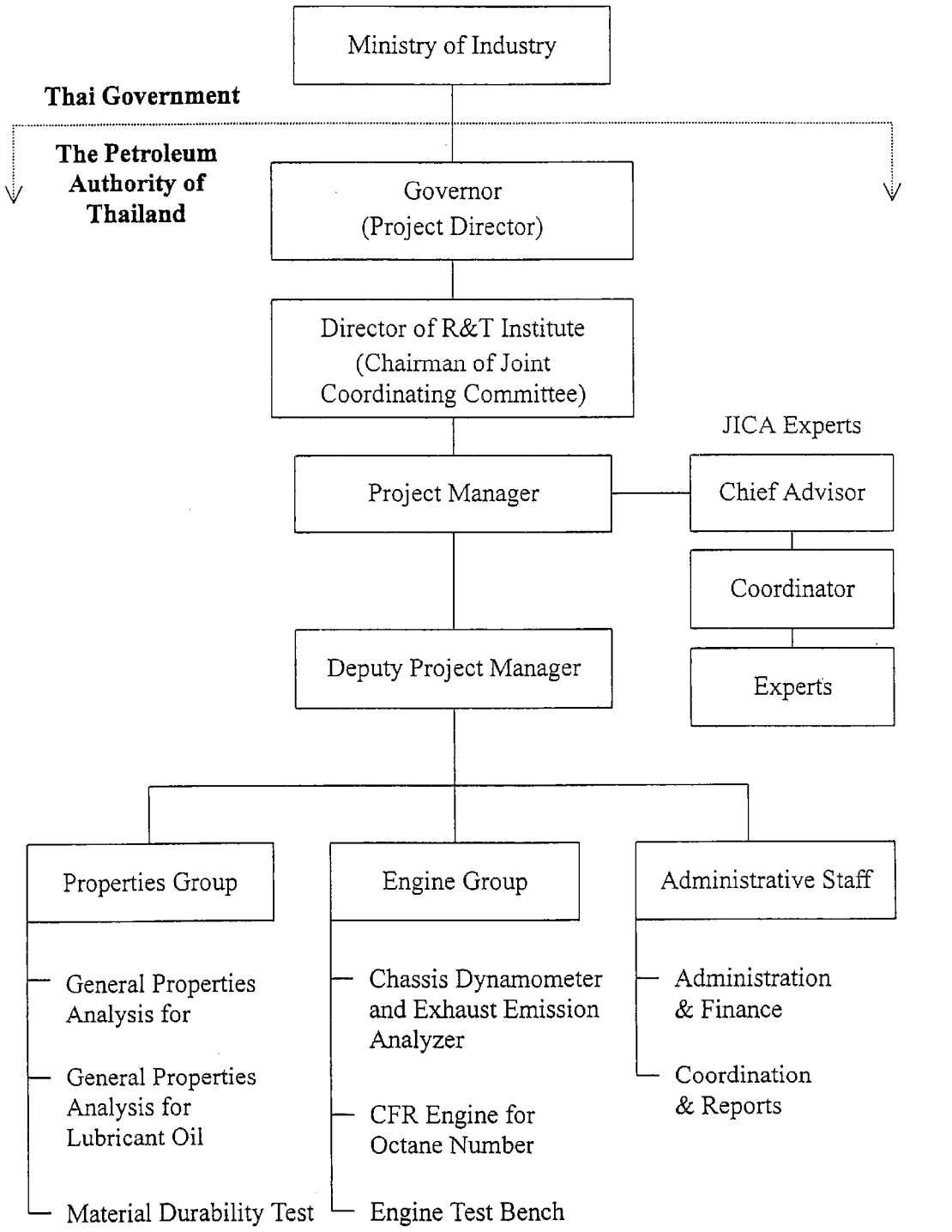


Note 1: * indicates full-time counterpart of the project

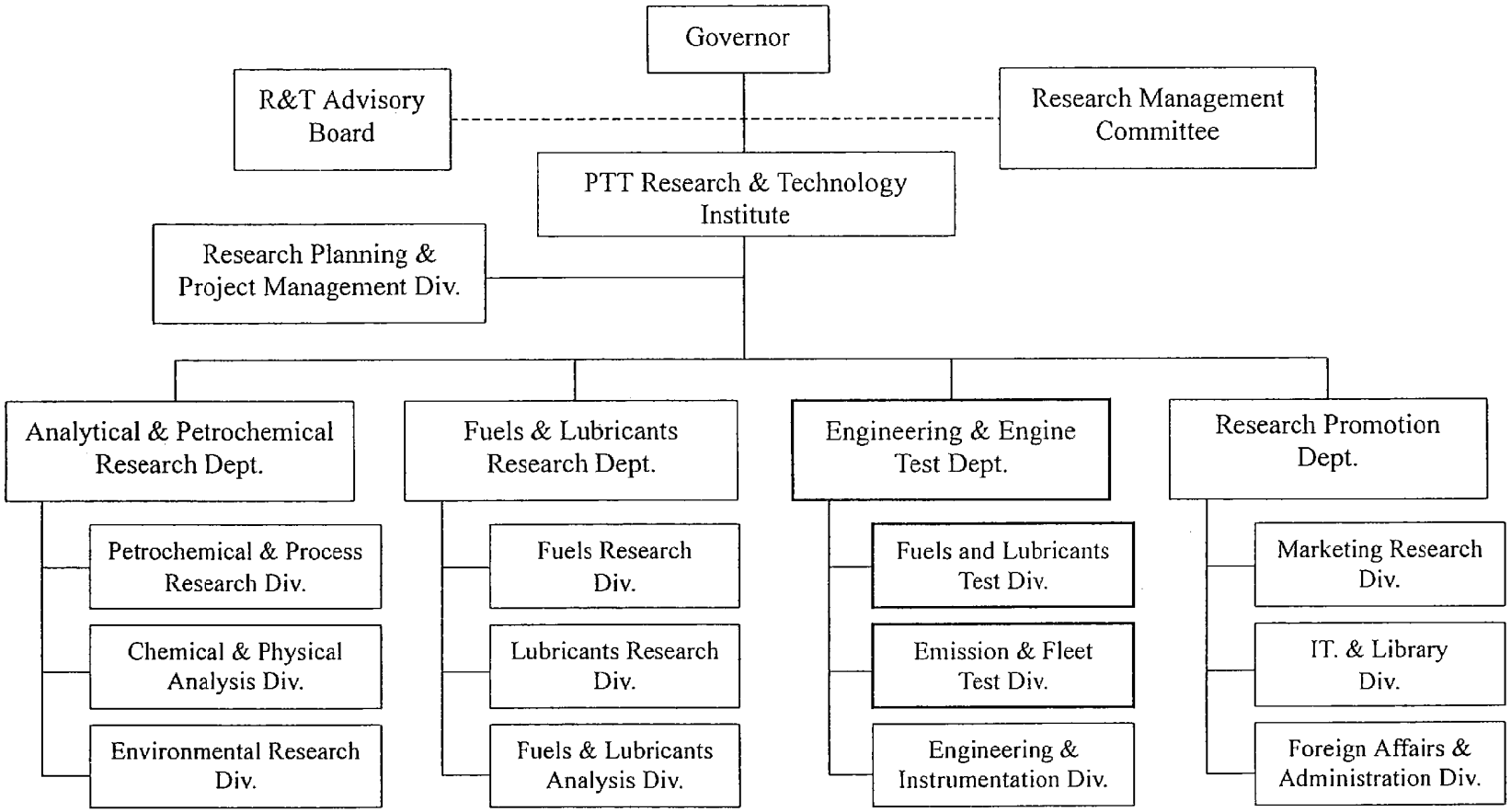
Note 2: ▬ indicates counterpart training in Japan

Annex 11

ORGANIZATION CHART OF PROJECT



ORGANIZATION CHART OF PTT RESEARCH & TECHNOLOGY INSTITUTE



Annex 12

Annex 13

BUDGET ALLOCATION BY THAI SIDE
(PTT FY1997-2000)

Unit : Baht

PTT Fiscal Year	1997	1998	1999	2000
Annual Budget of R&T Institute	95,675,60	84,978,370	155,129,960	136,000,000
Annual Budget of the Project				
1. Salaries, wages and employee welfare	3,000,000	3,500,000	4,000,000	750,000
2. Employee development expense	-	219,000	210,000	35,000
1. Vehicles Rent	1,200,000	1,640,000	1,804,000	500,000
2. Spare Parts	528,000	1,120,200	1,241,500	313,500
3. Consumable Materials	1,000,000	2,299,800	2,520,500	636,500
4. Maintenance Fee	1,506,000	1,546,000	1,700,600	400,000
5. Clearance Expense + Duty Tax	500,000	350,000	350,000	100,000
6. Photo copying Machine Rent	150,000	-	-	-
7. Land Rent / Structure Rent	200,000	-	-	-
8. Allowance & Pen Diem	30,000	30,000	30,000	10,000
9. Consultancy Service	-	600,000	600,000	150,000
10. Training + Seminar	-	80,000	80,000	40,000
11. Entertainment	30,000	30,000	30,000	15,000
12. Temporary Worker	864,000	995,000	995,000	250,000
13. Petroleum Oil	672,000	377,000	400,000	100,000
Total	9,680,000	12,787,000	13,611,000	3,300,000

N. Luttama

Annex 14

LIST OF PUBLISHED REPORTS &MANUALS

Reports

Development of Fuel Products for Minimal Environmental Impact in Thailand.	March, 1998
IVD Test Result	Dec, 1998
The Effect of Gasoline Composition and Properties on Tailpipe Emission of Currently Existing Vehicles in Thailand	May, 1999
Development of a TOYOTA 1G-FE IVD Test in Thailand (SAE-Paper)	(Oct. 1999)
Effect of Gasoline Compositions and Properties on Tailpipe Emissions of Currently Existing Vehicles in Thailand (SAE Paper)	(Oct. 1999)

Manuals

Operation Manual for Chassis Dynamometer, Constant Volume Sampler, Analyzer and Data Processor (English edition)	June, 1997
Operation Manual for Chassis Dynamometer, Constant Volume Sampler, Analyzer and Data Processor (Thai edition)	June, 1997
Manual for Making Gasoline Sample (English edition)	Nov. 1997
Manual for Making Gasoline Sample (Thai edition)	Jan. 1998
Maintenance Manual for Exhaust Emission Analyzer (English edition)	Dec. 1998
Automatic Carbon Residue Tester	Feb. 1999
Gasoline Analysis System (GAS-90)	March, 1999
Liquid Chromatograph for the analysis of aldehydes in emission (HP1100)	April, 1999
Oxidation Stability Tester of Gasoline	May, 1999
Gas Chromatograph for the analysis of oxygenates and benzene (HP5890)	June, 1999
Gas Chromatograph for the analysis of benzene in emission (HP6890)	June, 1999
Gas Chromatograph for the analysis of 1,3-butadiene in emission (GC353B)	June, 1999
Automatic Distillation Tester	June, 1999
Automatic Vapor Pressure Tester	June, 1999
Existing Gum Testing Apparatus	June, 1999
Automatic Sulfur Analyzer	June, 1999
Density Specific Gravity Meter	June, 1999
Copper Corrosion Testing Apparatus	June, 1999
Kinematic Viscometer	June, 1999
Universal Centrifuge	June, 1999
Automatic Flash Point Tester	June, 1999
Potentiometric Titration Meter	June, 1999
Trace Nitrogen Analyzer	June, 1999
Water Content Analyzer	June, 1999

N. Rattana

Strain-Stress Measurement Machine	June, 1999
Rubber Hardness Tester	June, 1999
Oven	June, 1999
Balance	June, 1999
CFR Operation	June, 1998
Dynamometer	(Dec. 1999)
Actuator	(Dec. 1999)
Check Standard	(Dec. 1999)

2 ミニッツ (M／D)

MINUTES OF DISCUSSIONS
BETWEEN THE JAPANESE EVALUATION TEAM AND THE AUTHORITIES CONCERNED OF THE GOVERNMENT OF THE KINGDOM OF THAILAND ON JAPANESE TECHNICAL COOPERATION FOR THE AUTOMOTIVE FUEL RESEARCH PROJECT FOR ENVIRONMENTAL IMPROVEMENT IN THE KINGDOM OF THAILAND

The Japanese Evaluation Team (hereinafter referred to as "the Japanese Team") organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Mr. Shigemaro AOKI, visited the Kingdom of Thailand from June 14 to June 30, 1999 for the purpose of evaluating jointly with the Thai Evaluation Team (hereinafter referred to as "the Thai Team") the achievement of the Japanese Technical Cooperation Project for the Automotive Fuel Research Project for Environmental Improvement in the Kingdom of Thailand (hereinafter referred to as "the Project") on the basis of the Record of Discussions signed on April 11, 1995 (hereinafter referred to as "the R/D").

After the Joint Evaluation of the Project, the Japanese Team discussed with the authorities concerned of the Government of the Kingdom of Thailand the matters required for the successful implementation of the Project.

As a result of the discussion, both sides mutually agreed upon the matters referred to in the document attached here.

June 30, 1999
Bangkok

Mr. Shigemaro AOKI
Leader
Japanese Evaluation Team
Japan International Cooperation Agency
(JICA)
Japan

Dr. Yodchai Jotiban
Director, Engineering and engine test Department
Research and Technology Institute,
Petroleum Authority of Thailand (PTT)
The Kingdom of Thailand

THE ATTACHED DOCUMENT

1. Recognition of the Joint Evaluation Report

Both sides recognized the Joint Evaluation Report submitted as the result of the joint work by the Evaluation Teams.

2. Further Input to the Project until February 29, 2000

Both sides confirmed that the present activities shall be continued until the termination of the cooperation period (Annex 1). Also, in consideration for the progress of the Project, the input plan until February 29, 2000 was prepared as follows ;

(1) Dispatch of Short-term Experts:

- Survey Method of Octane Number Requirement 1 person 1 week in September 1999
- Thermal Stability of Engine Oil and Engine Evaluation 1 person 1 week in November 1999

(2) Counterpart Training in Japan

Two counterparts will be trained for two weeks in October 1999.

(3) Provision of Equipment

None

3. Assurance of the Sustainability of the Project

In reply to the comment by the Japanese side that sustainability is an important factor, the Thai side expressed their intention to put emphasis on activities for securing the sustainability of the Project.

4. Operation and Maintenance Management on Provided Equipment

In reply to the comment by Japanese side that it is important to secure the cost for operation and maintenance of the provided equipment, the Thai side stated their recognition of it.

5. List of Attendance

The attendance at the meeting is as shown in Annex 2.

Annex 1

TCP Detail (1999-2000 Plan)
(Items in TSI / External Activities)

Activities	1999							2000	
	6	7	8	9	10	11	12	1	2
Japanese Side									
1. Dispatch of Short-term Expert									
1.1 Survey Method of Octane Number Requirement				1 expert x 1					
1.2 Thermal Stability of Engine Oil and Engine Evaluation				1 expert x 1					
2. Training of Counterpart in Japan									
Octane Number Requirement and Bench Engine					2 CP x 2 weeks				
Thai Side									
1. Building, Facilities and Space									
Office of the Project									
Room for Chassis Dynamometer									
Room for Bench Engine System									
Room for CFR Engine									
Room for General Properties Analysis									
2. Machinery and Equipment									
3. Budgetary Allocation									
4. Allocation of Counterpart Personnel & Staff									
5. Public Presentation on Project Results									
SAE International Conference at Canada						10/25-28			
Final Report to Thai Government								2/M ▲	

TCP Detail (1999-2000 Plan)

(A-1. Chassis Dynamometer - Exhaust Emission Measuring System)

Activities	1999 6	7	8	9	10	11	12	2000 1	2
1. Exhaust Emission Measure									
Presentation of Test Result	▬								
2. Octane Number Requirement									
2.1 Determination of ONR									
Making Blending Chart of FBRRF*	▬								
Blending Reference Fuel (PRF* & FBRRF)	▬	▬	▬	▬	▬	▬	▬		
Experimental Operation (Training Acceleration & Audible Knock)	▬	▬	▬	▬	▬	▬	▬		
Writing Manual & Making Report							▬	▬	▬
Presentation of Test Result								▬	
2.2 Planning ONR Survey in Thailand									
Estimation of ONR Distribution				▬	▬				

* FBRRF: Full Boiling Range Reference Fuel
* PRF: Primary Reference Fuel

(A-2. Bench Engine System)

Activities	1999 6	7	8	9	10	11	12	2000 1	2
1. Gasoline Detergency Evaluation Test									
Effect of Gasoline Components, Additives and Lubricant Oil on IVD (CCD)	▬	▬	▬	▬					
Manual Writing	▪	▪	▪	▪	▪	▬	▬		
Report Writing					▬	▬	▬		
Presentation of Test Result						▬			
2. Engine Oil High-Temperature Oxidation Stability Test									
Final Decision of Research Plan				▬					
Overhaul / Measuring / Reassembling / System Assembling					▬	▬			
Experiment						▬	▬	▬	
Disassembling / Rating							▬	▬	
Report Writing									▬

TCP Detail (1999-2000 Plan)

(A-3. CFR Engine)

Activities	1999							2000	
	6	7	8	9	10	11	12	1	2
Octane Number Measurement (as needed)	▪▪▪	▪▪▪	▪▪▪	▪▪▪	▪▪▪	▪▪▪	▪▪▪	▪▪▪	▪▪▪

(A-4. General Properties Analysis)

Activities	1999							2000	
	6	7	8	9	10	11	12	1	2
0. Lecture and Operation Training									
Repeatability & Reproducibility of Testing Method		▬							
1. Analysis of Gasoline & Engine Oil Properties									
General Properties of Lubricating Oil (Used)	▬	▬	▬	▬	▬	▬	▬	▬	▬
TGA for IVD and CCD Test	▬	▬	▬	▬	▬				
Component Analysis for IVD and CCD Test	▬	▬	▬	▬	▬				
Gasoline Analysis for Oxidation Stability Test					▬	▬	▬		
Repeatability & Reproducibility of Testing Method		▬	▬	▬	▬	▬	▬	▬	▬
2. Effect of RFG on Fuel Supply Components									
Gasoline and Elastomer Compatibility Test	▬	▬	▬	▬	▬	▬	▬		
Presentation of Test Result							▬		

(B. Formulation of Automotive Fuel for Emission Control)

Activities	1999							2000	
	6	7	8	9	10	11	12	1	2
1. Formulation of Automotive Fuel									
1.1 Designing of Test Fuel for A-1. / Preparation									
Blending Reference Fuel for ONR	▬	▬	▬	▬	▬	▬	▬		
1.2 Designing of Test Fuel for A-2.(2) / Preparation									
Discussion on Test Fuel				▬					
Procurement of Test Fuel					▬	▬			
2. Summarizing Experimental Data & Making Reports									
Summarizing Data & Making Report								▬	
Final Report to Thai Government								2/M ▲	

Annex 2

LIST OF ATTENDANTS

Japanese side

The Japanese Team

Mr. Shigemaro Aoki	Leader Development Specialist, Institute for International Cooperation (IFIC), Japan International Cooperation Agency (JICA)
Ms. Atsuko Saruhashi	Technical Cooperation Planning Assistant Director, Refining Division, Petroleum Department, Agency of Natural Resources and Energy, Ministry of International Trade and Industry (MITI)
Mr. Kiyohiro Tachiki	Fuel and Exhaust Evaluation & Analysis Researcher, International Cooperation Department, Petroleum Energy Center (PEC)
Mr. Takaoki Harada	Evaluation Management Staff, Second Technical Cooperation Division, Mining and Industrial Development Cooperation Department, Japan International Cooperation Agency (JICA)
Mr. Shigeru Kobayashi	Evaluation Analysis System Science Consultants Co., Ltd.

JICA Experts

Mr. Yasuo Yamamoto	Chief Advisor, The Automotive Fuel Research Project for Environmental Improvement in Thailand, JICA
Mr. Yoichi Kogure	Coordinator, The Automotive Fuel Research Project for Environmental Improvement in Thailand, JICA
Mr. Tsuguo Kimura	Long-term Expert, The Automotive Fuel Research Project for Environmental Improvement in Thailand, JICA
Mr. Daijiro Hosogai	Long-term Expert, The Automotive Fuel Research Project for Environmental Improvement in Thailand, JICA
Mr. Kazuki Fukuda	Long-term Expert, The Automotive Fuel Research Project for Environmental Improvement in Thailand, JICA

Thai Side

The Thai Team

Mr. Narong Rattana	Thai Director, Thai-German Institute, Ministry of Industry
Ms. Hathairattana Garivait	Environmental Scientist 6, Environmental Research and Training Center Ministry of Science, Technology and Environment
Ms. Duanghathai Chenchaivitha	Programme Officer Level 6, Monitoring and Evaluation Sub-Division, Planning Division, Department of Technical and Economic Cooperation (DTEC)
Ms. Hataichanok Siriwadhanakul	Programme Officer Level 6, Japan Sub-Division, External Cooperation Division 1, DTEC
Ms. Tanyaporn Lertlaksana	Programme Officer Level 4, Japan Sub-Division, External Cooperation Division 1, DTEC

Research & Technology Institute, PTT

Dr. Yodchai Jotiban	Director, Engineering & Engine Test Department
Mr. Nirod Akarapanjavit	Manager, Fuels & Lubricants Test Division
Miss Arunratt Wuttimongkolchai	Researcher, Fuels Research Division
Mr. Sanya Pannoi	Manager, Fuels and Lubricants Analysis Division
Mr. Suttipong Tunyapisetsak	Researcher, Fuels and Lubricants Analysis Division
Miss Jiraporn Ansomboon	Researcher, Fuels Research Division
Mr. Thummarat Thummadetsak	Researcher, Emission & Fleet Test Division
Mr. Wattanapong Khankeaw	Researcher, Fuels & Lubricants Test Division
Mr. Tharapong Pengsakul	Technician, Emission & Fleet Test Division
Mr. Chaiwat Panpaew	Technician, Fuels & Lubricants Test Division
Mr. Mongkol Jampamee	Technician, Fuels and Lubricants Analysis Division
Mr. Phanu Promnoi	Technician, Fuels & Lubricants Test Division

3　カウンターパートヒアリング結果

カウンターパートヒアリング結果

1. Bench Engine Group カウンターパート(3 人)
(1999 年 6 月 16 日実施)

1) 専門家に関して

特に問題は認められなかった。OJT による研修を受けたが、非常に効率的であった。後述の通り、日本での研修は十分なものではなかったが、タイ国内で専門家のサポートを受けられたため、業務に問題はでなかった。

2) 機材について

CFRエンジンのスペアパーツは代理店を通してシンガポールまで発注する必要があった。また、ベンチエンジンシステムも新型であったため、スペアパーツは輸入する必要があり、取り寄せには 2 週間から 1 ヶ月かかった。但し、これらのことにより作業が影響を受ける事はなかった。
また、1 実験中(100 時間)に 1 回は停電が起こるが、短時間であるため実験に支障はなかった。

3) 日本での研修

現在まで 1 名が派遣されており、期間中にあと 1 名が派遣予定である。
研修は 3 週間に及んだが、内 1 週間を JICA での研修に費やし、残りの期間ももう 1 名のカウンターパートと一緒に行動することとなったため、効率が悪かった。結果として、自分の分野の研修を受けられたのは 3 日間だけであった。

4) プロジェクトの成果

カウンターパートだけで実験及び機材のメンテナンスを行なえるだけの技術は習得した。今後もタイ側だけで実験の継続は可能である。

ベンチエンジン部門はスタッフが全部で 4 人しかいないため、100 時間の連続実験では 3 交代制でほぼ連日の作業となるが、要員の不足はないと考えている。

2. シャシーダイナモメータグループ
(1999 年 6 月 18 日実施)

1) 専門家について

最初はコミュニケーション上の問題があったが、現在は特に問題は無い。

訓練は OJT で行なわれたが、特に問題はなかった。但し、研修の範囲がプロジェクト内のことに限られたため、他のことは分からない状態にある。海外の研究機関等の現状も勉強したい。

2) 機材について

シャシダイナモメータは「バンザイ」というメーカーのものが納品されたが、当該メーカーのシェアは小さく、日本の研修先でも違うメーカーのシャシダイナモメータが用いられていた。タイ国内の代理店では対応できない問題が多々発生した。

これらの問題への対応により、メンテナンス技術は向上した。日常のメンテナンスはカウンターパートのみで行ない、年に 1 度のメンテナンスは JICA 専門家と行なっている。但し、基本的にメンテナンスは代理店に頼らざるをえない。

JARI から短期専門家が来た際に、バンザイのシャシダイナモメータは精度上、本研究所のような研究機関での使用には向かないと説明された(冷却ファンからの風が一部車体の下に流れ込むが、バンザイの機種ではこれが実験結果に影響を与える)。

プロジェクト終了後も代理店と連絡をとってメンテナンスを続ける事は十分可能である。

3) 日本での研修について
研修期間が短く、実質的に研究所へ訪問したのは 3 日間だけだった。実務レベルの研修が受けられなかった。

4) プロジェクトの成果
必要なことはほとんど習得した。現在、「Octane Number Requirement」の実験を行なっているが、スケジュール通りプロジェクト期間中に終了する予定である。
本プロジェクトの活動以外にも、NEPO や BFO などの他の機関からの実験も多数行なっている。この場合、グループリーダが要請に基づき実験計画を立て、これをリーダと研究者が協議の上確定している。
問題としては、シャシダイナモメータのドライバが 1 名しかいないため非常に厳しい労働条件となっていることが挙げられる。このため、今後、新たなドライバーを育成する計画を有している。

3. 分析グループ
(1999 年 6 月 18 日実施)
1) 専門家について
専門家との間に特に問題はなかった。言葉の問題は多少あったが、これはマイナーな問題である。OJT とセミナーによる研修を受けたが、実務的で非常に良かったと思う。

2) 機材について
供与機材は日本から納入されたものとタイ国内で購入したものに分かれる。タイ国内で購入したものは特に問題ないが、日本から納入した機材に関しては以下のような問題があった。
"Automatic Vapor Pressure Tester"の加温コイルが故障したが交換部品はタイ国内で入手できずに本から取り寄せた。
"Automatic Sulfur Analyzer"は日本から直接購入したため、タイ代理店のサポートサービスが無く、メンテナンスなどを依頼したときには余計な金を支払うこととなっている。
"Strain-Stress Measurement Machine"は研究が要求している能力を満たしていないなめ、必要に応じて他の部局の機械を使用している。
この他にも必要だが配備されていない機材は他の部局のものを借りている。また、一部機材は旧式なものがあり、計測機器に記録用のコンピュータではなくレコーダが設置されていたり、レコーダもついていないものもある。
機材はタイ国内でのサポート体制も考えて選択して欲しい。

3) 日本での研修について
研修期間中に複数の研究所を見学したが、内容が重複していた。訪問先の数を減らして滞在時間を長くたほうが効率的と思う。

4) プロジェクトの成果
基本的に機材のメンテナンスは代理店に任せており、必要に応じてこのための契約も結んでいる。プロジェクト活動を通じて、必要な分析技術は習得した。分析グループは燃料・潤滑油部の職員から成るが、プロジェクト終了後は、各カウンターパートは自分の所属先に戻り、他の研究者や職員に習得した技術を移転する。

4. Project Manager, Dr. Yodchai Jotiban
1) The Study on Changes in Specification for Gasoline and Diesel Fuels for Thailand における R&T 研究所の位置づけ
当該調査は NEPO が実施機関である。アメリカのコンサルタントが大気汚染の主要要因の調査

を行ない、何を減らしたら良いのかを NEPO に提言する。これに対し、R&T 研究所は当該物質を減らす事が技術的に可能か、減らした場合どのような効果が得られるかを過去の実験結果より導き出し、NEPO にアドバイスする。NEPO はこれらを受けて、燃料局へ燃料仕様の作成を依頼する。

R&T 研究所は、各機関より委託研究を受けている。現在、BMA が世銀のローンを使ってバンコク市内の大気汚染に関するプロジェクトを計画している。R&T 研究所は①オートバイ(2 サイクルエンジン)からの微粒子の減少、②ディーゼルエンジンの触媒、③オクタン価調査(現行プロジェクトの継続)を提案している。

なお、MOI には燃料組成に関する部局は R&T 研究所を除いて他にはない。唯一、製油所を担当する部局があるだけである。燃料組成に関する業務の担当は MOC である。

2) R&T 研究所の将来活動

本プロジェクト終了後も、ガソリン組成に関する研究は続けられる。但し、R&T 研究所は独自の研究課題を持っていない。全ての研究は、政府機関、PTT および民間企業からの委託を受けて行なっている。研究依頼は多数あるので、その延長線上で本プロジェクト活動が継続されることとなる。

3) 後継者育成

プロジェクト終了後にエンジンテスト部内での要員のローテーション行なう。これにより、他のスタッフにカウンターパートが習得した技術が伝えられる。また、化学、機械、電気のエンジニアを各 1 名と技術者 1 名を新たに雇用する計画である。

本プロジェクトでのカウンターパートの人数は、必要最低限であったことは認める。但し、100 時間連続実験等の際には補助要員が配置される。今後、同様のプロジェクトが行われる際には、そのプロジェクトのマネージャーが要員を含む組織体制を決定することとなる。

4) 予算

R&T 研究所の予算は2つに大別される。人件費や施設・機材の維持管理費は PTT からの年間予算で賄われている。本プロジェクトで使用した機材の維持管理費もこの予算で賄われている。したがって、今後の機材の(通常の)維持管理費に関しては問題は無い。

研究活動費は、固定予算としては措置されていない。各機関からの委託研究ごとに委託元から研究費をもらっている。

5) 本プロジェクトの問題点

R&T 研究所の活動目的は、燃料全般に係る研究活動である。本プロジェクトはガソリン組成の研究を目的としており、R&T 研究所の目的に沿ったものであった。

技術移転に用いられた OJT も、本研究所では新しい試みであった。通常は、教室での学習により新しい技術を学んでいるが、OJT の方が実務的で効果がある。

本プロジェクトは積極型案件であるが、最初に JICA ミッションが来たときには目的が分からず、誤解があった。PTT は過去に JICA の援助を受けた事はなく、日本側からの提案がなければ、こちらからプロジェクトを要請することは無かったと思う。本プロジェクトは現在は非常に高い評価を受けており、プロジェクトが実施できて良かったと思っている。

本プロジェクトでの問題点は供与機材の仕様の 1 点だけである。タイ側からは Emission analyzer のメーカー指定をしたが受け入れられなかった。指定したメーカーは世界的なシェアを誇るメーカーで、タイ国内のサポート体制も整っている。これに対し、供与されたメーカーはタイ国内に代理店があるものの適切な技術者がおらず、サポート体制が整っていない。このため毎回日本から技術者を呼ぶこととなり、非常にコスト高となる。前回のメンテナンスでは約 1000 万円の見積りとなった。機材の供与に関しては、サポート体制も考慮の上行なって欲しい。

4　関係省庁ヒアリング結果

関係省庁ヒアリング結果

1. 燃料局(Bureau of Fuel Oil)
(1999 年 6 月 16 日実施)
インタビュー対象者　：　Ms. Preeyaporn Vivekaphirat, Director of Bureau of Fuel Oil

1) 大気汚染に係る規制の制定について

燃料局では、NEPO、Pollution Control Department を始めとする関連省庁との協議の上で、ガソリンを始めとする自動車燃料の組成に関する規制を定めている。現在、最も問題となっているのはディーゼルエンジンに由来する微粒子、一酸化炭素、オゾン等である。
1999 年 5 月より 10 ヶ月間をかけて新たな規制を策定するための調査を実施している。規制の制定に際しては、何が大気汚染のパラメータとなるのか、そのパラメータの Source は何か、どのような方法で取り除けるのか、それによって消費者・生産者にどのようなインパクトがあるのかを検討することとなっている。。
但し、現在は経済危機であるため、すぐに規制を行なうことは適切でないと考えている。経済状態が改善され、製油所が新しい規制を受け入れる体制が整った後に規制を行なうこととする。
なお、当該調査には R&T 研究所も参加している。

2) 具体的な規制目標の有無

ガソリン中の芳香族の規制(2000 年以降は 50%から 35%に減少させる)は 7～8 年前より広報している(R&T 研究所が検証している)。今後の具体的な規制目標は、上記の調査結果に基づいて制定されるため、現状ではなんとも言えない。

3) R&T 研究所に期待する役割

R&T 研究所は、既に燃料局の依託で研究(分析)を行なっている。今後も必要に応じてこれらの研究を委託する方針である。
但し、その内容が政策決定に係る項目に関しては、政府としての中立性を保つため、R&T 研究所に一任することはない。CARB を始め海外の研究機関からのコンサルティングサービスを受けることもある。企業(PTT)の下部組織である R&T 研究所だけの試験結果を用いて政策策定をすることは、適切ではないと考えている。

2. National Energy Policy Office (NEPO)
(1999 年 6 月 16 日)
インタビュー対象者　：　Mr. Natie Tabmanie, Chief, Petroleum Business Section

1) 燃料に関する各省庁の役割

バンコクの大気汚染に関しては、多数の政府機関が関係している。燃料の品質調整に関しては、商務省の Commercial Registration Department (CRD)が責任を負っている。CRD は燃料の品質に関する基準発行および基準の実施機関である。NEPO はエネルギー政策全般および燃料の品質に係る計画策定の責任機関である。燃料の仕様に関するあらゆる政策の変更は、CRD と NEPO の責任のもと、財務省、科学・環境省等との協議により決定される。
自動車(新車)に対する排ガス基準は 1992 年に Thailand Industrial Standard Institute により始めて発行された。1995 年には Land Transport Department により始めて Inspection and maintenance program が限定的に実施された。大気汚染に関する政策全般は、科学・環境省の Pollution Control Department(PCD)が責任機関となっている。

2) The Study on Changes in Specification for Gasoline and Diesel Fuels for Thailand について

現在、NEPO が実施責任機関となり、CRD、PCD との共同プロジェクトとして上記の調査を行なっている。本調査では委員会を設置しているが、Bangkok Metropolitan Authority (BMA)や R&T 研究所もメンバーになっている。

R&T 研究所は、コンサルタントの調査結果より導き出された燃料の仕様の技術的検証や環境に対するデータ等を提出することとなっている(詳細内容は R&T 研究所より再確認します)。

3) R&T 研究所への期待

現在、R&T 研究所には Energy Conservation Fund を財源とした燃料基準の検証等を委託している。具体的な研究課題としては、MOC を経由して委託したディーゼルエンジンへの清浄剤の効果等が挙げられる。今後とも、このような委託研究を続けていきたい。

また、R&T 研究所の長期的な役割としては、当該分野に係る政府職員の訓練機関としての役割も期待される。

3. Pollution Control Department (PCD)

(1999 年 6 月 16 日)

インタビュー対象者:Mr. Panya Warapetcharayut, Air Quality and Noise Management Division, PCD,

1) 各種規制について

新車に対する排ガス規制に関しては、現在、新しいものを TISI に提案中である。但し、自動車メーカー側からも意見が出ており、決定するまでには時間がかかる。

燃料の仕様に関しても、PCD はアイディアを持っている。これを実現するためには NEPO と協議をして進める必要がある。技術面に関しては R&T 研究所に依頼することになる。

現在は各種規制は自動車に対するもの、燃料に対するものと分けて考えている。R&T 研究所のプロジェクトの結果は有効に活用できると思う。

PCD は大気汚染物質のモニタリングも行なっているが、現在、一番問題になっているのはディーゼルエンジンに由来する微粒子物質(Particulate)である。一酸化炭素も重要な問題であるが、近年、オゾンも問題になってきている。オゾン増加の原因となる物質を減らすべく、ガソリンスタンドでの蒸発物質回収装置の設置を規制したり、大型貨物車両やオートバイのガソリンタンクにも回収装置を設置することを考えている。

現在の自動車の排ガス規制は、ヨーロッパの規制をそのまま持ってきている。ヨーロッパで策定後、タイへ導入するまでに 2 年ほどのタイムラグがあるが、これを 1 年くらいに縮めたいと考えている。現在発表されている規制は、PCD、陸運局、警察の 3 ヶ所から出されているが、基本となっているのは PCD のものである。

なお、オートバイの排ガス基準は、ヨーロッパの基準では不十分なためタイ独自の基準を設置するとともに、世界で一番厳しい基準である台湾の基準も導入している。

2) R&T 研究所に期待するもの

The Study on Changes in Specification for Gasoline and Diesel Fuels for Thailand は燃料の品質を中心に行なう研究である。この成果を基に燃料の仕様は変更されるが、自動車からの排ガス規制が変更されることはない。

R&T 研究所には、特にディーゼルオイル中のどんな要素をどのように変えたら、どのような変化が起こるのか(改善されるのか)を明らかにしていってほしい。

5　プロジェクト実績概要表（和文）

	1994 年度	1995 年度	1996 年度	1997 年度	1998 年度	1999 年度
協力段階:期間 要請:'94 年 10 月　日 R/D: '95 年 4 月 11 日 TSI: '95 年 4 月 11 日 M/D:	環境保全技術調査員 / 協力要請 / 環境保全技術調査員(二次)	環境保全策定調査 / 実施設計	環境改善自動車燃料研究	計画打合	運営指導	終了時評価
環境保全技術調査員:5 名 1994 年 6 月 20 日～7 月 1 日	1)団長 2)技術協力計画 3)燃料評価技術 4)排ガス評価技術 5)運営管理					
環境保全技術調査員(第 2 次):4 名 1994 年 12 月 12 日～12 月 22 日	1)団長・総括 2)燃料分析 3)実用試験 4)排ガス評価技術					
環境保全策定調査団:6 名 1995 年 4 月 2 日～4 月 13 日		1)団長・総括 2)技術協力計画 3)研修計画 4)機材供与計画(分析) 5)機材供与計画(ｴﾝｼﾞﾝ) 6)運営管理				
実施設計調査団:5 名 1995 年 11 月 13 日～11 月 24 日		1)団長・総括 2)CDS 兼排気ガス分析システム 3)CDS 設計 4)排気ガス分析システム設計 5)業務調整				
計画打合せ調査団:4 名 1997 年 9 月 28 日～10 月 4 日			1)団長・総括 2)技術協力計画 3)技術移転計画 4)プロジェクト運営管理			
運営指導調査団:2 名 1998 年 8 月 18 日～8 月 22 日				1)技術移転計画 2)プロジェクト運営管理		
終了時評価:5 名 1999 年 6 月 14 日～7 月 1 日				1)団長・総括 2)技術協力計画 3)燃料・排ガス評価分析 4)評価管理 5)評価分析		
専門家派遣 長期:8 名(206.07MM)			派遣:1996 年 6 月 22 日 投入人月数:28.27MM 1.チーフアドバイザー 2.業務調整 3.ｼｬｼｰﾀﾞｲﾅﾓﾒｰﾀ 4.CFR ｴﾝｼﾞﾝ/ｴﾝｼﾞﾝﾀﾞｲﾅﾓ 5.一般分析	投入人月数:60.00MM 1.チーフアドバイザー 2.業務調整 3.ｼｬｼｰﾀﾞｲﾅﾓﾒｰﾀ 4.CFR ｴﾝｼﾞﾝ/ｴﾝｼﾞﾝﾀﾞｲﾅﾓ 5.一般分析	投入人月数:61.97MM 1.チーフアドバイザー 2.業務調整 3.ｼｬｼｰﾀﾞｲﾅﾓﾒｰﾀ 4.CFR ｴﾝｼﾞﾝ/ｴﾝｼﾞﾝﾀﾞｲﾅﾓ 5.一般分析	投入人月数:55.83MM 1.チーフアドバイザー 2.業務調整 3.ｼｬｼｰﾀﾞｲﾅﾓﾒｰﾀ 4.CFR ｴﾝｼﾞﾝ/ｴﾝｼﾞﾝﾀﾞｲﾅﾓ 5.一般分析
短期: 8 分野 11.93MM			1 分野 6 名 7.07MM	2 分野 5 名 3.53MM	3 分野 3 名 0.93MM	2 分野 2 名 0.40MM
研修員受入れ: 9 名、5.67MM		2 名 1)環境改善のための自動車燃料分析 2)環境改善のための自動車燃料分析 (0.87MM)	2 名 1)ガソリン一般分析 2)ガソリン一般分析 (1.87MM)	2 名 1)排ｶﾞｽ・VID へのｶﾞｿﾘﾝ組成及び添加物の効果 2)排ｶﾞｽ・VID へのｶﾞｿﾘﾝ組成及び添加物の効果 (1.13MM)	2 名 1)ガソリン一般分析 2)ガソリン一般分析 (1.80MM)	
予算 (x1,000)						
1)調査団派遣費 ￥31,873	￥14,840	￥8,137		￥2,232	￥864	￥5,800
2)専門家派遣費 ￥328,369			￥66,625	￥126,374	￥68,170	￥67,200
3)研修員受入れ費 ￥3,403		￥555	￥844	￥584	￥850	￥570
4)供与機材費 ￥370,436		￥19,025	￥199,771	￥147,973	￥3,667	
5)現地業務費 ￥12,067			￥2,429	￥3,077	￥4,748	￥1,813
6)ローカルコスト支援 ￥2,584					￥2,584	
その他						

5　プロジェクト実績概要表（英文）

Chronological Review of Project

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
Process of the Project Request : October, 1994 R/D: April 11, 1995 TSI: April 11, 1995 M/D:	**Project Formulation Team** **Request Submission**	**Project Formulation Team (Phase II)** **Implementation Survey Team** **Detailed Design Study Team**	The Automotive Fuel Research Project for Environmental Improvement	**Consultation Team**	**Technical Guidance Team**	**Evaluation Study Team**
Project Formulation Team : 5 members June 20, to July 1, 1994	1) Leader 2) Technical Cooperation Planning 3) Fuel Evaluation Technique 4) Exhaust Gas Evaluation Technique 5) Operation & Management					
Project Formulation Team : 4 members December 12, to December 22, 1994		1) Leader 2) Fuel Analysis 3) Practical Experiment 4) Exhaust Gas Evaluation Technique				
Implementation Survey Team : 6 members April 2, to April 13, 1995		1) Leader 2) Technical Cooperation Planning 3) Training Planning 4) Analytical Equipment Planning 5) Engine Equipment Planning 6) Operation & Management				
Detailed Design Study Team : 5 members November 13, to November 24, 1995		1) Leader 2) CDS & Exhaust Gas Evaluation System 3) CDS Planning 4) Exhaust Gas Evaluation System Planning 5) Coordinator				
Consultation Team : 4 members September 28, to October 4, 1997			1) Leader 2) Technical Cooperation Planning 3) Technical Transfer Planning 4) Project Management			
Technical Guidance Team : 2 members August 19, to August 22, 1998				1) Technical Transfer Planning 2) Project Management		
Evaluation Study Team : 5 members June 14, to July 1, 1999		1) Leader 2) Technical Cooperation Planning 3) Fuel and Exhaust Gas Evaluation & Analysis 4) Evaluation Management 5) Evaluation & Analysis				
Dispatching Japanese Experts Long Term Experts: 8 persons (206.07MM)		1 st Dispatching Experts was on June 22, 1996	Input MM/year : 28.27MM 1. Chief Advisor 2. Coordinator 3. Chassis Dynamometer System Mechanic 4. CFR Engine / Engine Dynamometer Mechanic 5. General Properties Analyst	Input MM/year : 60.00MM 1. Chief Advisor 2. Coordinator 3. Chassis Dynamometer System Mechanic 4. CFR Engine / Engine Dynamometer Mechanic 5. General Properties Analyst	Input MM/year : 61.97MM 1. Chief Advisor 2. Coordinator 3. Chassis Dynamometer System Mechanic 4. CFR Engine / Engine Dynamometer Mechanic 5. General Properties Analyst	Input MM/year : 55.83MM 1. Chief Advisor 2. Coordinator 3. Chassis Dynamometer System Mechanic 4. CFR Engine / Engine Dynamometer Mechanic 5. General Properties Analyst
Short Term: 8subjects(11.93MM)			1Subjects 6Experts 7.07MM	2 Subjects 5 Experts 3.53MM	3 Subjects 3 Experts 0.93MM	2 Subjects 2 Experts 0.40MM
Counterparts Overseas Training: 9 trainees 5.67MM		2 persons 1) Automotive Fuel Research for Environmental Improvement 2) Automotive Fuel Research for Environmental Improvement (0.87MM)	2 persons 1) General Property Analysis of Gasoline 2) General Property Analysis of Gasoline (1.87MM)	2 persons 1) The Effect of Gasoline Composition and Additive on Exhaust Emission and IVD 2) The Effect of Gasoline Composition and Additive on Exhaust Emission and IVD (1.13MM)	2 persons 1) General Property Analysis of Gasoline 2) General Property Analysis of Gasoline (1.80MM)	
Expenses by Japanese Side (x1,000)						
1) Dispatch of Survey Team ¥ 31,873	¥ 14,840	¥ 8,137		¥ 2,232	¥ 864	¥ 5,800
2) Dispatch of Experts ¥ 328,369			¥ 66,625	¥ 126,374	¥ 68,170	¥ 67,200
3) Acceptance of C/P Training ¥ 3,403		¥ 555	¥ 844	¥ 584	¥ 850	¥ 570
4) Provision of Machinery and Equipment ¥ 370,436		¥ 19,025	¥ 199,771	¥ 147,973	¥ 3,667	
5) Local Budget ¥ 12,067			¥ 2,429	¥ 3,077	¥ 4,748	¥ 1,813
6) Supplementary Local Budget ¥ 2,584					¥ 2,584	
Others						

6　評価用プロジェクト・デザイン・マトリックス（和文）（1／2）

プロジェクト名：環境改善自動車燃料研究協力事業　　期間：1996年3月1日～2000年2月29日
対象地域：アユタヤ、タイ国　　ターゲットグループ：PTTスタッフ　　作成日：1999年6月14日

プロジェクトの要約	指　標	指標データ入手手段	外部条件
【スーパーゴール】 大気汚染軽減のため、環境にやさしく、しかも技術的に実現可能性のある自動車ガソリンがタイの市場に導入される。	• 環境調和型の新規格ガソリンが市場で販売される。	• 燃料局統計資料 • 民間精油施設生産記録	• 政府の大気汚染予防に関する方針が変更されない。
【上位目標】 タイ政府が、PTT研究所の技術的助言や提案に基づき、環境にやさしく、しかも技術的に実現可能性のある自動車ガソリンに関する規格を制定する。	• 2005年までに排ガス中の有害成分を減少するための自動車ガソリンの規格が制定される。	• 自動車ガソリン規格（商務省）	• 経済状況が急速に悪化しない。
【プロジェクト目標】 タイ石油公社の技術研究所が、環境にやさしく、しかも技術的に実現可能性のある自動車ガソリンの性状および組成に関する技術的助言や提案を行う能力を有する。	• R&T研究所が環境に優しく技術的に実現可能な自動車ガソリンの組成に関する情報と実験結果をタイ政府に提出する。	• R&T研究所からタイ政府への報告書	• 自動車ガソリン品質に関する政府の規制が強化される。 • タイの石油精製業界が環境に優しいガソリンの導入に反対しない。
【成果】 0　プロジェクトの運営・管理システムが確立される。 1　自動車ガソリンおよび潤滑油に関する各種測定・分析機器が設置される。 2　設備および機器に対する予防的保全システムが確立され、効果的に活用される。 3　計測、分析、評価、製品品質設計に関する各種技術がタイC/Pにより習得される。 4　自動車ガソリンの分析、評価、品質設計に関する各種データが蓄積され、効果的に活用される。	0　プロジェクトの運営・管理に必要な人員が配置され、業務が分担される。 1　R/Dに記された必要施設・機材がTCPのスケジュール通りに整備される。 2　カウンターパートが独自で設備・機材の保守管理を行なえる。 3　C/Pは単独で計測、分析、評価、製品品質設計を行なえるようになる。 4　「環境への影響が少ないガソリン組成」、「オクタン価要求値」、「エンジン内部を汚さない清浄剤」、「オイルの性能を低下させないガソリン組成」、「部品を侵食しないガソリン組成」につき研究をまとめ、政府関係者に発表する。	0　プロジェクト年間報告書 1　プロジェクト年間報告書 2-1 専門家評価 2-2 機材維持管理台帳 3　専門家評価 4-1 研究発表会 4-2 研究レポート数	• カウンターパートが常勤従業員として継続して雇用される。 • 関連する業界/政府機関/学術団体がプロジェクト活動に協力する。

6 評価用プロジェクト・デザイン・マトリックス（和文）（2／2）

プロジェクトの要約	投 入	外部条件
【活動】 0-1 職員を配置する。 0-2 プロジェクトの運営計画を策定する。 0-3 適切な予算計画を策定し、かつ実施する。 1-1 各種測定・分析機材・機器の仕様を決定する。 1-2 機材・機器の期分け設置計画および配置計画を策定する。 1-3 各種測定・分析機材・機器を購入する。 1-4 各種測定・分析機材・機器の搬入・設置・調整作業を行なう。 1-5 付属機器およびアクセサリー類を調達する。 1-6 機材・機器に関する追加運転マニュアルを作成する。 2-1 機材・機器の保全計画を作成する。 2-2 機材・機器の保全マニュアルを作成する。 2-3 上記計画に沿った保全を行なう。 3-1 カウンターパートに対する下記技術の訓練計画を策定する。 - 各種測定・分析機材・機器の運転 - 測定・分析結果の評価 - 製品品質の設計 3-2 教材を作成する。 3-3 訓練計画を実施する。 4-1 測定・分析データを蓄積する。 4-2 蓄積データを報告書に取りまとめる。 4-3 報告書を関連機関に説明するための会議を開催する。 4-4 蓄積したデータを基に、環境に優しいガソリンの組成を提言するための準備を行なう。	日本側 1) 専門家派遣 -長期専門家 206.07M/M ① チーフアドバイザー ② 調整員 ③ シャシーダイナモメータメカニック ④ CFR エンジン/エンジンダイナモメータメカニック ⑤ 一般分析 -短期専門家 8分野、11.93MM 2) 予算 (X1,000) ¥748,732 - 調査団派遣 ¥31,873 - 専門家派遣 ¥328,369 - 研修員受入れ ¥3,403 - 機材供与 ¥370,436 - 現地業務費 ¥12,067 - ローカルコスト支援 ¥2,584 3) 研修員受入れ, 5.67MM タイ側 1) カウンターパート 19名 ①プロジェクトマネージャ ②副プロジェクトマネージャ ③分析分野 ④エンジン分野 ⑤管理分野 2) 土地・建物 - Research and Technology Institute - その他プロジェクトの実施に必要な土地・建物 3) 財務 (x 1,000) - 運営費 B 27,664.6	• 日本から供与される機材・機器の通関手続きが円滑に行なわれる。 **【前提条件】** • 大気汚染防止に関する研究活動の必要性が減少しない。 • PTT が大気汚染防止に関する研究活動の実施ために Research and Technology Institute を設立する意図を有する。 • Research and Technology Institute の建設が大幅に遅れない。 •

6 評価用プロジェクト・デザイン・マトリックス（英文）（1／2）

Annex 1

Project Design Matrix (1/2)

Project title : Automotive Fuel Research Project for Environmental Improvement in the Kingdom of Thailand　　Duration : March 1, 1996 to February 29, 2000

Project area : Ayutthaya, Thailand　　Target Group :Research and Technology Institute of the Petroleum Authority　　Prepared by JICA Evaluation Team on June 14, 1999

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
【Super Goal】 Environmentally-friendly and technologically-feasible automotive gasoline will be introduced into the Thai market to reduce air pollution.	• New specific environmentally-friendly automotive gasoline are sold in the Thai market.	• Statistical record of Bureau of Fuel Oil • Production records of fuel refining companies.	• Governmental Policy on prevention of air pollution will not change.
【Overall Goal】 The Government of the Kingdom of Thailand formulates specification of the environmentally-friendly automotive gasoline on the basis of the technical advice and proposal by the R&T Institute of the PTT.	• New specification on automotive gasoline for reducing toxic substances in exhaust gas is established by the year 2005	• Specification of automotive gasoline	• Economic situation will not get worse rapidly.
【Project Purpose】 R&T Institute of the PTT has the ability to give technical advice and offer proposals on the properties and composition of environmentally-friendly and technologically-feasible automotive gasoline.	• R&T Institute submits technical information and data to Thai Government for drawing up the specification of environmentally-friendly and technologically-feasible automotive gasoline.	• Submitted reports from R&T Institute to Thai Government	• Governmental regulation on the quality of automotive gasoline is strengthened. • Thai refining industry will not oppose to introduce the environmentally-friendly automotive gasoline.
【Output】 0 The management and operation system of the Project will be established. 1 Various measurement and analysis equipment for automotive gasoline and lubricant oil will be installed. 2 Preventive maintenance system for machinery and equipment will be established and effectively utilized. 3 Various technologies concerning measurement, analysis, evaluation and designing of product properties will be acquired by Thai counterparts. 4 Various data on analysis, evaluation and formulation concerning automotive gasoline will be accumulated and effectively utilized.	0 Necessary staffs for the project operation and maintenance are allocated, and duties are assigned to the staffs. 1 Necessary facilities and equipment mentioned in R/D are installed on TCP's schedule. 2 Counterparts can maintain the machinery and equipment by themselves. 3 Counterparts are able to implement measurement, analysis, evaluation and designing of product properties by themselves. 4 The results of study on "The effect of RFG composition on exhaust emission", "Octane number requirement", "Effect of detergent additives", "Effect of RFG composition on engine oil stability" and "Effect of RFG composition on car fuel supply components" are presented to governmental organization concerned.	0 Annual report of the Project 1 Annual report of the Project 2-1 Evaluation by JICA experts 2-2 Maintenance record of equipment 3 Evaluation by JICA experts 4-1 Records of meeting to the related parties 4-2 Number of published technical reports in each field	• Counterparts will be continuously employed as permanent employee. • The industrial / governmental / academic authorities concerned will cooperate to the project activities.

6 評価用プロジェクト・デザイン・マトリックス（英文）（2／2）

Project Design Matrix (2/2)

Narrative Summary	Input	Important Assumption
【Activities】 0-1 Allocate staffs. 0-2 Make operation plan of the Project. 0-3 Make and implement budget plan properly. 1-1 Make specification of the machinery and equipment for various measurement and analysis. 1-2 Make layout plans for the machinery and equipment as well as phased plans for installation. 1-3 Provide and purchase the machinery and equipment for various measurement and analysis. 1-4 Transport, install and adjust the machinery and equipment. 1-5 Procure supplementary materials and accessories. 1-6 Prepare supplementary operational manuals for the machinery and equipment. 2-1 Make maintenance plan for the machinery and equipment. 2-2 Make maintenance manuals for the machinery and equipment. 2-3 Implement the maintenance as planned. 3-1 Make training programs for the counterparts in the following techniques ; - operation of the machinery and equipment properly for various measurement and analysis - evaluation of measured and analyzed results - formulation of product properties 3-2 Make training materials. 3-3 Implement the training program. 4-1 Accumulate the measured and analyzed data. 4-2 Make reports on the accumulated data. 4-3 Hold meeting to explain reports to the related parties. 4-4 Prepare for the future proposal on the formulation of environmentally-friendly gasoline based on accumulated data.	<u>Japanese side</u> 1) Dispatch of Experts -Long Term Experts 206.07M/M ① Chief Advisor ② Coordinator ③ Chassis Dynamometer System Mechanic ④ CFR Engine/Engine Dynamometer Mechanic ⑤ General Project Analyst -Short Term Experts 8subjects, 11.93MM 2) Expenses by Japanese Side (X1,000) ¥ 748,732 - Dispatch of Survey Team ¥ 31,873 - Dispatch of Experts ¥ 328,369 - Acceptance of C/P Training ¥ 3,403 - Provision of Machinery & Equipment ¥ 370,436 - Local Budget ¥ 12,067 - Supplementary Local Budget ¥ 2,584 3) Overseas Training 9 staffs, 5.67MM Two more staffs will be trained in 1999. <u>Thai side</u> 1) Counterparts 19 persons ①Project Manager ②Deputy Project Manager ③Properties Group ④Engine Group ⑤Administrative Group 2) Land and buildings - Research and Technology Institute - Other land, building and facilities necessary for the implementation of the Project 3) Financial Inputs (x 1,000) - Local running cost B 39,378.0	• Machinery and equipment provided by the Japanese side will obtain easy custom clearance.
		【Preconditions】 • Necessity of research activities for preventing air pollution will not be decreased. • PTT will have a strong intention to establish its Research and Technology Institute in order to implement research activities for preventing air pollution. • Construction of the Research and Technology Institute will not be delayed much.