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ADVISORY ASSISTANCE IN FORMULATING A PROGRAMME
FOR WASTE OIL RECYCLING

SI/THA/88/801

THE KINGDOM OF THAILAND

Terminal report*

Prepared for the Government of the Kingdom of Thailand
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

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Introduction

At the request of the Ministry of Industries on behalf of The Kingdom of Thailand, UNIDO is providing assistance to enable the Government to take urgent measures to arrest the threat of environmental pollution resulting from indiscriminate disposal of substantial amounts of waste oil.

In phase I of the project a report on the subject of waste oil handling, collecting and recycling in the Kingdom of Thailand was prepared and submitted. The report covered policy measures which would enable the Government to solve the environmental problems caused by waste oil, including technical, financial, economic and organizational conclusions and recommendations for the construction of a waste oil rerefining plant.

The present study assesses the status of the project, examines and evaluates the conclusions and recommendations contained in the opportunity study, and includes a draft project formulation framework and project document for the envisaged Phase II of the project, namely, advisory assistance in formulating a programme for waste oil recycling. In this phase, all preparatory measures needed to undertake the construction of a waste oil rerefining plant in Thailand would be made.

The opportunity study, carried out in January/February 1989, should be viewed as an integral part of this report, which is organized as follows:

- **Chapter one** deals with the opportunity study and the assessment of the status of the project in face of the conclusions and recommendations contained in the opportunity study.
- **Chapter two** consists of the Project Formulation Framework.
- **Chapter three** is the Draft Project Document for Phase II.

Summary

The conclusions reached in this study support the recommendation that the project should be continued as envisaged in the opportunity study, and that UNIDO's technical assistance is provided to assist the Government to undertake all necessary preparations required to construct a waste oil rerefinery plant in The Kingdom of Thailand.

The proposed plant, when actually constructed, would take the most advanced waste oil recycling technology available.

By absorbing substantial quantities of waste oil and rerefining it into commercially viable lubrication oils, the proposed plant would have, over and above the economic advantages, the following environmental benefits:

- reduce the indiscriminate disposal of waste oil in Greater Bangkok area and Central Region by 13 to 15 per cent per year during the 15-year lifetime of the plant;
- contribute to the reduced pollution of the atmosphere resulting from the burning of waste oil as fuel;
- contribute to the arrest of rapid deterioration of oil burners resulting from the burning of waste oil as fuel; and
- contribute to increased home safety through reduction in boiler fires.

A waste oil collection system is recommended to be designed and operational well ahead of the planned operation of the rerefinery plant. The collection network is recommended to be designed with the help of computer, and will be included in UNIDO's assistance for phase II.

The rerefinery plant is recommended to be equipped to produce a fully downstream line of products.

No specific recommendations are included as to the location or organizational structure of the proposed waste oil rerefinery plant. However, it is noted the environmental impact would be greatest if the raw material for the plant is collected in the Greater Bangkok area and Central Region, and that a location to any of the designated industrial areas would bring financial advantages to the project. With respect to the organizational structure it is noted that an organizational arrangement through which the waste oil rerefinery would co-operate closely with the Petroleum Authority of Thailand (PTT) would minimize the risks associated with the supply of waste oil and with the marketing of the finished products.

CHAPTER ONE - THE OPPORTUNITY STUDY

A. The expected output

The expected output of the UNIDO-sponsored opportunity study was specified in the project proposal document dated 30. 3. 88 revised 12.5.88 and 30.11.88, respectively. The report should present policy measures to solve the environmental problems caused by waste oil and include a techno-economic opportunity study on the establishment of a waste oil refining plant, using optimal available technologies. This comprehensive report should cover, specifically, the following:

- 1) Estimate of the total oil consumed (by type) specifying the user.
- 2) Assessment of the quality of generated waste oil by an international chemist at international laboratory.
- 3) Description of methods used for handling, storing and recycling waste oil.
- 4) Information on how waste oil is collected and proposals on how this could be improved.
- 5) Assessment of alternative current uses of waste oil and their environmental, technical and economic/financial dimensions.
- 6) Identification and assessment of optimal potential uses of waste oil and their environmental, technical and economic/financial viability.
- 7) Assessment of potential local and external markets for recycled and rerefined products.
- 8) An outline of possible key risk factors and potential benefits for the establishment of a waste oil refining plant, including: a) estimation of the financial return in general terms from the establishment of such a plant, and b) estimation of the broad range of the potential foreign exchange savings possible from such a plant through the reduction in the level of imports.
- 9) Recommendations for an optimal regulatory framework to channel waste oil to desired uses.

The study should also include an estimate of the optimal plant capacity, desirable location of the plant, the required materials and inputs for the plant and their availability and manpower requirements and a recommendation as to the type of organization to manage the rerefinery.

B. General assessment

In broad and general terms the opportunity study covers all of the above. The additional work required before construction of a waste oil rerefinery plant can begin may be linked to a) the split missions of the two international experts responsible for the opportunity study, and b) institutional and legal complexities of the host country and its Government. The nature and scope of required work is specified below in Chapter One and in Chapter Two, the Project Document.

The overall conclusion, therefore, is the following:

- * the project should be carried forward into Phase II and
- * UNIDO's technical assistance in Phase II should be used to enable the Thai Government to undertake all preparations necessary to establish a waste oil rerefinery plant as outlined in the opportunity study.

C. Technical specifications

The purpose of a technical analysis is to find the most suitable technology and capacity of the plant given local conditions, including the availability of required inputs and the market for the product(s) produced by the plant.

A set of technical requirements, valid for a rerefining plant in Thailand, can be formulated as follows:

- (a) The plant should have a good feedstock flexibility and be capable of rerefining the complete range of waste oils available now and in the future.
- (b) The plant should be capable of handling a large variation in contaminants present in the feedstock without negative effects on operational costs and product yield.

- (c) The plant must produce high quality products with commercial value and the potential of being accepted by major consumers.
- (d) The plant should have low operating costs and should need a minimum amount of foreign import content.
- (e) The plant should not produce by-products which could have detrimental effects on the environment.

The analysis contained in Sections 3.1. + 3.5. of the opportunity study deals with this in broad terms as was envisaged in the project proposal document, thus rendering support to the technical conclusions and recommendations presented there, namely, the following:

- i) Available waste oil in Thailand is well suited for rerefining as shown by tests of the feedstock and product quality by international laboratory (test results from Caleb Brett & Son, Continental Bv are attached in Appendix III/I).
- ii) A plant based on the Advanced Distillation Process, followed by Hydrofinishing meets all relevant minimum technical requirements for a waste oil rerefining plant in Thailand.

Based on the opportunity study's conclusions, it is recommended that the plant should be constructed. The next phase of the project, however, would consist of UNIDO assistance in arranging all preparatory work, to be done by a subcontractor, necessary before actual construction of the plant would begin. This next phase would include the following civil works:

- plot layout
- architectural concepts
- layout and construction drawings
- flow charts
- dynamic and static calculations
- bill of quantities

Based on the marketing analysis, as contained in Sections 4 and 6 of the opportunity study, and as discussed more in detail below, it is for Phase II of the project envisaged that the plant will be fully designed so as to produce a fully downstream product. In addition, policy, negotiating and contracting advice will be provided to the government, a waste collection network will be designed and a number of study tours arranged.

The waste oil rerefinery plant , when finally constructed, is envisaged to have the following characteristics:

- an output capacity of 20,000 tons per annum initially (which would use up some 28,000 tons of waste oil); after six years of production the capacity is proposed to be increased to 30,000 tons (raising the input requirement of waste oil to some 42,000 tons); and
- the operational time period of the plant is expected to be 15 years.

In the base version the final outputs are the following:

- heavy/medium base oil
- light neutral base oil
- gasoil
- asphalt

In the version with a fully downstream product some technical adjustments are required.

The specific equipment required for the base version of the plant is listed in section V, chart V/1. The additional equipment required for the more expanded version is found in section 5.5. (page 64) of the opportunity study.

As an aside it can be noted that Section 3.6. contains a reference to an integration of the waste oil rerefinery plant with an already existing oil refinery. Also in Section V such an arrangement is mentioned but nowhere is it discussed in any detail and no technical explanation is given for how such an "integration" has been envisaged. This can be clarified in detail in discussions between UNIDO and the Government.

D. Waste oil collection

A crucial aspect of a waste oil rerefinery is the system for collecting the raw material. This aspect deserves a detailed elaboration. The aggregate information and general guidelines presented in Sections 3.7. and 4.2. of the opportunity study and the connected tables seem to be appropriate and based on technical facts and expertise in the field. The major conclusions are:

- The sources of waste oil in any given area depend on the type of industry prevalent in that area.
- The waste oil collector must identify the various sources in his area and systematically contact each source to develop a collection network.
- Automotive sources represent the largest proportion of waste oil available.

The major recommendations are:

- A collection network should be designed with the help of computer.
- Collection should be initiated approximately one year before the rerefining plant starts operating.

To minimize risks and maximize marketing potential, it is also recommended that:

- The rerefinery shall cooperate with P.T.T. and get access to its network of customers and use them both as suppliers of waste oil and as customers of the finished products.

If the P.T.T. scenario is chosen, the proposed plant will benefit from a ready made network of potential suppliers and customers. However, if the "P.T.T. scenario" is not chosen by the Thai Government, there is insufficient information in the opportunity study in order for a collecting system to be designed, and a network of waste oil suppliers outside P.T.T. to be identified. Much more detailed information on potential suppliers of waste oil will have to be collected. The same goes for the finished products. Only a handful of individual consumers of lubrication oil, viewed as potential suppliers and/or customers, were visited in the course of the study.

As a result of the lack of information on individual suppliers of raw material to the proposed rerefinery plant, the conclusions and recommendations of the opportunity study relies heavily on the "P.T.T. scenario".

It should be noted that the analysis contained in section 4 of the opportunity study shows that also under the "P.T.T. scenario" some additional supplies outside of the P.T.T. network would be required.

It is clear that more detailed information must be collected as a basis for designing a collection system as well as for analyzing the market potential of the plants' products. The amount of work required under Phase II to develop the network will, however, depend on whether the "P.T.T. scenario" will be realized or not.

E. Marketing aspects

The opportunity study presents a full account of the petroleum and lubrication oil sub-sector in Thailand, including the national and regional total availability of raw material for a waste oil rerefinery in 1988, plus a forecast for the period until year 2001, and the characteristics of the market for final lubricant products. However, there is no detailed information on individual waste oil producers, i.e. potential suppliers of raw material to the proposed refinery plant.

Nor is there any comprehensive analysis of potential buyers of the rerefined product and firm recommendations as to the best product mix to be produced at the proposed plant. These shortcomings of the report are irrelevant if the P.T.T. scenario will be utilized, since such an arrangement will provide the proposed plant with both raw material and a net of reliable customers. The marketing analysis will also be dealt with in Phase II of the project.

The description of the petroleum and lubricant oil sub-sector in Thailand is contained in Sections 4.1 - 4.3 plus Appendix IV/I and Tables IV/2-IV/8 in the opportunity study

The major conclusion resulting from the analysis of the market size concerns the size, or production capacity, of the proposed plant. As already mentioned, this conclusion is that the plant should have an initial capacity of 20,000 tons per year and be designed as to allow for an increase to 30,000 tons per year after six years of operation.

The composition and marketing of the finished refined lube oil products is discussed in terms of competition versus co-operation and is contained in Sections 4 and 5 (particularly in subsections 4.3-4., 5.2.2 and 5.5) of the report*.

*It would have been preferable to have this analysis in only one section of the report.

Based on the market analysis, it is recommended that the plant should produce a fully downstream line of lubrication oils.

The reason a fully downstream product is preferred is that it would improve the profitability of the rerefinery plant regardless of which marketing strategy is chosen; competition or co-operation. If the P.T.T. scenario is realized, the most co-operative strategy, a full line of lube oil products would, in addition to facilitating the raw material supplies, also decrease the dependence on outside supplies of raw material.

F. Organizational arrangements

The organizational arrangements of the proposed waste oil rerefining plant are at the discretion of the Thai Government. However, as already noted, the recommendations presented in the opportunity study, based on the conclusions drawn from the technical and marketing analysis, have some important ramifications for the organizational structure of the proposed rerefinery plant. This creates some uncertainty as to the precise status of the project in this respect. Therefore, it seems appropriate to link the initiation of Phase II of the project to the Government's decision on the organizational arrangements. These organizational arrangements for the waste oil rerefinery plant should be discussed and agreed upon during discussions with UNIDO as a pre-requisite for UNIDO's technical assistance in Phase II of the project.

G. The location of the plant

It is envisaged in the opportunity study the plant will be located in the Eastern Seaboard Development Area in one of two newly established industrial zones (along with the full description of the sites, a map is contained in section 5.2 of the opportunity study), namely:

- Laem Chabang or
- Map Ta Phut

The major advantages with any of these two locations are:

- both locations are close to the areas in Thailand where the consumption of lube oil is highest, facilitating the supply of raw material for the rerefinery;
- industrial zones offer well developed infrastructure required for the proposed plant, such as transportation, utilities, waste disposal systems;

- both locations offer possibilities of mutually attractive co-operation with other chemical or petrochemical plants which would imply lower operation costs and higher profitability; and
- both locations offer possible tax and duty privileges.

The financial analysis is partly carried out on the assumption that Laem Chabang will be chosen. This location carries with it a higher cost of land and is chosen in the financial analysis primarily to keep the analysis within prudent limits. No final recommendation on the location is presented in the opportunity study. A decision by the Government is required before Phase II of the project is started.

Nothing in the opportunity study contradicts, per se, a location outside the Greater Bangkok area or Central region. At the same time, both the marketing and financial analysis contained in the opportunity study would be rendered irrelevant by a decision on another location. In fact, the profitability of the project would not be secured if a location outside the Greater Bangkok area or Central region was chosen. Another location would require a much more in-depth marketing study to be conducted in order for a collection system to be designed and a collection network identified. In addition, also as a consequence, the financial analysis would need to be adjusted.

In the Project Formulation Framework and Project Document included in this report, it has been assumed that a location in the Greater Bangkok area will be chosen, albeit not which particular alternative. Since the subcontractor cannot begin until the location is decided, a decision on the site must precede any other step in Phase II of the project.

H. Financial analysis

The financial analysis contained in the opportunity study (Section V) is based on the UNIDO standard package, the COMFAR programme. The following financial aspects of the project are covered:

- investment, production, operational and financial cost analysis,
- revenue analysis,
- financial plants and evaluation,
- sensitivity analysis, and
- discussions on market conditions, location of the plant, regulatory and legal aspects, as well as marketing strategies and production programmes.

In addition to those financial aspects of the project Section V contains segments of the marketing analysis, the location analysis, as well as discussions on legal, administrative and environmental matters, a fact which probably reflects the problems the experts had in co-ordinating their missions and finalizing the report. The financial analysis by itself is, however, complete and the conclusions and recommendations contained in the opportunity study's Section V seem appropriately based on relevant technical, marketing, legal, administrative and other considerations, as well as on prudent financial and economic assumptions, i.e. there is nothing to contradict the conclusion and recommendation that Phase II of the project should be implemented.

The two different versions of the plant's production profile are simulated, the base and the fully downstream product version, respectively. Major assumptions in those simulations are:

- waste oil (input) price of 3 B/1, compared with market prices ranging up to a reported maximum of 2.5 B/1,
- sales price of basic output of 11 B/1, compared with a market price of 13.2 - 15.6 B/1,
- an average sales price of the fully downstream product version of 20 B/1, compared with a market price varying from 23 B/1 up to 35 B/1,
- all price changes are proportionate, i.e. the price structure is assumed to be constant for the 17 years covered by the simulation,
- the plant would eventually be constructed in the Laem Chabang industrial zone. implying land cost would be a recurrent expenditure of some 826,000 B/year, compared with 480,000 B/year for the alternative location at Map Ta Phut,
- the plant would be subject to normal national taxes and duties, including corporate tax of 35% on net profits,
- total investment required during the two-year period of construction of the refinery plant has been estimated, and for the purpose of the financial simulation assumed, to be Baht 303.7 MM of which Baht 17.5 MM would have to be foreign, equivalent to close to US\$ 7 million.

Although individual assumptions may be questioned, the assumptions overall seem reasonable. In addition, the sensitivity analysis reinforces the major conclusion that the project is commercially viable under both the base version and the fully downstream product version.

Financial statistics to support the conclusion are contained in the V/15, from which the following is of particular significance:

	IRR (%)	Pay-back period (years)
Base version	27.4	4
Fully downstream	45.5	2

The sensitivity analysis reveals that the profitability under the base version is most sensitive to changes in output prices; in the base version an output price fall of 20 per cent would lower the IRR from 27.4 to just over 20 per cent, which is on the low side. In the fully downstream product version, the IRR is 45.5, which is a strong argument for this production alternative.

Full details of the sensitivity analysis are contained in Section 5.5, tables V/14 and V/15 and charts V/13 and V/14. The complete printouts of the COMFAR simulations are contained in Appendix V/1 (base version) and Appendix V/3 (fully downstream production version), respectively.

I. Economic impact

The relation of the project to national development plans, including environmental impact and foreign exchange effects, are dealt with in Section VI of the opportunity study. The conclusions are:

- the proposed waste oil rerefinery plant would bring Thailand the most recent rerefining technology;
- the technology transfer is favorable in light of national development plans as it may have directly stimulating and multiplier effects on industrial development in Thailand;
- in line with national development objectives of the project, it would reduce conflicts in the use of natural resources;
- it would promote conservation and reduce pollution of the environment; and

- it would use natural resources efficiently and without damaging the environment or causing pollution problems.

In addition to those conclusions, the foreign exchange effects are separately analyzed. This comprehensive analysis reveals the following:

- The final output of the waste oil rerefinery plant would contribute to foreign exchange savings by fully substituting for imports.
- The outflows of foreign exchange under the base version would consist of a) some 70 per cent of initial and recurrent investment costs, and b) some 10 to 12 per cent of recurrent operational expenditures.
- The net foreign exchange effect is positive; approximately US\$ 153 million without discounting to present value, and some US\$ 32.2 million when discounted at a rate of interest of 20 per cent.

A calculation of the net foreign exchange effect of the fully downstream product version ought to have been included, but was sent separately by the economic expert at a later date.

J. Regulatory and legal considerations

There are no comprehensive recommendations on an "optimal regulatory framework to channel waste oils to desired uses", as such, in the opportunity study. A few comments and notes on the subject are contained in various sections. The following recommendations can be extracted:

- the location of the plant should be in an area where it can be granted tax and duty privileges as a so called promoted project. The specifics of such a status are described in section 5.2.2 "Prices".

- In case, as expected, close co-operation with P.T.T. is established and the rerefinery plant will depend on P.T.T.'s network of customers, the regulations governing purchases of lubrication oils from other sources than P.T.T. should be amended so as to remove the uncertainty presently surrounding these regulations.

- Licenses for waste oil recycling should be restricted even further than presently. Inappropriate technologies result in low quality products. Such products threaten to spoil the market for the products of the proposed plant and, in addition, have negative effects on the environment through the high content of contaminants in those low quality products.

The two last issues are discussed in both Sections 4 and 5 of the opportunity study.

With respect to the above, it is recommended and seems reasonable to expect, that relevant regulations will be adopted according to the specific design, location and administrative structure given the proposed plant by the Thai authorities. Phase II will address the problem by including the services of an international expert to assist the Government in its decision-making. Beyond the regulatory framework directly limited to the establishment of a waste oil rerefinery plant, Phase II of the project should address also the general standards for pollution control as well as workmens' safety, areas which are actively being pursued by UNIDO.

D R A F T**Chapter Two****Project Formulation Framework**

Country: Thailand

Date: 3 November 1989

Project No.: XX/THA/89/XXX

Proposed Title: Advisory Assistance in Formulating Programme for Waste Oil Recycling, Phase II

Estimated duration: One year

Tentative UNIDO and cost sharing contribution: US\$ 768,000 (excl. UNIDO overhead)

Estimated counterpart costs: (in kind)

Sources of funds: _____

A. Development problems intended to be addressed by proposed project

1. At the macro level, the project addresses a) the environmental pollution caused by indiscriminate disposal and burning of waste oil, and b) the constraint on national industrialization programmes caused by the waste of scarce energy and oil resources as well as by the use of scarce foreign exchange resources for the importation of lubricating oil.

2. At the micro level, the project addresses the problem of transforming waste oil into a commercially viable raw material and recycling it in a fashion which is both commercially competitive and environmentally sound, as well as the problem of accelerated deterioration of boilers and boiler fires caused by waste oil used as fuel.

B. Concerned parties and target beneficiaries

1. The Ministry of Industry is seriously considering the possibility of establishing a waste oil rerefinery. However, authorities have requested UNIDO's urgent assistance in assessing the local conditions with respect to starting waste oil rerefining. UNIDO has developed its ability to respond to this request for cooperation through, among others, successful projects in Togo (SI/TOG/86/801) and Burkina Faso (SI/BKF/86/801).

2. The Ministry of Industry is UNIDO's counterpart for this project and will, on behalf of the Government of the Kingdom of Thailand, designate the direct recipient of UNIDO's assistance. The direct recipient may well be the national oil company, PTT. In such a case the target beneficiaries would include the network of PTT's consumers and small-scale producers who would supply waste oil to the rerefinery and be potential consumers of the finished products.

Major target beneficiaries consist of the population of Greater Bangkok and the Central Region. A waste oil rerefinery would also benefit national public health and the national economy, as well as the environment through reduced indiscriminate disposal of waste oil, reduction in the pollution of the atmosphere through burning of waste oil as fuel and through reduced use of low quality rerefined waste oil.

C. Pre-project and end of project status

1. The Ministry of Industry estimated in 1988 that out of 180,000 tons - of which 60,000 tons are imported - of lubricating oil consumed annually in Thailand, some 70,000 tons of used waste oil could be recovered.

The UNIDO-sponsored Opportunity Study undertaken in January/February 1989 reports that consumption of lube oil can be expected to double by the year 2000 and that approximately 70 per cent of all petroleum products are consumed in the Greater Bangkok area and in the Central Region. Recent lube oil consumption in these two regions is estimated to be between 137 million and 156 million liters per year.

The exact quantity of waste oil presently recycled is not known. Traditionally, considerable amounts of waste lube oil is burned in various types of industrial furnaces, heaters and boilers, usually after mixing with some fuel oil. The ceramic industry is often quoted as an example of a Thai industry which is still using waste lube oil for heating purposes. This practice causes severe pollution of the atmosphere since these oils contain heavy metals, chlorines, fluorines and other contaminants. The wood paint industry uses lube oil for the manufacturing of cheap paints protecting construction wood. No bigger industrial unit of this specialization has been identified, but there are numerous small-scale producers. Finally, some waste oils are already being recycled into lube oil. However, many of the producers have no license and, therefore, create a black market of rerefined lube oil, difficult to assess in size and difficult for the Thai authorities to control. The issuing of new licenses is restrictive with respect to environmental impact as well as with respect to product quality.

2. UNIDO's assistance in Phase II is expected to last throughout the period of preparation of the construction of a waste oil rerefinery plant. The proposed rerefining plant is envisaged to have an initial output capacity of 20,000 tons per year and also it is envisaged that after six years of production the output capacity will be increased to 30,000 tons per year. The waste oil quantity used up by the envisaged plant is estimated to be some 28,000 tons initially and rising to some 42,000 tons at the higher output level. This comprises slightly less than 10 per cent of estimated national consumption of lubrication products at the respective point in time - 1992 to 1996, respectively. The impact in the Greater Bangkok area and the Central region would be a reduction of between 13 and 15 per cent in indiscriminate disposal of waste oil. In addition, the operation of the envisaged rerefining plant would create some employment (directly 30 persons), and the recycling of lube oil would substitute for imported products, saving scarce foreign exchange. The net foreign exchange effect is estimated at some US\$ 32 million.

D. Special considerations

1. The project is closely related to resource conservation recycling of waste materials in general, low waste/non-waste technologies, water and air pollution control, safety in home and industrial petroleum boilers, environmental legislation and collection systems for waste materials in general;

2. No negative effects on the environment or on particular groups have been identified.

E. Other donors, programmes active in the same sub-sector

There is no report of other donors being active in this sub-sector in Thailand. However, UNIDO is actively pursuing similar programmes in other countries and has developed its capacity for this type of assistance through successful projects in Togo (SI/TOG/86/801) and Burkina Faso (SI/BKF/86/801).

F. Development objectives and its relation to the country programme

1. The development objective is to maintain and improve the quality of life through environmental pollution control while the country pursues its industrialization programmes. The technology transfer is favorable in light of national development plans as it may have directly stimulating and multiplication effects on industrial development.

2. The project would reduce conflicts in the use of natural resources, promote conservation and more efficient use of natural resources without damaging the environment or causing pollution problems. It will also result in substantial foreign currency savings.

G. Major elements

The immediate objective is the complete preparations for the construction of a waste oil rerefinery plant. Once the selection of plant site has been made by the Government based on the opportunity study findings, this can be broken down to the following required outputs and activities (more exact details, including government counterparts will have to be added after further discussions with the Ministry of Industry have been carried out. However, it is expected that the subcontract should include at least the following types of specialists: financial analyst, energy economist, petroleum engineer and production/process engineer.):

<u>Outputs</u>	<u>Activities</u>	<u>Party responsible for the activities</u>
1.1 Technical drawings and charts	plot layout, architectural concepts, flow charts, dynamic and static calculations; verify and as required update scientific methods presented in the opportunity study	Technical subcontractor in collaboration with the designated direct recipient.
1.2 Premises and facilities	Specifications of the premises and facilities needed during the construction period	technical subcontracts and the designated recipient
1.3 Lists of equipment and supplies required for full operation of the plant	check and update the list presented in the opportunity study	as above
1.4 Qualified management	study tours and other training as required	UNIDO and technical subcontractor
1.5 System for waste oil collection	collecting data and designing a collection network	designated direct recipient with required assistance from technical subcontractor
1.6 Qualified negotiations	assistance in negotiating and contracting skills for eventual procurement of equipment/services	designated direct recipient with technical subcontractor

There will be two success criteria applied. The first is the physical documents associated with each respective output. The second is the clearance from an independent technical adviser, appointed and funded with UNIDO's assistance.

H. Project strategy and institutional arrangements

1. The Thai economy has for several decades experienced a rapid economic growth and accelerated qualitative changes. In 1988, GDP growth was recorded at 10.3 per cent at constant 1972 prices, and non-agricultural GDP at 10.7 per cent. This development has put pressure not only on domestic prices, but also on the balance of payments.

Parallel to the rapid economic growth, Thailand is experiencing a rapidly changing environment and pressure on its traditional ecological system.

In response to these developments, the Thai Government is actively pursuing policies to help maintain and improve the quality of life through pollution control and other environmentally beneficial programmes. Specifically, the Government has embarked on a route towards establishing a waste oil rerefining plant based on the most modern technology available in the field. A preliminary study submitted to the Ministry of Industry showed that substantial quantities of consumed lubricating oil could be recovered. In early 1988 the Government requested UNIDO's urgent assistance in assessing the local conditions with respect to starting waste oil rerefining in the country.

2. Through UNDP assistance, a techno-economic opportunity study has been submitted to the Government. The study supports the preliminary assessment that a waste oil rerefinery in Thailand is environmentally beneficial and commercially viable. Phase II of the project will encompass all preparatory activities which will enable the Government to construct the envisaged waste oil rerefinery plant.

3. Phase II of the project is envisaged to be carried out by a technical subcontractor in close collaboration with the direct recipient who will be designated by UNIDO's counterpart, the Ministry of Industry. The preferred direct recipient would be PTT, as this would minimize the costs of establishing the rerefinery and provide a stable set of customers for the finished products and therefore also minimize the risks associated with the operation. Setting-up the rerefinery plant as an independent unit would require additional costs, both physical and human, to administer it, to set up a functioning system for collecting the raw material, i.e. waste oil, as well as requiring substantially greater costs and efforts to market the finished products.

I. Host country commitment

The Government of the Kingdom of Thailand has through the Ministry of Industry repeatedly manifested its commitment to this project. For the opportunity study the Ministry offered to assign four full-time senior officers, including specialists in the relevant technical and economic fields, plus one full-time secretary. It is envisaged the Ministry will assign all required personnel also to Phase II of the project, and, in addition, allocate the chosen land for the site, premises and other facilities required for the construction as well as arrange with UNIDO for the funding of the project. Exact Government inputs will be discussed in preparation of the final project document.

J. Risks

The only major risks to the project would be failure to secure sufficient and appropriate sources of supply of waste oil, specifically including failure to identify sufficient number of appropriate and reliable suppliers of waste oil, and failure to set up and operate a well functioning collection network. However, the envisaged institutional and administrative arrangements minimize these risks.

Over time the deliberations of the financial and administrative structure of the re-refining plant may become protracted, the price structure may move adversely to the profitability of the project or technological developments may render the chosen technical method obsolete and less profitable. The opportunity study included a financially comprehensive analysis. The highest sensitivity is recorded for drops in the sales price of the finished product, a 10 per cent price fall reduces the IRR from 27.4 per cent to 20.7 per cent. Given the conservative estimates of the price structure in the basic financial evaluation, however, the likelihood attached to this risk must be considered low.

K. Inputs

1. Skeleton budget

Project Personnel	Expert in negotiation and contracting, 6m/m	US \$60,000
Sub-Contracts		US \$600,000
Project Travel - UNIDO staff missions		US \$20,000
Study Tours		US \$80,000
Miscellaneous		US \$8,000
TOTAL		US \$768,000



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Project Document

Title: Advisory Assistance in Formulating a Programme for Waste Oil Recycling, Phase II

Number: XX/THA/89/XXX

Country: Thailand

Total UNIDO Budget: US \$ 768,000
(exc. support costs)

Estimated Starting Date: 4 months after approval Planned Duration: One year

Backstopping Branch: IO/IIP

Government Implementing Agency: Ministry of Industry

Official Government Request:

Endorsement by the UNDP
Resident Representative:

A. Context

1. The lubricating oil sub-sector:

A Techno-economic opportunity study was carried out by UNIDO in January/February 1989 under project SI/THA/88/801 - Advisory assistance in formulating a programme for waste oil recycling. The study shows that Thailand has to rely heavily on the importation of lubricating oil. Approximately 80 per cent is blended domestically while the remaining 20 per cent is imported in the form of finished lubricating oil.

The annual lubricating oil sales in Thailand in 1988 was 208,205,00 liters and the forecast for lubricating oil sales is as follows:

1989:	219,329,999 liters
1990:	242,240,000 litres
1995:	331,090,000 litres
2000:	431,910,000 litres

The Greater Bangkok area and Central region together account for some 70 per cent of national consumption. Recent annual consumption in these two regions is estimated between 137,000,000 and 156,000,000 liters.

Consumption of lubricating oil is divided between industries as follows:

Automotive Industry:	73.6 %
Manufacturing Industry:	15.6 %
Other:	10.8 %

The bulk of the oil is retailed under the labels of the multinational oil companies which dominate the Thai market:

- ESSO Standard Thailand Ltd.
- SHELL (Thailand) Co., Ltd.
- CALTEX OIL (Thailand) Ltd.
- MOBIL OIL Thailand Ltd.

In addition to the multinational companies there is a great number of small-scale blenders and/or suppliers. In this segment of the market, there are 50 or so brand-names. The leading representatives are:

- THAI PETROLEUM AND TRADING CO., LTD.

This company represents the domestic private sector and imports and blends products under license from the USA based PENNZOIL Co.

- SIAM FINE CHEMICALS CO., LTD.

This is a joint venture between domestic private and public interests and Japanese companies and derives its lube base stock from China and Japan.

- The Petroleum Authority of Thailand (P.T.T.)

P.T.T. is the national oil company of the Kingdom of Thailand, established in 1987. As a retailer, P.T.T. has a considerable share of the lube oil market of Thailand, although it buys the final product on a wholesale basis from other suppliers of lube oil. Using its own filling facilities, P.T.T. can provide its network of customers with necessary lube oil. The customers comprise most government agencies, the defence sector and other public sector consumers of lube oil. According to some interpretations of existing regulations, state sector consumers of lube oil must purchase from P.T.T., unless P.T.T. is unable to supply a particular product.

Total sales by P.T.T. of lube oil products in recent years were as follows:

1986: 11,336,000 liters

1987: 12,666,000 liters

1988: 14,238,000 liters

2. Host country strategy:

The Thai economy has entered a period of accelerated growth and qualitative changes. In 1988 GDP growth was recorded at 10.3 per cent at constant 1972 prices, and non-agricultural GDP at 10.7 per cent. This rapid growth has put pressure not only on domestic prices, but also on the balance of payment.

Parallel to the rapid economic growth, Thailand is experiencing a rapidly changing environment and pressure on its traditional socio-ecological system.

In response to these developments, the Thai Government is actively pursuing policies which will help maintain and improve the quality of life through pollution control and other environmentally beneficial programmes as well as help conserve scarce energy resources and ease foreign exchange constraints.

The Thai government has embarked on a route towards establishing a waste oil rerefining plant. A preliminary study submitted to the Ministry of Industry showed that out of the estimated 180,000 tons of consumed lubricating oil, some 70,000 tons of used or waste oil could be recovered. The large public sector consumers of lubricating oil, *inter alia* including defense installations, airport and large garages, all constitute important sources of waste oil. In early 1988, the Thai government requested UNIDO's assistance in assessing the local conditions with respect to starting waste oil rerefining.

3. Prior assistance

A pre-feasibility, Techno-Economic Opportunity Study was submitted to UNIDO in July 1989, somewhat delayed due to the unexpected split mission by the two international experts conducting the study. Nevertheless, the Opportunity Study contains most relevant technical, marketing, organization, locational, institutional, legal as well as financial, economic and environmental information on the issue of constructing a waste oil rerefining plant in Thailand. The conclusions and recommendations of the opportunity study throughout and firmly support the preliminary assessment by the Thai Government that a waste oil rerefining plant in Thailand is environmentally beneficial and commercially feasible.

4. Institutional framework

The project is under the auspice of the Ministry of Industry. The Ministry has direct influence on the national oil company, P.T.T., and its customers, including major industries which are state owned and subject to the regulatory framework governing P.T.T. Environmental aspects are considered in conjunction with the National Environment Board.

B. Project justification

1. The present situation and host country commitment

The pre-feasibility, Techno-Economic Opportunity study estimated total consumption of lubricating oils reached 208,000 tons in 1988 and will more than double by the year 2000. Thailand relies entirely on the importation of lubricating oils, thus existing foreign exchange constraints to national development are exacerbated. Waste oils are disposed of indiscriminately into the environment, thus posing a great threat to public health. Waste oils used as fuels are polluting the atmosphere, since such oils contain heavy metals, chlorines, fluorines and other contaminants, and, in addition, are the cause of accelerated deterioration of oil boilers and often cause fires in those boilers.

The Government of the Kingdom of Thailand has through the Ministry of Industry repeatedly manifested its commitment to this project. For the opportunity study the Minister offered to assign four full-time senior officers, including specialists in the relevant technical and economic fields, plus one full-time secretary. It is envisaged the Ministry will assign all required personnel also to Phase II of the project, and allocate the chosen land for the site, Laem Chabang or Map Ta Phut in the Eastern Seaboard Development Area. The government is also expected to provide the premises and other facilities required for the construction as well as arrange for the funding of the construction of the rerefining plant.

2. Expected end of project situation

UNIDO's assistance in Phase II will put the government in a position to promptly initiate the construction of the rerefining plant. The assistance will encompass all necessary preparations for the construction of the rerefining plant including technical, administrative, financial and operational specifications, which will be based on the conclusions and recommendations contained in the opportunity study. It will also provide for assistance in negotiation and contracting skills.

The proposed plant is envisaged to be based on the most up-to-date and environmentally-sound technology available. An initial (1992) output capacity of 20,000 tons per year can be expanded upon after seven years of operations to 30,000 tons per year. The quantity of waste oil used up by the plant is estimated at some 28,000 tons at the initial output capacity and rising to 42,000 tons per year at the higher output level. At the initial level of output proposed in the UNIDO sponsored study, slightly less than 10 per cent of the annual consumption of lubricating oils would be rerefined at the plant. If the capacity is increased after several years of production, as envisaged in the study, the proportion would remain the same until the year 2000. Taking into account that the impact would be greatest in the Great Bangkok area and the Central region, the effect would be a 13 to 15 per cent reduction in indiscriminate disposal of waste oil in those areas.

The operation of the plant would create employment for some 30 persons plus the indirect employment effects through the collection and marketing systems.

Investment and operational expenditures connected with the plant cause a net outflow of foreign exchange, estimated over the 17 year lifetime of the project at Baht 174 million (ca US\$ 7 million). At the same time, the domestic production of lubricating oil would substitute for imported products and save foreign exchange so that over the 17 year period there would be a positive net foreign exchange effect. The present value of the net foreign exchange effect was estimated to be equivalent to some US\$ 32 million.

3. Recipients and beneficiaries

1. The Ministry of Industry is UNIDO's counterpart for this project and will, on behalf of the government of the Kingdom of Thailand, designate the direct recipient of UNIDO's assistance. The direct recipient may well be the national oil company, P.T.T. In such a case the beneficiaries would include the network of P.T.T.'s consumers and small-scale producers who could supply waste oil to the rerefinery and be potential consumers of the finished products.

Major beneficiaries also consist of the population of Greater Bangkok and Central Region. Consumers of lubricating oil would benefit from the added supply of domestically produced high quality lubricating oils. A waste oil rerefinery would benefit national public health, the national economy as well as the environment through reduced indiscriminate disposal of waste oil, reduction in the pollution of the atmosphere through burning of waste oil as fuel and through reduced use of low quality rerefined waste oil.

4. Project strategy and institutional arrangements

1. The Thai economy has for several decades experienced a rapid economic growth and accelerated qualitative changes. In 1988 GDP growth was recorded at 10.3 per cent at constant 1972 prices, and non-agricultural GDP at 10.7 per cent. This development has put pressure not only on domestic prices, but also on the balance of payments.

Parallel to the rapid economic growth, Thailand is experiencing a rapidly changing environment and pressure on its traditional ecological system.

In response to these developments, the Thai Government is actively pursuing policies to help maintain and improve the quality of life through pollution control and other environmentally beneficial programmes. Specifically, the Government has embarked on a route towards establishing a waste oil rerefining plant based on the most modern technology available in the field. A preliminary study submitted to the Ministry of Industry showed that substantial quantities of consumed lubricating oil could be recovered. In early 1988 the Government requested UNIDO's urgent assistance in assessing the local conditions with respect to starting waste oil rerefining in the country.

Through UNIDO's assistance, a techno-economic opportunity study has been submitted to the government. The study supports the preliminary assessment that a waste oil rerefinery in Thailand is environmentally beneficial and commercially viable. Phase II of the project will comprise all preparatory activities which will enable the Government to construct the envisaged waste oil rerefinery plant.

2. Phase II of the project is envisaged to be carried out by a technical sub-contractor in close collaboration with the direct recipient who will be designated by UNIDO's counterpart, the Ministry of Industry. The preferred direct recipient would be P.T.T., as this would minimize the costs of establishing the rerefinery and provide a stable set of customers for the finished products and therefore also minimize the risks associated with the operation.

Setting up the rerefinery plant as an independent unit would require additional costs, both physical and human, to administer it, to set up a functioning system for collecting the raw material, i.e. waste oil, as well as requiring substantially greater costs and efforts to market the finished products.

5. Special considerations

The project is closely related to resource conservation, recycling of waste materials in general, low waste/non waste technologies, water and air pollution control, safety in home and industrial petroleum boilers, environmental legislation and collection systems for environmentally hazardous waste materials.

C. Development objectives

To maintain and improve the quality of life through environmental pollution control while the country pursues its industrialization programmes and to save scarce energy and lubricating oil resources as well as foreign exchange.

D. Immediate objective, outputs and activities

The immediate objective is the complete preparations for the construction of a waste oil refinery plant. This can be broken down to the following required outputs and activities (NOTE: the more exact details, including UNIDO's substantial inputs, government exact counterparts, scope and volume of training, the timing of various activities etc. will have to be added after further discussions with the Ministry of Industry have been held and the terms of reference for the technical subcontractor has been determined. However, it is expected that the subcontract should include at least personnel of the following type: financial analyst, energy economist, petroleum engineer and production/process engineer.):

Output 1.1: Technical drawings and charts

Activities	Party/ies responsible	Starting time & estimated duration
Verify and as required update scientific methods presented in the opportunity study	Technical subcontractor and advisor	Beginning month 2 and lasting 1 month

Plot layout, architectural concepts, flow charts, dynamic and static calculations	Sub-contractor and the designated direct recipient.	After 1 month and lasting 4 months
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Output 1.2: Premises and facilities

Activities	Party/ies responsible	Starting time and Estimated duration
Specifications of the premises and facilities needed during the construction period	Sub-contractor and the designated direct recipient	9 months after initiation and lasting 1 month

Output 1.3: Lists of equipment and supplies

Activities	Party/ies responsible	Starting time and Estimated duration
Check and as required update the listings in the opportunity study	Sub-contractor and technical advisor	After 6 months and lasting 1 month

Output 1.4: Qualified management

Activities	Party/ies responsible	Starting time and Estimated duration
Study tours to existing plants using the chosen technology	UNIDO	After 5 months and lasting 5 months

Output 1.5: System for waste oil collection

Activities	Party/ies responsible	Starting time and Estimated duration
Collecting data and designing a collection network	Designated direct recipient with required assistance from sub-contractor	After 2 month and 6 months

Output 1.6: Qualified negotiators

Activities	Party/ies responsible	Starting time and Estimated duration
Assistance in negotiating and contracting skills for eventual procurement of equipment/services	International consultants	Split missions during final 6 months of project

F. Risks

1. Insufficient availability of raw material for the waste lube oil rerefinery, specifically including:

- failure of identify sufficient appropriate and reliable suppliers of waste oil,
- failure of setting up and operating a good collection network.

The pre-feasibility, opportunely study included the recommendation the rerefinery plant be set up in conjunction with P.T.T. Hence, these risks would be avoided by using P.T.T.'s network of customers. The envisaged Phase II includes further field studies and data collection on the availability of waste oil and systems for collecting it (see D.1.2.5. above).

2. Over time the deliberations of the financial and administrative structure of the rerefining plant may become protracted, the price structure may move adversely to the profitability of the project or technological developments may render the chosen technical method obsolete and less profitable. The opportunity study included a financially comprehensive analysis. the highest sensitivity is recorded for drops in the sales price of the finished product, a 10 per cent price fall reduces the IRR from 27.4 per cent to 20.7 per cent. Given the conservative estimated of the price structure in the basic financial evaluation, however, the likelihood attached to this risk must be considered low.

G. Prior obligation and pre-requisites

1. Prior obligation

The project document will be signed by UNIDO and UNIDO assistance to Phase II of the project will be provided only if the location of the waste oil refinery plant has been chosen to UNIDO's satisfaction. Based on the findings of the opportunity study it is envisaged the location will be either Lam Chabang or Map Ta Phut in the Eastern Seaboard Development Area.

2. Pre-requisites

The project document will be signed by UNIDO and UNIDO assistance to Phase II of the project will be subject to designation of a direct recipient and confirmation that funding for the Phase II has been secured and that financing for the eventual construction of the waste oil refinery plant has been arranged, or is likely to be arranged.

H. Project review, reporting and evaluation

The project will be subject to tripartite review (joint review by representatives of the Government of Thailand, UNIDO and UNDP. such a meeting should be held at least once and within the first 12 months of the start of full implementation. the national project co-ordinator and/or senior project officer of UNIDO shall prepare and submit to the tripartite review meeting a Project Performance Evaluation Report (PPER). Additional PPERs may be requested, if necessary, during the project.

A project terminal report will be prepared for consideration at the terminal tripartite review meeting. It shall be prepared in draft sufficiently in advance to allow review and technical clearance by the executing agency at least four months prior to the terminal tripartite review.

After consultation between the parties to the project document, the project shall be subject to evaluation. The organization, terms of reference and timing of such an evaluation will be decided upon between the parties to the project document.

I. Legal context

1. This project document shall be the instrument referred to as such in Article 1 of the Standard Basic Assistance Agreement between the Government of the Kingdom of Thailand and the United Nations Development Programme, signed by the parties on the _____. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the Government co-operating agency described in that Agreement.

2. The following types of revisions may be made to this project document with the signature of the UNDP Resident Representative only, provided he or she is assured that the other signatories of the project document have no objections to the proposed changes:

(a) Revision which do not involve significant changes in the immediate objectives, outputs or activities of a project, but are caused by the rearrangement of inputs already agreed to or by cost increases to inflation; and

(b) Mandatory annual revisions which rephrase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility.

NIDO

PROJECT BUDGET/REVISION

COUNTRY Thailand	4. PROJECT NUMBER AND AMENDMENT XX/THA/89/XXX	5. SPECIFIC ACTIVITY J19200
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1. PROJECT TITLE
Advisory Assistance in Formulating a Programme for Waste Oil Recycling, Phase I

INTERNATIONAL EXPERTS (functional titles required except for line 11-50)	16. TOTAL		17. 1990		18. 1991		19.		20.	
	M/M	\$	M/M	\$	M/M	\$	M/M	\$	M/M	\$
11-01 Expert in negotiation and contr.	6	60,000			6	60,000				
02										
03										
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										
16										
11-50 Short term consultants										
11-99 Sub-total international experts	6	60,000			6	60,000				

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REMARKS

If more than 16 experts required check here and attach continuation sheet 1A. This sub-total must include all experts.

4. PROJECT NUMBER XX/THA/89/XXX	16. TOTAL		17. 1990		18. 1991		19.		20.	
	M/M	\$	M/M	\$	M/M	\$	M/M	\$	M/M	\$
OPAS EXPERTS (functional titles required)										
12-01										
12-02										
12-03										
12-99 Sub-total-OPAS experts **										
ADMINISTRATIVE SUPPORT PERSONNEL										
13-00 Clerks, secretaries, drivers										
13-50 Freelance interpreters (non-UNDP projects)										
13-99 Sub-total-administrative support personnel										
UN VOLUNTEERS (functional titles required)										
14-01										
14-02										
14-03										
14-04										
14-99 Sub-total-UN VOLUNTEERS **										
15-00 Project travel										
16-00 Other personnel costs (including UNIDO staff mission costs)		20,000		12,000		8,000				
NATIONAL EXPERTS (functional titles required)										
17-01										
17-02										
17-03										
17-04										
17-05										
17-99 Sub-total-National experts **										
18-00 Surrender prior years' obligations										
19-99 TOTAL-PERSONNEL COMPONENT	6	80,000		12,000	6	68,000				

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** If additional individual budget lines are required, check here and attach continuation sheet 1A. These sub-totals must include budget lines listed on page 1A.

4. PROJECT NUMBER XX/THA/89/XXX	16. TOTAL		17. 1990		18. 1991		19.		20.	
	M/M	\$	M/M	\$	M/M	\$	M/M	\$	M/M	\$
SUBCONTRACTS										
21-00 Subcontracts	40	600,000	15	225,000	25	375,000				
28-00 Surrender prior years' obligations										
29-00 TOTAL-SUBCONTRACTS										
TRAINING										
31-00 Individual fellowships										
32-00 Study tours; UNDP group training	5	80,000	5	80,000						
33-00 In-service training										
34-00 Non-UNDP group training										
35-00 Non-UNDP meetings										
38-00 Surrender prior years' obligations										
39-99 TOTAL-TRAINING COMPONENT										38
EQUIPMENT										
41-00 Expendable equipment										
42-00 Non-expendable equipment										
43-00 Premises										
48-00 Surrender prior years' obligations										
49-99 TOTAL-EQUIPMENT COMPONENT										
MISCELLANEOUS										
51-00 Sundries		8,000		4,000		4,000				
55-00 Hospitality (non-UNDP projects)										
56-00 Support costs (CC and DC projects only)										
58-00 Surrender prior years' obligations										
59-99 TOTAL-MISCELLANEOUS COMPONENT										
99-99 PROJECT TOTAL	51	768,000	20	321,000	31	447,800				

Annex I

Work Plan

The order and duration of the activities will be as follows*

Activity	Starting Time	Duration
Determine the terms of reference for the sub-contractor	Beginning month 0	0.5 month
Determine the terms of reference for the independent technical adviser (if any)	Beginning month 9	0.5 month
Selecting sub-contractor	Beginning month 1	0.25 month
Selecting technical adviser	Middle month 1	0.5 month
Review technical methods for the rerefinery plant	Beginning month 2	1 month
Produce technical drawings and charts for the plant	Beginning month 2	6 months
Produce lists of equipment for the plant	Beginning month 8	1 month
Specify required premises and facilities for the period of construction	Beginning month 9	1 month
Designing a collection network for the rerefinery as required	Beginning month 2	6 months
Study tours	Beginning month 5	5 months
Assistance in negotiation and contracting	during final 6 months	6 months

* Note: The work plan can only be finalized after further discussions have been held with the host country government.