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DS 135.22

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THAILAND RENEWABLE NONCONVENTIONAL ENERGY PROJECT:

AN EVALUATION

September 1982

Prepared for:

USAID/BANGKOK AND THE
THAILAND NATIONAL ENERGY ADMINISTRATION

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6. Sixty-two percent of the project time (3 years) has passed with 24% of the U.S. funds and 14% of the RTG funds having been spent.

7. Delays in organizing the project and selecting the coordinating contractor and major problems with management, the long term coordinator, work planning and approval of work plans have resulted in almost two and one-half years passing while work on only three components proceeded.

8. In late 1981 a new project coordinator was appointed and by mid-1982 many of the other problems had been diminished to the point that all but one of the elements of the project (training) had been approved and work started.

Overall Project Design

1. The project was appropriate at the time the agreement was signed, but was overly ambitious, contained too many components and did not consider normal AID and Thai problems with project start-up.

2. The project did not include an element to combine and evaluate the results of all components. A comprehensive assessment of social, economic, environmental and technical implications was not an explicit project activity and was not built into the components.

3. The testing of dissemination techniques for successfully demonstrated technologies was not planned as a coordinated activity but was to be done on a component-by-component basis.

4. The delays have made the original project design and some of the expectations, especially the development and testing of dissemination techniques for all technology components, impossible to accomplish.

EXECUTIVE SUMMARY

Introduction

This major evaluation of the Thailand Renewable Nonconventional Energy Project was designed to provide advice and guidance to USAID/Thailand and the host country project manager, the National Energy Administration (NEA). The principal focus was an analysis of the overall project objectives and design, the nature and status of individual project elements, and the institutions involved. Recommendations were to be made covering those changes and additional actions necessary to accomplish the project goals or modify goals to fit present and future conditions. The evaluation also addressed issues of general relevance to AID and its role in major renewable energy project design and implementation. A two person team from Development Sciences Inc. performed the evaluation in Thailand in late August and early September 1982.

History and Project Status

1. The 5-year Renewable Nonconventional Energy Project was grant funded at $5,000,000 U.S. and $3,150,000 U.S.-equivalent in host country funds in August 1979.

2. The National Energy Administration (NEA), a part of the Ministry of Science, Technology and Energy, is the RTG project manager.

3. The project is subdivided into 14 components implemented by a variety of institutions including NEA.

4. A U.S. coordinating contractor (Meta Systems Inc.) was selected to locate a full-time coordinator in Thailand and provide a substantial amount of U.S. technical assistance to NEA and other component leaders.

5. Work on many of the components only started recently (mid-1982).

5. The planning of dissemination was not coordinated or very complete. There was no formalized approach or general protocol for this activity.

6. The lack of renewable energy resource quantity and quality data was being treated somewhat by the survey effort; however, a general biomass evaluation, originally a part of the project and subsequently cancelled, could be very useful. The solar and wind resource mapping effort has been delayed. This could cause problems later in the project when data, especially on solar and biomass, will be needed.

7. The micro hydro component is requesting authorization to change sites for the system but because micro hydro is now widespread in Thailand there is some question as to the validity of this component as a part of the overall project.

8. The one major renewable energy technology of possible application and not now being studies in Thailand is solar ponds.

9. The survey and energy master planning assistance components were found to need rethinking if they were to be of maximum utility to the project.

Institutional Roles

Project Management and Administration

1. The use of workshops and the creation of project technology and administration subcommittees is a positive step to improve management performance and address problems.

2. There appears to be a divergence between AID, NEA, and some component leaders in how the project is viewed. AID, following the project paper, views the project as defining technologies worthy of investment and beginning to disseminate these. NEA sees the project as mostly a preinvestment study. Component leaders vary in their opinions as to emphasis and expected outcomes.

5. There is little explicit planning for what to do if a component is not completed by the end of the project funding. This is especially critical in light of the RTG need for at least one year between a request for funding and receipt of funds.

6. The project paper emphasis on training and U.S. technical assistance has been diminished by RTG over the life of the project. At this time there is much less reliance on U.S. TA and the training element has been redefined to require only one-third its original level of finding.

7. Consideration of the tradeoffs between using renewable resources as energy sources or for other purposes such as for fertilizers, irrigation water supplies, etc., is not emphasized in the overall project design.

Component Design and Implementation

1. An initial attempt by Meta Systems (in late 1980) to prepare work plans for the project and all components was not successful.

2. Following this failure more plans were prepared and approved sequentially and only for individual components. No overall project work plan has been prepared.

3. The current approved component work plans are general activity descriptions useful to project management but not sufficiently detailed to guide work execution. Plans which contain milestones, expected results and a stepwise approach to achieve the expected results are needed. These execution plans need not be approved by project management and should be used by component leaders to guide day-to-day work.

4. Findings about specific components indicated that almost all the technology components were too ambitious and could probably not be completed before July 1984.

highly skilled and very senior personnel experienced in the particular work undertaken by the component leaders.

7. The use of the Thai Consulting Group to handle local consultants may no longer be necessary in that other mechanisms for identifying, contracting and monitoring local consultants are available.

8. The training element in the original project was very substantial (over 20% of the U.S. Grant). Presently it is less than 8 percent. The current plan is also a balancing of individual requests and desires to meet a limit imposed by the availability of Thai travel funds.

9. There is presently no in-Thailand training proposed.

Conclusions and Recommendations

The major conclusions and recommendations were influenced by the team's feeling about the following:

- The project goals, for the most part, are valid and are still accepted by the participants.
- Work on all components has finally started, and in some significant progress has been made.
- The existing project resources, the institutions, people, money and time could be combined in at least one way to make most of the goals achievable without radical shifts in the project.

We have tried to be sensitive to the above and the fact that the project has already experienced a significant number of changes and alterations. We have attempted to put together a package of recommendations which are consistant and which, if adopted, will allow the components to meet the project objectives and be completed on time and within budget. The major recommendations which form this package should be adopted and implemented in phases.

3. AID's role in directing the project and in overall decision-making needs to be reassessed. This reassessment should consider mission policies, skills and interests and the findings and recommendations of this evaluation.

Coordinating Contract: Coordinator and Technical Assistance

1. The original mechanism adopted to facilitate contracting with a U.S. consulting firm has not worked well and NEA, rather than AID, should be firmly established as the manager of the coordinating contractor and coordinator.

2. The roles of all major participants - AID, NEA, DTEC, and the coordinating contractor - should immediately be clearly defined and mutually agreed to. AID, NEA, and Meta Systems should enter into face to face discussions to achieve this understanding.

3. All major project participants seem to agree that a long-term project coordinator is needed for at least one more year. The nature of the role for this coordinator is not agreed upon.

4. The DSI evaluation team also agrees that an on-site coordinator is necessary and could be very cost effective.

5. Technical assistance is held as necessary by all project participants but the amount, nature and origin of the TA are not agreed upon. NEA project management personnel would rather spend project monies on consultants from Thailand or in component institutions.

6. The most important need for TA is to accelerate progress, prevent problems, and focus on technology design, construction, operation, testing and scale-up in the field and in rural areas. The second need is to provide training by example to Thai personnel. This type of TA must be provided by

The total cost of the recommended expanded TA including the two months of senior project management will depend on many factors but can roughly be estimated at $12,000 per person month or $144,000 for approximately 12 person months. This money can come from savings created by adopting recommendations as to simplification in and curtailment of work on various components.

The third phase of implementation will involve the training element. This will require additional funds but the amount can only be known following preparation of a plan. This phase will also include a project evaluation at the end of 1983 (costing approximately $30,000) and work on component results analysis and overall project impact assessment.

The project must be adjusted by the short term strengthening of project management services, the continuation of the project coordination element, the simplification and curtailment of selected components, the expansion of others and the redirection of training to include in-country short courses. If this is not done the team feels that many of the components will not meet their objectives, others will only be partially completed and the project will likely remain a series of loosely connected elements.

There are many other specific recommendations contained in the body of the report, especially in Chapter VI, IMPLEMENTING THE RECOMMENDATIONS. We feel that it is essential that the report be read in full by those who are going to deal with the project, be impacted by the team's findings and recommendations or judge the evaluation.

What does the "coordinator" coordinate

The first phase should include: immediate reopening of a discussion in Bangkok between AID, META and NEA of contractual issues; this discussion should include the definition and agreement on a role and set of responsibilities for a project coordinator and the type of person necessary. The team has recommended that a coordinator be provided for at least one more year and if finances allow -- two years. The role of the coordinator in the future can only be accepted if it emphasizes leadership, senior contributions to project management and substantive (technical and economic) inputs and assistance.

The second part of the first phase involves the identification, acceptance and arrival of a senior technical project management expert with a good knowledge of the renewable energy field. This expert, to be on site for two months, will assist the project manager and the coordinator in developing an overall integrated work plan and expanding the training plan. He/she will also begin the process of preparing and expanding component execution plans.

The second phase of implementation will involve the revision of component plans and preparation of future budgets to reflect inputs from the overall project work planning process and the detailed component execution plans. This phase will also include the expanded use of U.S. Technical Assistance in selected components. This technical assistance in the following component list will include at least four week visits of agreed-upon experts in technology design, construction demonstration, testing in the field, and dissemination:

What will all this do to provide more energy for the Thais

Regional Energy Centers	Surveys
Charcoal Improvement	Gasification
Stove Improvement	Pyrolysis

CHAPTER I

INTRODUCTION AND ACKNOWLEDGEMENTS

Introduction

The Thailand Renewable Nonconventional Energy (TRNE) Project, started in 1979 with the signing of the agreement, includes a major mid-project evaluation. This evaluation was scheduled in the Project Paper for July 1982 at a time when it was expected that the work would be 60 percent complete. The topics of concern to this evaluation are described in the project agreement and these formed the basis of a scope of work for the evaluation team. The other major input to this work scope was the issues and problems which had developed over the course of the project. The scope of work (presented in full in the Appendix) requires that the team:

- Review project design, plans, expectations and accomplishments to this point to determine if project objectives are being and can be met.
- On the basis of the above review, the team is required to summarize its findings and recommend those additional actions necessary to accomplish project goals, any changes in goals which may be needed and those modifications in project and component makeup to assure accomplishment of the existing and/or new goals.
- A number of specific areas are also identified to focus the team's evaluations.

Funding, timing and contractor experience requirements resulted in a two-person team from Development Sciences Inc. being selected to perform the evaluation. Dr. James D. Westfield, a renewable energy technology specialist, served as the Team Manager, and Dr. Ulrich Ernst, a senior

economist, was the second team member. The team arrived in Thailand in August of 1982 and spent 35 person working days in country performing the evaluation. The evaluation included attendance of a three-day project workshop; discussions with and visits to representatives of all major project participants; review of plans, reports, memos, files and other official and unofficial documents; and meetings with others not participating in the project but knowledgeable about renewable energy development in Thailand. The team members also drew heavily on their recent involvement in several other ongoing renewable energy projects and on their combined experience with project review and evaluation assignments.

The following report chapters and appendices present data, summaries, findings and recommendations. A draft of the report was completed by the team prior to leaving Thailand and was discussed and left with AID mission personnel. A briefing on findings and recommendations was also presented to NEA. This final report reflects editing and suggestions made by AID mission and NEA personnel but is, in its findings and recommendations, the same as the draft left in Thailand.

Acknowledgements

The DSI team encountered cooperation and an attitude of openness and willingness to discuss all aspects of the project in Thailand. The mission, META, NEA, and those involved in component activities were available and helpful. The three-day project workshop was very revealing and the simultaneous translation was a work of art. There are many individuals who could be singled out for their assistance and positive contribution to this evaluation; however, because everyone was helpful, we have decided that, rather than miss mentioning someone, we will issue this general

acknowledgement. This spirit of cooperation and openness was one of the things that made us believe that the project goals could still be accomplished.

CHAPTER II

HISTORY AND STATUS OF PROJECT*

The Thailand Renewable Nonconventional Energy (TRNE) Project was conceived and planned in 1978, and the Project Paper was written and approved in 1979. The Grant Agreement was signed in August of 1979 for a USAID Grant of $5 million, and $3.2 million in counterpart funds from the Royal Thai Government (RTG). A Coordinating Consultant was selected and placed under contract to USAID, and a project coordinator was in Thailand by September 1980. Work planning, budgeting of counterpart funds, project organization, management and coordination problem resolution, and substantive work on one or two components proceeded in 1981. Work on the majority of the project components was underway by mid-1982. Initial delays were the result of a number of factors, including required waiting periods associated with the RTG budget process, and the complex approval processes for component work plans.

The project is organized into 14 components, covering the areas of institutional development, renewable energy technology demonstration in rural areas, and development and testing of technology dissemination techniques. They are listed in Table II-1

The project is managed and coordinated by the National Energy Administration (NEA). NEA is also responsible for the conduct of selected project components, while other institutions, such as the Royal Forest Department (RFD), universities and the Coordinating Contractor, Meta Systems (MSIA) handle others. The Department of Technical and Economic Operation (DTEC),

*A more complete project history and a description of the project organizational background is included in the Appendix.

Table II-1

COMPONENTS, THEIR BUDGETS AND EXPENDITURES*

(As of July 1, 1982)

Components		Implementing Agency	Funding US $1,000 USAID	RTG	Total	Percentage Spent
1	National Energy Info Center	NEA	356	238	594	4.9
2	Regional Energy Ctrs	NEA	459	1,329	1,788	3.1
3	Energy Master Plan Support	NEA	132	70	202	8.9
4	Surveys	NEA	353	78	431	80.5
5	Micro Hydro	NEA	320	208	528	50.2
6	Water Lifting	NEA	307	83	390	5.9
7	Biogas	NEA	125	39	164	0.0
8	Solar Drying/Distillation	KMIT	106	86	192	1.1
9	Gasification	CU	192	39	231	0.4
10	Village Woodlots	RFD	554	395	949	10.7
11	Charcoal Improvement	RFD	182	131	313	6.9
12	Stove Improvement	RFD	208	151	359	1.7
13	Solar/Wind Resources Assessment	MET	254	16	270	0.6
14	Pyrolysis	TISTR	90	74	164	7.3
	(Technology Monitoring)	NEA	35	-	35	60.6
	(Training)	NEA	500	90	590	0.0
	Coordinating Consultant	MFTA	670	-	670	86.0
	Contingency		157	123	280	0.0
			5,000	3,150	8,150	18.1

*Data in this table were taken from several sources including AID financial status reports, MFTA invoices and quarterly reports and component budgets. It represents the team's best effort in compiling budget and spending information. There are several anomalies and because component budgets are being revised, it may not be up to date.

in its role as the Thai agency responsible for Grant funded activities, approves budgets, supervises offshore procurement, and manages counterpart funds for out-of-Thailand travel and training. The Grant Agreement is unique for Thailand, bypassing DIEC, which is the normal conduit for USAID grants, in favor of direct transfers to the implementing agency, NEA.

Over the last year, project management and coordination has improved mainly as a result of quarterly workshops, bringing together all participants, and monthly administrative meetings. These functions have been transferred to two newly created subcommittees of the National Energy Committee, one for administrative and one for technical issues.

The project has slightly less than two years remaining (62% of the time has passed); approximately $1.2 million or 24% of the total of $5 million U.S. funds and $450,000 or 14% of the $3.15 million in RTG counterpart funds have been spent. The U.S. funds have been used mostly for project coordination and survey activities. RTG funds have been spent mostly on the Micro Hydro, Woodlot and Regional Energy Center components. Table II-1 presents selected data about the project components as of July 1982.

This report presents the results of a major project evaluation, carried out by a two-man team from Development Sciences Inc. (DSI). The evaluation comes at a time when many components have just started, planning has been completed, plans are approved, and work on virtually all components is underway. Less than two years remain to complete the project work and there are few outputs, results or indicators of progress in most components to confirm judgements about the chances of success of components and the whole project. Therefore, the judgements of the DSI team had to rely on reviews of existing plans and documentation, extensive interviews and discussions,

attendance at and participation in a three-day project workshop involving all project participants, and the team's experience in reviewing and participating in numerous other renewable energy projects around the world. The team was presented only one limitation by the USAID Mission staff; at this time, no time extension or funding increase to facilitate project completion should be considered. In most respects, this project has just begun; thus, the evaluation focused on opportunities and problems which will affect the future of the project. The past was reviewed to gain sufficient knowledge of what happened and why. The report, however, does not dwell on these aspects. The evaluation addresses the scope of work and the team has chosen to subdivide our analysis into the following major categories; Overall Project Design, Component Design, Institutional Roles, Training and Implementing the Recommendations.

CHAPTER III

OVERALL PROJECT DESIGN

The DSI team feels that the project was appropriate for Thailand at the time the Agreement was signed. However, even then it was overly ambitious, contained too many components, and did not consider the normal AID and Thai problems with project startup. The ambitious scope of the project reflected, at least in part, AID's lack of familiarity with the renewable energy field. At that time, there was no fistory of or performance data on Renewable Energy Projects in AID.

The project also did not contain any element to combine and evaluate the results of all components. The comprehensive assessment of the social, economic, environmental and technical implications of the components, and the tying together and evaluation of results of the total project were not an explicit project activity. In light of the fact that part of the project emphasized use of technologies already demonstrated elsewhere, this seems to be a serious shortcoming. The testing of dissemination techniques for successfully demonstrated technologies was also not planned as a coordinated action, rather, it seems that this was to be done on a component-by-component basis. The Regional Energy Centers were to play a major role in dissemination. Even so, the development of dissemination skills and technologies, and the process of deciding what, when, where and how to disseminate was not given much explicit attention.*

Work planning and startup suffered from a number of problems, some of which seem to have resulted from AID's decision to bypass some of the established operating procedures for grant-funded host country projects.

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* See Appendix on Data Collection for Design and Evaluation for a detailed description of the type of planning needed.

This seems to be predicated on small scale appropriate tech approach.

The critical steps included:

- Selection and direct contracting with the coordinating contractor by AID.
- Making the coordinating contract very flexible, and initially establishing the coordinating contractor as responsible (in cooperation with NEA/USAID and the Meta home office) for project planning and implementation.

This post facto judgment overly simplifies the situation and does not present the rationale behind or expected positive results of these actions. The contracting mechanism, the contract terms and their interpretation continue to represent project specific issues, and are still a major point of contention.

It's not project implementation that is at fault - but project design causes this

The long delay in starting work on most of the project components, together with the decision to attempt to meet the Project Assistance Completion Date of July 1984, has made some of the original project expectations and resulting design decisions inappropriate. they were inappropriate to start with The team feels that the development and testing of techniques for dissemination of the renewable energy technologies demonstrated in the components, a major goal of the project, will not be possible in several of the components. The tight schedule, as well as the decision by NEA and AID to favor in-country development at the expenses of US expert technical assistance, call for a re-examination of each component's and the overall project objectives. Applying component-specific objectives that can be reached by mid-1984 would acknowledge the fact that components are at different points on the technology development-dissemination spectrum. In some instances, this

and will needed in most of them.

reassessment and setting of objectives will identify the need for additional resources, primarily technical assistance. Moreover, the technologies originally selected for inclusion have undergone testing and development outside the project and the country since the conception and inception of the project in 1978 and 1979. This has rendered some currently included technologies less appropriate and made some others candidates for inclusion.

very true

A now obvious problem in the overall project design is the lack of a contingency plan or agreement for handling partially completed components at the end of the project. This is exacerbated by the emphasis on individual technologies and separate components. This is especially critical in light of the problems of finding funding for projects without going through at least one year wait for the normal RTG budgeting process.

The Project Paper theme (page 6B. Description) to provide the basis for the development and implementation of a continuing rural energy policy could well serve as a guide to rethinking the project design, and completing an overall project work plan. The DSI team recommends that the overall project design should be maintained for the most part and enhanced by the following steps:

- It should be made explicit in the form of an overall project work plan (the nature of this work plan is explained later).
- The project management should acknowledge that some of the technologies are unlikely to proceed all the way to developing and testing dissemination methods in the time remaining. In these cases, objectives should be formulated with respect to laboratory and field testing to assure adequate time and resources for the best possible performance of these tasks.

this is unclear

respect to determining how renewable energy can contribute to the national energy product

- Planning is needed for project follow-on and continuation of any component work necessary to complete a component beyond the PACD.
- The original emphasis of training and use of U.S. TA should be readopted and incorporated in the overall project design.
- The agreed upon emphasis on the role of women in the project should be examined and additional efforts in this area should by planned. We attempted to ascertain what special emphasis had been made to include women and did not discover any. However, there are a number of women involved in the project and the rural emphasis of many components will ultimately benefit women.
- A second mid-project evaluation should be performed one year from now to incorporate independent thinking and to encourage maximum emphasis by NEA and the component leaders on integrat of individual project activities.
- The project should consider evaluation of the trade off between a variety of possible uses of the renewable energy resources being considered. For the components involving biomass and hydro and for the project as a whole, some recognition and consideration of non energy uses of renewable resources and the impact on these of the adoption of the component technology is necessary.

In adopting these recommendations, the team has rejected other, more radical options. The team concluded that the project is still viable, necessary, for the most part composed of appropriate components, and should

be continued. Therefore, cancellation was deemed not to be a reasonable alternative approach. Radical changes in the current project scope or emphasis were considered, such as significant shifts of project management and execution responsibility to the coordinating contractor, other IA, or non-Thai entities; redirection of remaining funds to institution building activities, such as training and importation and use of mostly US or developed-country technologies; or withdrawings of funds from the project. Such changes were felt to lessen rather than support the chances of accomplishing even diminished or altered project components and goals. In the final analysis, the project can still meet a number of the early expectations. The team feels that the changes recommended in the evaluation will enhance the utility of the project to the RTG without diminishing the current work or disturbing what has already been accomplished.

CHAPTER IV

COMPONENT* DESIGN AND IMPLEMENTATION

The present components evolved from those outlined in the Project Paper. The initial action of the project following organization of RTG project management and arrival of the Project Coordinator was work planning. The work planning task which was assigned to the resident coordinator, a U.S. TA team from META and RTG personnel did not result in a work plan acceptable initially to AID or later to RTG. This failure caused a series of delays and ultimately led to the sequential preparation and approval of individual component work plans.

The project lacks a lot more than a work plan a work plan which integrates and combines components. It has a work plan which is, at best, the sum of all approved component plans. Furthermore, while work planning has taken substantial time and project resources, the individual component work plans are not detailed operational statements directed to guide execution. The existing plans are general activity descriptions, time estimates and spending projections useful for Project Management to monitor progress and grant budget approvals at designated times. Even here, though, information useful in monitoring progress in terms of accomplishments of specific objectives is not included.

Work planning is felt to be complete for the time being by the NEA project manager and most component leaders. Expansions or changes will be made when the existing plans are proven incorrect or inadequate or to reflect purposeful changes in the nature or timing of work.

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* A summary and assessment of each ongoing component is found in the Appendix.

The composition of the project has frequently changed since its inception and it is still experiencing minor changes. The major change which took place during the early part of the project was the elimination or major curtailment of the project financed renewable and nonrenewable energy resources assessments. Today, only the Solar and Wind Assessment remains in a diminished form, and has not yet been started. The others were eliminated for a variety of reasons including plans to conduct similar surveys under different funding (Micro Hydro and Geothermal), a decision that an area was not appropriate for this project (lignite, tarsands and oil shale), and becuase AID and NEA Project Management felt that enough was already known about a resource (biomass). Some information on biomass has been and is being collected by the rural base line and transition surveys. The evaluation team believes it is unfortunate that an acceptable biomass survey work plan and component could not have been developed. The need for good data on the quantity, quality and distribution of biomass throughout the country is evident and has been expressed by several people interviewed. It may not be possible at this time to complete a major biomass assessment under the project, but when the survey is reevaluated, special attention should be given to biomass data collection. A second major change in the project was in the type and amount of training to be financed. Much less training activity is now anticipated and there may be no long-term academic training.

A third major type of change is that of substitution of one technology component for one judged not appropriate. This type of change has resulted in the addition of a major Gasification and an Industrial Biogas component and the elumination of industrial conservation and conversion system integration components. The criteria used to decide on appropriateness have not

been made explicit. The addition or elimination in itself is not a problem. Rather, it is this seeming lack of explicit decision criteria which may have been a problem. An evaluation of those technology components now a part of the plan with those which could be considered for Thailand has identified that solar ponds is a technology system which should be considered for inclusion in the project. Solar ponds have been used in several countries for power generation and as a source of heat for industrial and commercial purposes. The usefulness of heat and especially electricity in rural areas and the potential to supply large amounts through a relatively simple technology makes solar ponds worth investigating. The technology (see the Appendix for an explanation of the technology) is being used extensively in Israel and a new major use is being started in the Dominican Republic. Because of its potential for Thailand, it should be considered for inclusion in the project. The project manager should investigate the possibility and impact of applying this technology in Thailand. At least one previous study has been performed in Thailand* and this could be used as a starting point for the investigation.

No where not even Israel has real solar ponds practice

With respect to other components, the following recommendations have been made:

- All components need detailed execution plans. These plans should contain milestones, describe why each element is being performed, the outputs and expected results of each task and define the steps to be taken to achieve the expected results.

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*Rojanasaroj, S., KMIT Research and Development Bulletin, Vol. 4, No. 2 (Nov 1980), pp 42037-42047.

The plans need not be approved by Project Management but should be used by those working on the component to direct their day-to-day activities. One person such as the coordinating consultant could work with each component leader to assist in the preparation of these. This should be a high priority activity and should not require the stoppage of work. It can be accomplished rapidly with the proper direction and assistance. A senior technical and project consultant (described later in the report) can initiate this effort.

- Data so far produced by the survey component have proved useful to component leaders. However, they do not satisfy all of the baseline data needs. As new sites are chosen, and as field tests change emphasis, data collection and analysis requirements regarding the contract and impact of the respective technologies will grow significantly. Because of this growing need, the survey component should be reassessed and expanded.*

Should try and determine what wind data lapse calibration about instrument calibration.

- The Solar/Wind resource survey component should continue to emphasize instrument calibration. It should also be expanded to consider siting of instruments and the rapid preparation of at least a country solar energy profile (SEP) using transforms of the existing hours of sunshine data.
- The Stoves and Charcoal components should have additional TA in the form of dissemination planning assistance.
- A concerted and special effort should be directed to planning dissemination of technologies. This effort should draw on Thai skills as well as foreign TA.

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* See Appendix description of Data Collection for Design and Evaluation for details and specific recommendations.

- Purchases or rental of computer equipment for the National Energy Information Center should be made contingent on a more precise assessment of the nature and scope of work (library management, data base management) to be performed.
- The Energy Master Plan Support should be reassessed because the limited budget proposed is unlikely to develop the tools and elements expected. The support should be redirected to providing assistance and tools to component leaders which will enable them to assess market potential at the rural and village level.

These changes will require some time to implement, more U.S. TA than is currently planned, and more funds than are allocated. Because the team believes that these changes are necessary, and because our assessment has identified other areas where curtailment and narrowing is called for, the evaluation team feels that these needs can be met through a reallocation of existing funds. More detailed descriptions and justifications of the proposed component alterations can be found in the Appendix.

In the components discussed below, the recommendation is to focus on activities that can be completed in the remaining time, and to leave much of the dissemination for another project at a later time. The change will result in the development of a much better understanding of the technologies and in a more reasonable set of component goals. The team's decision to recommend this has taken into consideration the time remaining; the skills and experience of the component personnel and institutions; and the nature of technology adaptation, evaluation, redesign, scale up and testing in village and rural settings and DSI experience in other renewable energy projects:

What industry?

- The Industrial Biogas component should be altered to concentrate on one or, at the very most, two locations for a demonstration. Because this is a new venture (industrial applications) for NEA, more emphasis and time should be spent on the design and the actual testing of the demonstration units. This diminished scope will emphasize learning about problems with design, location and operation of units and will collect data on the economics of this application.
- The Solar Drying and Distillation component should focus on the previously approved village demonstration of water distillation and several types of drying. The contemplated expansion into solar powered (thermal) refrigeration should not be included even at the laboratory scale. More emphasis should be placed on quantifying needs and on designing and testing distillation and drying systems appropriate for rural needs and uses.

why not?

A.T

- The biomass gasification component is too ambitious and seeks to cover too many technologies or equipment types. Only two equipment types should be selected for development and testing and more effort should be placed on their prototype testing, operation and redesign.

how can you say this without a program

This is a test program with a production program

- The Pyrolysis component is also too ambitious and efforts should be limited to design, construction and operation of the training converter. The demonstration converter should be designed but not constructed under this component. This limitation of scope will allow more effort and time to be allocated to development of the data and understanding necessary to move site selection and village demonstration of a converter.

- The Micro Hydro component is a victim of time and in-country development of capabilities and applications outside this project. Because of this and because of the new major Micro-Mini Hydro project being funded by AID, serious consideration should be given to completing only the Bo Keao site. The remaining three sites can be considered for funding by the new projects. This curtailment of this component can have political and other project implications. The removal of the three new sites may, in fact, prevent them from getting any funding. The benefit from this component not received in the other Mini Hydro projects is the testing of operation and maintenance of the systems by a local cooperative. The Bo Keao site will not do this and one example may not be enough to test this mechanism. The decision to keep or eliminate the three additional sites in this component should be made on the basis of an examination of a detailed plan describing how the cooperatives will be developed and monitored. The value of the saving of funds ($245,000 from AID and $140,000 from NEA) to support other project activities, such as payment for the coordinator vs. the value of having the three sites, should be evaluated.

The first step in this process of redirection and shifting component emphasis is reexamination of the content and timing for work tasks. In most of the work plans, the time given to accomplish tasks such as design, siting, construction, testing, data analysis and reaching conclusions tends to be much too short. In one case, as an example, a prototype technology not previously built by the component personnel will be designed, bids let,

contracts signed, construction, testing, data analyzed and conclusions drawn in the space of seven months. The construction, test running, data analysis and conclusion tasks are to be completed in 3.5 months. This type of timing is not reasonable and must be lengthened in order to allow for normal occurrences and complete accomplishment of task objectives.

The component leaders working with the project manager and the coordinator should be able to quickly perform this redirecting and limiting of components. Several components need only a few changes while others need more. The skills and knowledge of the component leaders and staff also varies and some will need much less help than others. While this process is being accomplished, an additional emphasis, for the technology components, on analysis of the systems and village and rural needs should be included. The design of technologies, equipment and the testing tasks should take into consideration the setting in which they will ultimately have to perform; the advice of Thai village social and economic specialists should be sought. The component specific data collection and analysis requirements need to be looked at from an overall project perspective. At the present time, there is duplication in some areas and a total lack of data in others.* The preparation of an overall project work plan will also help identify data needs and opportunities for coordination.

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* See Appendix covering "Data Collection for Design and Evaluation" for more details on this.

CHAPTER V

INSTITUTIONAL ROLES

The discussion of institutional roles has been subdivided into three sections. The first section includes Project Management and Administration, the second covers the Coordinating Contract, Coordinator and Technical Assistance, and the third section covers Training. Some of the issues have been previewed earlier; however, this section will treat them more comprehensively and consider alternative ways of addressing them.

Should be renewable to project management team committees

Project Management and Administration

It appears that the project management activity has recently (early August 1982) been strengthened significantly with the creation, within NEA, of the Technology and Administrative Subcommittees. These subcommittees are organized to perform the following functions:

Technology Subcommittee

Monitor technology development and progress inside and outside Thailand, encourage rapid dissemination and assure that project technologies are appropriate.

Administrative Subcommittee

Monitor project progress, resolve administrative and management problems and review and evaluate work plans.

Both subcommittees are chaired by the Deputy Secretary General of NEA, and have the AID and NEA project manager and selected component leaders as members. DTEC is represented on the Administrative Subcommittee, and 3 to 5 outside technical advisors will be members of the Technology Subcommittee. These committees can be used to rapidly resolve problems and to assure the

integration and interaction of components necessary to produce a successful and complete project. There has not yet been time to see if they will perform this badly needed function.

The three completed project workshops have been a positive force in getting the project moving, and the most recent, held for three days late in August and attended by the DSI team, was impressive. The component leaders worked together, openly discussed problems and approaches, answered questions and learned what others were doing and planning. NEA and AID project management and the project coordinator also had an opportunity to interact with all participants and to hear and respond to questions, concerns and needs. A number of issues were raised, some were resolved and others set aside for later discussion or for immediate subcommittee attention. It is the team's recommendation that, in spite of the cost of these meetings (1 working day and two weekend days and travel and per diem at approximately $1,000), they should be scheduled every four months for two meetings and then twice more before the end of the project. The meetings will not substitute for overall integrated planning and management or a total project work plan but they will greatly facilitate the timely and efficient meeting of project goals if these two other management needs are also fulfilled.

The overall project work plan must be prepared rapidly if it is to do more than reflect and describe the inevitable. It must be available to component leaders to guide them in making decisions about emphasis, approaches to analysis of results and the extent and type of effort to be placed on village or rural testing and impact evaluation. For this reason, the plan must be more than a combination of component work plans. The overall project

work plan should integrate and set additional requirements on common project activities, such as data collection, siting, training, results analysis and reporting, as well as component interaction. It should also focus project elements such as TA, technology monitoring, surveys and training to be most useful to other components. The team feels that this is an important and absolutely necessary element if the project is to become more than the sum of 14 parts. To be successful, this type of integrative planning will require a very senior person with a substantial amount of experience in planning and managing large projects involving technologies (hopefully, renewable energy technologies). It is the team's feeling that the current project coordinator cannot accomplish this type of work alone and, thus, there is a short-term need for someone with additional skills and experience. Therefore, the project management should immediately arrange for at least two person months of TA to assist in this effort. The person chosen to perform this TA should have a techno-economic background, experience with major renewable energy projects and be a senior level project manager.

NEA now looks at this project as a "preinvestment" rather than an investment project. AID, the Project Paper and some component leaders seem to emphasize more of an investment flavor with selection of appropriate technologies and the beginning of investment in those selected being the expected outcome. As was mentioned in the project design section of this report, this issue, as well as that of the need for contingency planning for follow-on activities, should be resolved. It is the recommendation of the DSI team that the NEA attitude of emphasizing preinvestment be adopted. When this is done, the NEA project manager needs help in accomplishing this and, if accepted, in meeting the other recommendations and requirements

of this assessment. Both this need and the continuing role of AID project management will be influenced by decisions made about coordination and technical assistance. AID should also reevaluate its participation and define a role that will be compatible with mission skills, interests and policies.

Coordinating Contract: Coordinator and Technical Assistance

The coordinating contractor was initially included in the project to work with NEA to facilitate, lead, advise, and in a word -- to assist. For many reasons, this desired role has not fully materialized. One major reason (in addition to problems with the first project coordinator who was replaced in mid-1981), in the view of the DSI team, is that the contract was with USAID, rather than the implementing agency, NEA. There were many excellent reasons not to contract with NEA, the best of which was that it would not have been possible without many changes in existing practice and regulations. The only feasible alternative to a USAID contract at the start of the project was to contract with DTEC. This was also turned down in the project paper.

Contracting directly with NEA is apparently still impossible. However, the evaluation team believes that at least the present AID contract should be altered or reinterpreted to clearly and firmly establish NEA as the Manager of the coordinating contractor and the coordinator. A second desirable alteration in the contract would be to clearly redefine the role and responsibilities of the contractor, the coordinator, NEA, DTEC and AID. At present, the contract and especially a recent amendment tends to make it difficult to know what the contractor or the coordinator is responsible for. (See a discussion of this in the Appendix.)

There are long standing substantive and financial issues which can be addressed in an altered or officially reinterpreted contract and AID, NEA and META should be a party to this discussion. Anything more severe than an agreed upon renegotiation of substantive and financial terms with the goal of the project in mind will be too time consuming, possibly cause work stoppages, and unnecessarily delay badly needed TA and project management assistance. The previous sections of this report give guidance as to some of the important substantive issues and future responsibilities which need to be considered.

In addition, the need for and role of the long term coordinator must be settled. It is the team's judgement (for that matter, all other major project participants also agree) that a long term coordinator is necessary for at least one more year; two more years is desirable. The different groups disagree on the definition of a role for the coordinator. Some people, principally component leaders, feel they need a technical person with experience in handling an activity like their task and someone who can help them identify foreign TA. The NEA project manager desires an experienced technical project manager to work for and with him in evaluating technical components, supplying technical and economic advice to component leaders, and someone who can help him integrate and, in the end, evaluate the results of the components and overall project. There are several other models but in these the differences rest principally in who the coordinator works for (AID, NEA, both) and whether he/she helps manage, administer, or pays attention to technical issues and component performance.

The DSI team recommends that the long term coordinator should be directly responsible to NEA and should work with the NEA project manager to:

- Help prepare an overall work plan.
- Help component leaders prepare operational plans.
- Advise component leaders on technical and economic issues.
- Facilitate and arrange technical assistance from abroad using some limited form of backup on the U.S.
- Work out foreign procurement details with NEA and DTEC.
- Assist the project manager in integrating and evaluating the components.
- Help the project manager address and resolve management problems.

The coordinator must be able to accomplish these through mutual consent and his substantive and management knowledge. In spite of the past problems with project management and coordination, the team feels that the current attitudes, personnel and mechanisms will allow a coordinator to perform this role successfully.

The team has recommended expanded use of U.S., foreign, and Thai technical assistance, as explained above. The utility of this TA is twofold. Its main purpose is to accelerate progress, prevent problems and allow efficient and economical accomplishment of component goals. The second purpose is to provide training by example in the skills necessary to design, manufacture, test and analyze results from rural energy technology demonstrations. The training impact of TA should not be minimized. When TA is scheduled for a particular component, the person selected should, if possible, be called upon to transfer his skill and knowledge to a wide audience. Some formal training, as well as the informal training which comes from problem-oriented and component specific work, should be made a part of each scope of work for a TA assignment. In addition, we believe that the project should expand its sources for U.S. TA to include the 11 new U.S. Energy

IQC firms and the East-West Center. There have been problems in the past that arose because a U.S. specialist needed or proposed for a TA assignment was not acceptable, could not come when wanted, was perceived to be too expensive or did not perform up to expectations when he or she arrived. There have been problems on the other side resulting from delays in decisions, inadequate communications and lack of preparation for and anticipation of the needs upon arrival of the technical assistant. It appears that many of these problems are being resolved by improved procedures; however, unless the best and most responsive people are made available, many of the old problems will persist. The project coordinator and project management must be able to keep an expanded resource base of TA,especially if a larger than presently planned number of person months of TA will be utilized. This is one of the issues which must be resolved in the discussions about contract adjustments. The team feels strongly that the recommended type and application of TA is essential to component and overall project success.

The mechanism selected for providing local technical assistance initially worked well, especially in facilitating contracting. At this point, it seems that the Thai Consulting Group serves almost totally as a mechanism to channel local TA to component leaders. It performs accounting and assures quick payment but does not negotiate scopes of work, monitor progress, or assure acceptable performance. There are now other mechanisms to supply local TA and the other items are done, to some extent, by the project coordinator and component leaders. The present utility of the Thai Consulting Group appears to be in accounting and rapid payment. The cost of this limited service is viewed as excessive at this time by almost everyone even though the service is necessary. This is another issue which must be

addressed in contract discussions. If eliminated from the contract, this necessary service and that of monitoring must be provided by other means.

Training

The delays in preparing and receiving approval for a training plan (a condition precedent for releasing of funds), continuing disagreements about whay type of training is useful and needed and the limit on RTG counterpart funds* have combined to forestall the initiation of any project-related training. A training plan is now prepared but concerns by component leaders and DTEC have prevented even this from being approved.** This plan reflects a balancing of requests for training from component leaders with available funds rather than an assignment of funds to the types of training decided as necessary to meet the project goals. The divergence may not, in fact, be as sharp, but is difficult to assess. As with the components, training is a sum of a series of parts. This condition must be addressed, and, in conjunction with the preparation of an overall work plan, additional training activities should be included. The present training plan issues should be addressed rapidly and resolution of the existing issues between component leaders, NEA and DTEC should be seen as approval of only a first stage training plan. This first phase plan can emphasize out-of-Thailand and long-term-in-U.S. training if this is the decision of NEA and DTEC. A second stage plan should be prepared which emphasizes in-Thailand training (short courses) by U.S. experts in the following areas:

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* Since all foreign travel is to be paid for out of the $54,000 counterpart funds administered by DTEC, total training funds are effectively constrained by this sum, depending on the ratio between in-country and international travel expenses. In essence, more funds would be available for long-term training if it minimized out-of-Thailand travel by trainees.

** An analysis of this training plan is found in the Appendix.

- Project management
- Technology demonstration and site testing
- Data analysis and evaluation
- Technology dissemination
- Rural energy policy and strategy

This approach will provide a number of badly needed training opportunities to a wide range of in-country specialists.

CHAPTER VI

IMPLEMENTING THE RECOMMENDATIONS

The set of recommendations made as a result of the team's work and experience were influenced by a number of factors. The most important factor was that the project goals were valid and that they were still accepted by the participants. The second factor was that work on all components had finally started. In some components significant progress had been made and we did not want to create a situation through our recommendations where the work stopped. The third factor influencing our recommendations was our feeling that the existing project resources, the institutions, people, money and time could be combined is at least one way to make most of the goals achievable without radical shifts in the project.

We have tried to be sensitive to the above and the fact that the project has already experienced a significant number of changes and alterations. We have attempted to put together a package of recommendations which are consistent and which, if adopted, will allow the components to meet the project objectives and be completed on time and within budget.

The major recommendations, which form this package should be adopted and implemented in phases. The first phase should include immediate reopening of a discussion in Bangkok between AID, META and NEA of contractual issues. This discussion should include:

- Scope change and refinements to define the roles and responsibilities of NEA, AID, META and DTEC.
- Coordinating consultant role.
- Technical assistance strategy, mechanisms and procedures.

- Other issues pertinent to each parties' future roles and responsibilities including financial arrangements and costs.

This discussion should be focussed on establishing a contractual mechanism, working arrangements, and related terms and condition which will facilitate the accomplishment of the project goals. The discussions must have the best interests of the project in mind and must be used as an opportunity to make the project successful in the future. Blame for past problems and discussions about old and now unimportant issues must not be introduced. This process cannot be drawn out or delayed. It should be scheduled immediately and after it is started, it should be concluded within one or, at most, two weeks.

The coordinator is presently being continued, to be terminated by the end of November, or to be given two months' notice of termination. The team has recommended that a coordinator be provided for at least one more year and if finances allow -- two years. The present coordinator was brought in following major problems early in the project and through his, the NEA Project Manager's and AID's efforts, many of those problems have diminished or been solved. The DSI team has recommended a role and set of responsibilities, but the actual role which is defined for the coordinator during the recommended discussions between NEA, META and AID will determine the type of person necessary.

The cost for one or two years of additional coordination is significant; it has been estimated at approximately $170,000 per year*. This estimate

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* Estimated using data for total coordinator costs given in META letter of 19 August, 1982, R. Vernstrom to R. Halligan of AID.

does not include Thai Consulting Group costs. If this money is allocated to coordination at this stage in the project, the coordination must be less administrative and facilitative than it has been in the past. Previous emphasis on this area, though necessary, cannot be continued. These activities must be handled by project and component managers, DTEC and AID. The role of the coordinator in the future can only be accepted if it emphasizes leadership, senior contributions to project management and substantive (technical and economic) inputs and assistance. The funds for this type of assistance will come from savings which result from the previously described necessary curtailment and simplification of selected components. Justification of this type of fund switching must not be done on a gross project budget level but must be built up from details of new estimates of component costs over the life of the project. If project management accepts the team's recommendations about the need for at least one additional year of a full time U.S. coordinator and the limiting of work and spending on selected components, the money will be available for the extra year of coordination.

The second part of the first phase involves the identification, acceptance and arrival of a senior technical project management expert with a good knowledge of the renewable energy field. This expert will assist the project manager and the coordinator in developing an overall integrated work plan and expanding the training plan. He/she will also begin the process of preparing and expanding component execution plans. The completion of this process will be handled by the coordinator and project manager. This person should arrive in October or early November at the latest and

stay approximately two months. These activities should not require work stoppage on any component but will require some time from each component leader and the project manager.

The second phase of implementation will involve the revision of component plans and preparation of future budgets to reflect inputs from the overall project work planning process and the detailed component execution plans. This phase will also include the expanded use of U.S. Technical Assistance in selected components. This technical assistance will include at least four week visits of agreed upon experts in technology design, construction demonstration and testing in the field. These people will, for the most part, be very experienced and, thus, will be costly per hour charged. However, their value to the components in terms of problem prevention and solution and progress acceleration should be much greater than their cost or than could be achieved by other means in the time available. The added benefit of expanded TA use will be formal and informal training of Thai personnel. The expanded use of U.S. TA must be accepted by NEA and the component leaders as necessary and valuable. The team believes that major reservations about TA exist at the Project Management level and this issue must be addressed and resolved in contract discussions between AID, NEA and META during phase one.

The team has recommended additional TA, over that which is now planned, in the following components:

Regional Energy Centers

Charcoal Improvement

Stove Improvement

Surveys

Gasification

Pyrolysis

In the first three components in the above list the need is for assistance in selecting strategies and developing procedures for dissemination. This could be provided by one person working in Thailand for two months. This should be arranged for and started within the next few months.

The TA necessary in the surveys involves two months of a person to assist in developing a data management process and in redefining parts of the future survey activities. The details of this help have been described elsewhere. This person should have designed and participated in other survey efforts and have a knowledge of rural energy data.

The two technology demonstration components which could benefit the most from additional U.S. TA are Gasification and Pyrolysis. These components require help at two times over the remaining project. The first involvement should be early next year after the components have been simplified as has been recommended earlier. This one to two month visit of a technical person experienced in building and testing each technology in the field will help develop testing and analysis procedures which will assure that the data necessary to meet component objectives will be collected. This person can also preview problems, help with siting preparation and review the progress of equipment fabrication. The second visit, also for one to two months, should be scheduled after testing has started and some data are available. During this visit preliminary evaluation of the first data can be performed, additional testing needs identified and programmed, and any early or potential operating problems can be addressed. The value of this type of help is that it complements existing Thai skills and provides

the additional element of experience necessary for successful and timely field demonstration projects.

The total cost of the recommended expanded TA including the two months of senior project management will depend on many factors but can roughly be estimated at $12,000 per person month of $144,000 for approximately 12 person months. This money can come from savings created by adopting recommendations as to simplification in and curtailment of work on various components. It must be stated that the components are not being simplified in order to save money, they are being changed to improve results and to allow completion with the remaining project time. These changes, if accepted, will free up money that can be reallocated to other purposes, some of which are parts of the components themselves. Not all components will be affected, some will receive increased funding, some will experience shifts in fund uses and others will lose funds.

The third phase of implementation will involve the training element. This will require additional funds but the amount can only be known following preparation of a plan. The money for this must also come from a reallocation of project funds budget to components; however, it should not take as much money as was originally budgeted in the Project Paper. This phase will also include initiation of a project evaluation at the end of 1983 (costing approximately $30,000) and work on component results analysis and overall project impact assessment. This latter activity will be performed by the Project Manager, component leaders and the coordinator.

The project must be adjusted by the short term strengthening of project management services, the continuation of the project coordination element, the simplification and curtailment of selected components, the expansion of others and the redirection of training to include in-country

short courses. If this is not done the team feels that many of the components will not meet their objectives, others will only be partially completed and the project will likely remain a series of loosely connected elements. Even if these recommendations are taken there can and likely will still be some failures. However, if the recommended package is adopted, failures in parts will not mean failure of the overall project. Those failures which do occur will be beneficial and positive learning experiences rather than negative and preventable outcomes of little utility in meeting project goals.

APPENDIX

EVALUATION SCOPE OF WORK

PROJECT HISTORY

PROJECT ORGANIZATIONAL BACKGROUND

INDIVIDUAL COMPONENT EVALUATIONS

SOLAR PONDS

TRAINING PLAN REVIEW

EVALUATION OF TECHNOLOGIES AS CANDIDATES FOR PROJECT INCLUSION

DATA COLLECTION FOR DESIGN AND EVALUATION

PERTINENT RENEWABLE ENERGY RESEARCH IN THAILAND

PARTIAL LIST OF PEOPLE DSI EVALUATION TEAM MET WITH

PARTIAL LISTING OF PUBLICATIONS REVIEWED BY DSI TEAM

ABBREVIATIONS

GENERAL IMPLICATIONS TO AID OF FINDINGS

EVALUATION

SCOPE OF

WORK

ARTICLE I - TITLE

Evaluation of Renewable and Non-Conventional Energy Project, No. 493-0304.

ARTICLE II - OBJECTIVE

To conduct an evaluation of the Thailand Renewable/Non-Conventional Energy Project.

ARTICLE III - STATEMENT OF WORK

The Contractor shall perform the following tasks:

A. Review the design of the project and information produced thus far on various renewable energy technologies.

B. Determine whether the technology demonstrations/tests undertaken or planned have or will likely lead to accomplishment of project goals, including the demonstration of economic feasibility.

C. Consider experience of other renewable energy projects within and outside Thailand in this review, and make recommendations on priority technologies for concentration and/or possible reorientation of the project.

D. Review available survey results and synthesize, in the form of a matrix (and supporting narrative), the status of following renewable energy technologies, and the principal institutions or firms involved in research, demonstration, development or commercialization of each technology:

1. Charcoal improvement
2. Biomass gasification
3. Microhydro electric
4. Pyrolosis of rice husk
5. Solar process heat
6. Solar/wind assessment
7. Stove improvement
8. Village woodlots
9. Water lifting
10. Industrial biogas

Identify additional renewable technologies considered appropriate for AID involvement.

E. From the above list, identify those technologies:

1. which are potentially most cost-effective (based on analysis of time, effort and resource requirements of each technology);

2. With evidence of acceptance and utilization, by a well-defined clientele group, without direct subsidies; and

3. With relative high development impact in terms of its potential for wide-spread use, and reduction of Thailand's dependence on fossil fuel.

F. Isolate major and minor implementation concerns/issues in the development and diffusion of technologies identified above, and recommend appropriate actions, in order to resolve the identified constraints.

G. Evaluate the institutional framework under which this project is being managed by the RTG. Recommend actions (staffing adjustments, organizational arrangements, and the like) which would improve the chances of this project's success.

H. Examine the nature, mix adeqacy and the duration of technical assistance made available to this project and suggest improvements or alternatives as appropriate.

I. Examine project approach towards developing RTG institutional capacity to perform and sustain energy policy planning. Recommend modifications as appropriate.

ARTICLE IV - REPORTS

The Contractor shall submit fifteen (15) copies of the report to USAID and five (5) copies to AID/W within 30 days of return to the U.S. A draft report shall be left with the Mission prior to departure.

ARTICLE V - RELATIONSHIPS AND RESPONSIBILITIES

The Contractor will receive technical directions from James Sloan, Acting Chief of Science, Technology and Engineering USAID/Bangkok.

ARTICLE VI - TERM OF PERFORMANCE

The desired starting date is August 12, 1982 and the estimated completion date is November 30, 1982.

PROJECT HISTORY

PROJECT HISTORY

The Project Paper for the Thailand Renewable Nonconventional Energy (TRNE) Project was prepared in early 1979. The purpose of the project was stated as follows:

"B. Purpose

The project will asist the RTG work towards reducing imported energy resources, arresting environmental degredation due to deforestation, and creating increased income opportunities in rural areas. This will be carried out through:

none of the sub-projects will do any appreciable amount of this

- developing RTG institutional capacity to perform and sustain energy policy planning.

hardly any of this

- introducing and testing renewable energy technologies in rural areas, and

why not in an industry energy system designed to cut substantial amount of energy to reduce imports

- developing and testing techniques for disseminating such technologies.

why do these have to be dissemination if these intermediaries to allow - technical support? farmers? blacksmiths

C. Description

The project has two reinforcing components: and institutional development emphasis; and the testing, adaptation and dissemination of renewable energy technologies relating to rural needs."

I can't see it

The Project Paper further provides descriptions of the various components and of technical, social, economic, administrative and environmental analyses. A particularly revealing section of the Project Paper is found on page 6 under a subheading title B. Description. This section reads:

> "The project has two complimenatary and reinforcing themes. First, and the longer item in its implications, is an institutional development component. This is designed to provide the basis for development and implementation of a continuing rural energy policy for Thailand. The second component involves carrying out a series of tests and adaptions of renewable energy technologies related to rural energy needs. This rural-oriented energy technologies component will be carried on at the same time as the work of institutional and data base development goes forward. Accordingly, at the end of the project there should coincide a tested

selection of rural renewable energy applications and the data and institutional base to implement them in the framework of a broader RTG energy policy."

Under the institutional development component there were four related activities covering; 1) establishment of a National Energy Information Center, 2) Renewable and Non-renewable Energy Resource Assessments, 3) Energy Technology Monitoring and 4) Support of the Energy Master Planning activity. The rural oriented technologies component focused on; 1) Biomass Conversion, 2) Micro-hydro, 3) Solar Drying, Solar Distillation and Process Heat, 4) Water Lifting Technologies and 5) Village Woodlots. The technologies proposed for inclusion with the exception of photovoltaics were said to meet these seven criteria. They were believed to be cost-effective, have a positive environmental impact, meet a development need of the poor, be controllable by individuals or small groups of poor peasants, and have the flexibility to respond to differing conditions in Thailand.

The project was recommended for a duration of 5 years (July 1979 to July 1984) with a $5,000,000 USAID Grant and a $3,149,000 RTG contribution. UNDAP and ADB funding of $1,010,000 was also available for an Energy Master Plan Study (EMP) project which was to run concurrently with the TRNE project. The National Energy Administration was designated as overall Project Manager. NEA was expected to execute some of the project activities and have a Project Manager to coordinate, monitor, and report on all project activities. Funding for a coordinating contractor was included to provide a link between NEA and the US energy community. The coordinating contractor was to provide a long term person for approximately 30 months of work in Thailand and, over the 5 year project life, 12 additional person months of short term consulting. In order to expediate hiring and to guarantee early arrival of the cooordinating contractor (CC) USAID and NEA agreed to have the CC handled as a direct USAID contract.

The Project Grant Agreement, which adopted the philosophy and wording of the Project Paper, was signed 16 August 1979. One change was that only a $2.5 million Grant was initially authorized. In late August of 1979 an additional $1.0 million was authorized bringing the Grant total to $3.5 million. In January of 1980 the remaining $1.5 million was committed by USAID.

On 26 August 1980, a 4 year Contract for $2,097,605.00 was signed between USAID and Meta Systems, Inc., a U. S. Consulting firm. The contract objective was to provide technical assistance to RTG in developing the USG of renewable and nonconventional energy resources. The contract level of effort included provision of two years of a resident project coordinator and 191 total work months of short term assistance. Of this 191 person months, 118 were estimated to be US and other non Host Country professionals and 73 were to be Thai National Professionals.

TABLE II-1

PROJECT PAPER FINANCIAL PLAN
BY PROJECT COMPONENT AND CATEGORY OF ASSISTANCE

($1,000's)

	AID FINANCED						
	TA	Training	Equipment	Workshops & Other	Total AID	Total RTG	TOTAL
NEIDCT	116.4		75.5	-	191.9	148.0	339.9
REDCs	-	-	246.0	-	246.0	1,395.6	1,641.6
Resources Assessment							
- Solar	150.5	148.5	70.0	-	369.0	47.3	416.3
- Biomass	182.7	-	50.0	-	232.7	26.0	258.7
- Mycro-Hydro	53.1	-	-	-	53.1	22.5	75.6
- Lignite, Oil Shale Tar Sands, Geothermal	298.8	162.0	15.0	-	475.8	27.0	502.8
Energy Tech. Monitoring	198.7	216.0	50.0	-	464.7	120.0	584.7
Energy Master Plan	282.2	270.0	2.0		554.2	135.3	689.5
Rural Oriented Tech.							
- Biomass	462.5	58.5	67.0	65.0	653.0	442.2	1,095.2
- Micro-Hydro	101.3	13.5	170.0	13.0	297.8	202.2	500.0
- Solar Drying & Dist. Process Heat	96.9	-	15.0	-	111.9	43.2	155.1
- Water Lifting	219.5	54.0	207.0	20.0	500.5	131.1	631.6
- Village Woodlots	210.5	18.0	72.0	136.0	436.5	318.0	754.5
Coordinating Consultant	366.4	-	-	-	366.4	91.5	457.9
Contingency	-	-	-	-	46.5	-	46.5
	2739.5	940.5	1039.5	234.0	5000.0	3149.9	8149.9

TABLE II-2

PROJECT PAPER FINANCIAL PLAN
BY CATEGORY OF ASSISTANCE BY YEAR

($1,000's)

AID $	PROJECT YEAR 1	2	3	4	5	TOTAL
Technical Assistance						
Long Term Consultants	85.5	291.0	111.0	21.0	-	508.5
Short Term Consultants	291.5	602.5	370.0	273.5	52.5	1590.0
Travel & Transportation	57.7	104.5	63.7	36.7	8.8	271.4
Local Subsistence (per diem)	66.3	140.1	84.3	66.3	12.6	369.6
Training	108.0	217.5	495.0	90.0	30.0	940.5
Equipment and Materials	152.5	556.5	275.5	30.5	24.5	1,039.5
Workshops	-	-	28.0	35.0	10.0	73.0
Other	12.5	22.1	36.25	44.8	45.35	161.0
Contingency	-	-	-	-	46.5	46.5
Sub Total	774.0	1934.2	1463.75	597.8	230.25	5000.0
RTG $ ($ equivalent)						
Salaries & Staff Related Costs	170.5	[illegible].6	481.4	510.8	492.0	2,044.3
Participant Travel	18.0	16.5	18.0	1.5	-	54.0
Local Support & Subsistence	8.7	30.3	15.0	-	-	54.0
Facilities & Construction	28.5	268.5	235.0	195.0	-	727.0
Other	14.4	56.0	57.85	69.4	72.95	270.6
Sub Total	240.1	760.9	807.25	776.7	564.95	3149.9
TOTAL	1014.1	2695.1	2271.0	1374.5	795.2	8149.9

Table II-I presents the original Project Paper financial plan showing expected expenditious by major component. Table II-2 presents a breakdown by category of proposed assistance. This division of the project into components as listed in Table II-3 was adopted and served as the basis for planning the initial project actions.

Table II - 3

ORIGINAL PROJECT COMPONENTS

INSTITUTIONAL DEVELOPMENT

National and Regional Centers
Renewable and Nonrenewable Resource Assessments
Energy Technologies Monitoring
Energy Master Planning Support

RURAL ORIENTED TECHNOLOGIES

Biomass Conversion
Micro-Hydropower
Solar Drying, Di illation and Process Heat
Water Lifting Te ologies
Willage Woodlots

In the year between grant agreement signing and selection of the coordinating contractor there was very little project activity. This was primarily due to a pre-project organization by Thai entities, the lack of counterpart funding for NEA activities and the time required to select and contract with a U. S. coordinating contractor.

The first major project funded activity was the preparation of component work plans by staff of Meta Systems, Inc., NEA and other implementors. This process was initiated in late 1980. Difficulties in reaching agreement about work plans, procedures and substantive issues and the slowness of the Thai review and approval process extended work planning well into 1981. During the first quarter of actual project activity (1 January 1981 - 1 April 1981, which was Meta's second project quarter) a survey component was also started. During the work planning and project start up process a series of difficulties with and misunderstandings about roles and project responsibilities began to surface. This is evident in the project correspondence in quarterly reports from Meta Systems and in AID Project Implementation Reports.

During the next quarter (1 April 1981 - 1 July 1981) component descriptions for surveys Pyrolysis and Solar Process Heat were approved by all entities. Three other component work plans; Water Lifting, Improved Charcoal Production and Improved Stoves were still under review by Thai entities. The Survey Component was in its data analysis stage and completion was projected by the end of the following quarter. Work Planning for the Village Woodlots, NEIC, the Energy Master Plan and Resource Assessment components were also undertaken.

The differences in opinion about and problems with the performance of project management, the consultant project coordinator, U. S. consulting assistance and component progress continued. The situation was deteriorating in spite of attempts by all those involved to resolve issues and improve relationships. The major issue appeared to be who was responsible for what with personality and style differences exacerbating this.

Work during the project quarter ending 1 October 1981 (the fourth quarter) resulted in approval of six additional components. At the end of the quarter NEIC, EMP, Water Lifting, Village Woodlots, Charcoal Improvement and Stove Improvements compnents had been newly given approval. Work, except for pre-implementation planning was performed only on the Survey and Village Woodlots components. Total reported project spending including all entities was approximately $[illegible],000 at the end of the quarter and this was almost entirely for the project coordinator and U. S. staff and consultants. A new project coordinator had been assigned and working relationships among project participants had improved. At this point the project had been running slightly more than two years and the project coordinating consultant had been under contract for one year. The main problem still facing the project was delays in receiving official RTG approval for component work plans and thus funding for the components.

In the next quarter (1 October thru 31 December 1981) [illegible] administrative, approval and funding process problems were dimished and 11 components were at the point that work was already under way or could begin. Another four components were under active consideration for implementation. At the end of this quarter, although problems still existed, the general mood was one of optimism and forward movement.

The coordinating contractors quarterly report for the quarter ending 1 April 1982 starts out as follows:

> "The sixth quarter of activity for the Renewable Non-conventional Energy Project was the first in which there was clear forward progress in almost every component."

The project was now considered to have 15 components, only two of which, Industrial Biogass and Industrial Conservation, did not have USAID, NEA, and DTEC approval and fiscal year operating funds. The project was now composed

of the components shown in Table II - 4. At the end of this period many problems had been resolved but there were still concerns over technical assistance requirements, training and project coordination.

Table II - 4

PROJECT COMPONENTS

	COMPONENT	RESPONSIBLE ENTITY
1.	Micro Hydro	NEA
2.	Water Lifting	NEA
3.	Industrial Biogas	NEA
4.	Solar Drying & Distillation	KMIT
5.	Biomass Gasification	Chulalongkorn University
6.	Charcoal Improvement	RFD
7.	Stove Improvement	RFD
8.	Pyrolysis	TISTR
9.	National Energy Information Center	NEA
10.	Regional Energy Centers	NEA
11.	Energy Master Plan Support	NEA
12.	Survey	META, NEA and Others
13.	Village Woodlots	RFD
14.	Solar/Wind Resource Assessment	Meterological Department
15.	Industrial Conservation	Still under planning

The most recently completed quarter (1 April through 31 May 1982) shows optimism and reports progress in many components. There are still some of the old problems, but for the most part they are component specific rather than generic. The generic types of problems which exist are essentially new, or rather recently discovered. They include questions about the need for a full-time foreign coordinator in Thailand, the relevance of some of the components to the project purpose, the need to use any further foreign consultants, and the reallocation of funds based on existing and/or projected shortages.

PROJECT ORGANIZATIONAL BACKGROUND

The implementation of the Thai Renewable Nonconventional Energy (TRNE) Project involves several institutions. Figure A provides an overview of this organizational structure of the project.

The implementing agency is the National Energy Administration (NEA), where the Project Manager is located. The Department of Technical and Economic Cooperation (DTEC), the normal conduit for any grants from USAID (and other donors) to the Royal Thai Government (RTG), administers the Thai counterpart funds, and must approve any work as well as operational and financial plans. The grant funds, however, flow directly from USAID to the implementing agency, NEA. This arrangment represents a new change in the USAID/RTG interaction. It was created in response to complaints about problems in getting funds from DTEC to the individual project components.

As the organization chart in Figure A illustrates, component leaders for exactly half of the project components are employed by NEA. (The budgeted funds for these seven components amount to roughly 52 percent of the project total.) The remaining component leaders are located in four other institutions, the Royal Forest Department (RFD) with three components (accounting for about 21 percent of total budgeted funds), three university research organizations, and the Meterological Department.

The coordinating contractor, Meta Systems, Inc., contracts directly with USAID. The contractor's responsibility includes provision of a resident coordinator, the administration of technical assistance, as well as assistance in procurement and training in the U.S.. While the resident coordinator is technically (and legally) under USAID, he has been directed to report directly to the NEA Project Manager, as explained further elsewhere.

IMPLEMENTING AGENCY

The National Energy Administration is part of the Ministry of Science, Technology and Energy. Its responsibilities are outlined in the National Energy Authority Act of B.E. 2496 (AID 1953), which established NEA's governing board. The Act outlines a broad range of activities for NEA, including regulation, price setting, research and development, promotion of the use of energy for economic development in various sectors, and to bring about joint benefits, such as irrigation and flood control. For this broad mandate, NEA has a relatively small staff of less than 2,000. By comparison, the country's major electricity producer, the Electricity Generating Authority of Thailand, (EGAT), employs a staff of 18,000.

NEA recently underwent a reorganization, resulting in the organization structure shown in Figure B. The TRNE Project will be administered out of the Research and Development Division (which is headed by the Project Manager), with the participation of other divisions as requred. Overall direction for NEA's activities are provided by the National Energy Board

ORGANIZATION CHART
RENEWABLE NONCONVENTIONAL ENERGY PROJECT

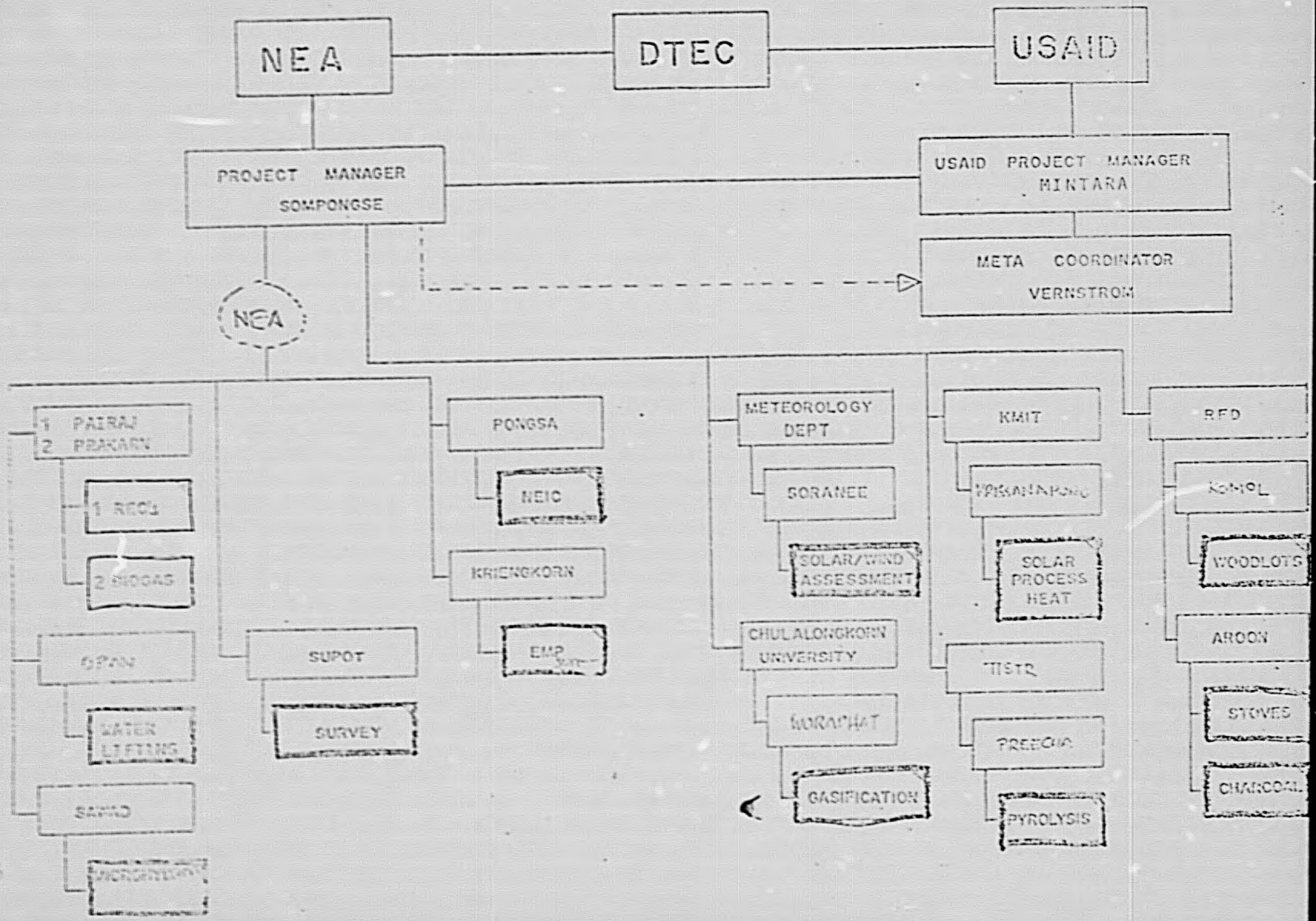
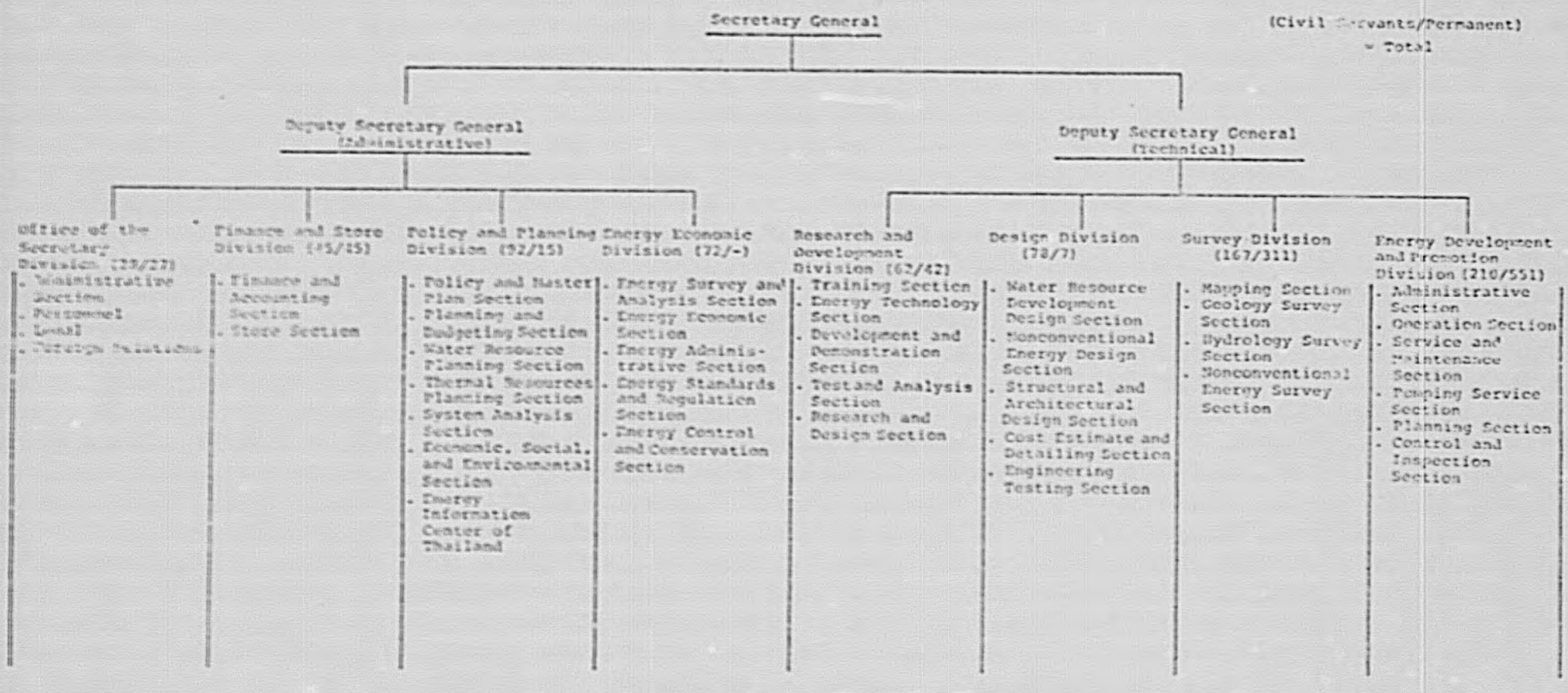


Figure B

NEW ORGANIZATION CHART OF MEA (PRELIMINARY)



Notes: 1. Figures do not include four division directors.
2. Figures do not include administrative staff of each division.

Source: Robert R. Nathan Associates et al., Thailand Energy Master Plan Project. Vol. 8, Energy Sector Management, Institutional Considerations. Bangkok, Feb. 1982.

Best Available Document

Committee, chaired by a Deputy Prime Minister and comprising representatives from NEA, the Petroleum Authority of Thailand, EGAT, the Provincial Electricity Authority, the Metropolitan Electricity Authority, the National Economic and Social Development Board, and concerned ministries. Two of its subcommittees, established recently, refer directly to the TRNE Project, one for administration and the other for technical issues. Other subcommittees deal with the subject matter of individual components, such as Biogas, the National Energy Information Center, or the Energy Master Plan.

COORDINATING CONTRACTOR

The coordinating contractor was selected in August 1980. In a major departure from original plans, outlined in the Project Paper (which specified a resident coordinator for 24 months plus 12 months of short-term consultants), the contracting coordinator, Meta Systems, Inc., was given the responsibility for all technical assistance -- which accounted for approximately 40 percent of the total contract amount of $2.1 million. Funds for Thai technical assistance went through a subcontractor, the Thai Consulting Group.

Two things are important about the contract. First, it was deliberately general to allow for greater flexibility. Unfortunately, that approach resulted in too little guidance for the contractor, NEA, and USAID. Second, the contract was negotiated with USAID, rather than a host country agency. This approach was chosen for several reasons. A contract with NEA was not possible; rather, the contracting agency would have been DTEC, which probably would have delegated the administration to NEA. Contracting with USAID also promised to speed up the payment process, and avoided some potential tax problems. On the minus side, it precluded a negotiated agreement between NEA and the contractor. Moreover, it severely muddled lines of authority and reporting requirements.

One indication of the resulting problems is a letter (dated March 30, 1981) from USAID's Director of the Office of Engineering, Science, and Technology to NEA's Secretary-General, seeking to clarify lines of authority:

> ...Contractually all (Meta Systems) personnel are responsible to the coordinator... who in turn is responsible to me.
>
> However ... (t)he effort will be carried out on a day to day basis under NEA's direction and therefore Meta must be responsible to NEA for their activities.

That kind of structure tends to leave the smooth functioning to informal arrangements, often on a personal basis. Any personality conflict can make such arrangements impossible. Such a conflict seems to have been a major factor in the decision to replace the resident coordinator in mid-1981.

In March 1982, a memorandum officially "interpreted" a number of the provisions in the contract with Meta Systems. The memorandum, signed by the USAID representative and president of Meta, established that the contractor will not be held responsible for accomplishing certain tasks where the authority to initiate action lies elsewhere. While it may not be a formal contract amendment, it efffectively changes the nature of this contract.

INDIVIDUAL COMPONENT

EVALUATIONS

BIOMASS GASIFICATION

- Chulalongkorn University
- Budget:

Total	$231,000
USAID	$197,000
RTG	$39,000

- Work Plan Approved 2/4/82
- July 1984 (completion date)

The component involves design, construction and/or application of six gasifier units. Different pieces of equipment and raw materials for fuel will be used. Several of the units have been built before and the component will provide site specific details of specific application. In other technologies, such as the direct fire fluidized bed gasifier system, this will be the first time such a unit is built and used with the proposed fuel material (crop residue). TheThai Cabinet has passed a resolution approving a simple down draught Thai design for a gasifier unit (small and rough) for manufacture and initial dissemination (10 units initially) by an agency other than NEA. The units considered in this component are improvements on and more flexible than this initial Thai unit and should have a wider applicability.

- Discussions with Dr. Woraphat indicated that there will be much additional work planning as the component continues. Refinement of budgets and time schedules is underway now.
- One of the units to be used for the 16hp gasifier system has been tested extensively at Prince of Songkia University in Thailand and its application in this component will be an extension of this initial laboratory testing.*
- The other systems have not been built in Thailand before and Dr. Woraphat has not had experience in building or operating gasifiers before.
- He has decided to limit the use of TA from foreign experts and to test many different technologies and raw materials.
- This component has one of the better work plans but it is still not thorough enough to guide day-to-day work.
- It is likely that delays will be encountered and the objective of dissemination may not be reached. The component may only be partially completed and only a few technological systems constructed, tested and analyzed. The attached table shows

the system to be constructed and tested and summarizes some of the component approaches. It is our recommendation that items 3 and either 1 or 5.1 be retained. The remaining gasifiers should not be included in this component. It is too ambitious.

- Further use of TA should be included both prior to completion of fabrication of the units and early on in the testing phase of units. This TA will be very helpful in previewing and solving problems and in deciding on what the next steps in technology testings and demonstration should be.

PYROLYSIS OF RICE HUSKS

- TISTR
- Budget

Total	$164,000
AID	$90,000
RTG	$74,000

- Work plan approved 11/26/81
- Thru July 1984 (completion date)

This component involves the design and testing of a small scale prototype and a full scale pyrolysis unit using rice husks as a fuel. Based on the testing program for the prototype (built from an existing set of plans which have been revised), design for a full scale unit will be prepared. The full scale unit will be built in Thailand and installed in a rice mill. The unit will be used in the rice mill to evaluate its utility and economy. TISTR has performed other scientific and technical work and is interested in this technology because of the abundance of unused rice husks and the potential to produce liquid hydrocarbon from them at the village level through pyrolysis.

- The TISTR team has not built a functioning combusion unit although they did build a laboratory scale pyrolysis unit which did operate using rice husks. This lack of prototype of full scale experience could be problem.

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*The Feasibility of Producer Gas in Electricity Generation, Naksitle, Witayce & Chukiat, a paper presented at the Seminar on "Solar Electric Power Systems," organized by KMITT and UNESCO, Bangkok, 12-15 June 1982.

GASIFIER COMPONENT SUMMARY

ACTIVITY	FUNDS ($)	TIME FRAME	UNIT DESIGN	RAW MATERIAL	TA
1. 500 We GASIFIER SYSTEM 5 Months	$ 2,500	FY83	Static bed or morable bed	Wood chips charcoal or crop residues	Student + local TA Dr. Worophat
2. 7 h.p. GASIFIER SYSTEM 16 Months	$ 3,000	FY83/FY84	Scraper system	Crop residues	Student + local TA Dr. Worophat
3. 16 h.p. GASIFIER SYSTEM	$ 7,000	FY83/FY84	Downdraft imbert design	Wood chips or corn cobs	Local TA
4. DIRECT FIRE FLUIDIZED BED GASIFIER SYSTEM	$ 6,000	FY83/FY84	Fluidized bed	Any crop residue	Dr. Phol local TA
5.1. 20-50 KWe* GASIFIER SYSTEM	$30,000	FY83	U.C. Davis design	Wood chips or low ash content crop residue	Foreign or local TA
5.2. SITE-SET UP/ EQUIPMENT AT CHULALONGKORN	$25,000	FY 83			
5.3. RURAL SITE SET-UP/EQUIPMENT FOR ALL UNITS	$30,000	FY84			
6. 40 KWe RICE HUSK GASIFIER SYSTEM	$20,000	FY83	Unit given by outside party	Rice Husk	NEA + local TA
TOTAL	$123,500				

*Last FY82 proposal had 2 units of this size. We have changed this to only one unit.

- Some of the tasks in the component, such as training unit testing, construction of training converter, detailed site survey for the demonstration converter are not programmed with enough time to allow completion.

- Several tasks, such as testing, siting, analysis of operating data, etc., are not yet completely thought out.

- If the component is not complete when project time and component budget run out, a contingency plan is needed. This is especially important because this component is very ambitious.

- It is recommended that this component be reprogrammed to include only construction and testing of the training converter and design of a demonstration converter. Continuing experience with demonstration units in the Philippines and Latin America should be awaited. When this information is available in approximately 18 months and the training converter experience is completed, an excellent demonstration converter design can be prepared.

- The expanded use of TA should also be programmed. This TA will be most useful during the construction of the training converter and later when some converter testing has been accomplished. The first visit can help in assuring that problems which arise during fabrication are appropriately handled and in preparing a testing protocol. The second visit is necessary to help analyze data, adjust the testing protocol, if necessary, and help prepare a design for the demonstration converter.

MINI HYDRO ELECTRIC

- NEA

- Budget

Total	$422,000
AID	$320,000
RTG	$102,000

- Work plan approved January 11, 1982

- Thru July 1984 (completion date)

NEA had planned to develop two sites: Bo Keao, 200 Kw. and Mae Sa, 100 Kw.

The civil work and transmission lines are under construction at Bo Keao

and expected to be complete in November and September 1982.

Equipment is under procurement and expected to be delivered in April, 1983.

A transmission line from grid will be brought to the Mae Sa area. Thus, the site does not now fulfil the project objective of village need and participation in management, construction, operation and maintenance. This element of the component was cancelled and three other elements were planned to replace this. The new elements are listed below:

SITE	NEA CONTRIBUTION	USAID CONTRIBUTION
Kam Pong Project	฿ 1,521,000	฿ 1,794,000
Mae Ton Luang Project	฿ 152,000	฿ 2,182,000
Hui Puy Project	฿ 1,543,000	฿ 1,297,000
Contingency		฿ 362,000
Total	฿ 3,216,000	฿ 5,635,000
	($ 140,000)	($ 245,000)

The $245,000 USAID contribution for these three elements is the same as that for the cancelled Mae Sa site and additional funds will not be required.

- The change is appropriate in terms of substituting similar elements for one which is no longer appropriate but several other issues exist. Since the planning and conception of this component three to four years ago, much has happened in Thailand. AID is funding other small-micro hydro subprojects for other agencies and is considering a major micro-mini hydro project with the Thai Government. The Thai Government is now building over 50 micro-mini hydro units each year in isolated areas. This technology is no longer undemonstrated in Thailand.

  For this component to be changed to allow the substitution of the three new sites for the one which is no longer appropriate, several issues must be addressed:

  - Does the component still meet the project objectives in light of other occurrences and ongoing and planned projects in Thailand?

  - What is the justification for transferring money if the technology is demonstrated; are institutional factors new or different?

  - Could the money needed for the three sites ($245,000) be better applied to other components?

- The component staff from NEA is obviously qualified to carry out the component but they do not have detailed plans for operation and maintenance of the units once they are installed. Spare parts and repair details are also lacking.

- Performance monitoring following startup is not well defined and the type of information necessary for the "Project" is not being considered. This is needed by the project to know that its objectives are satisfied and to learn how, where, and when to disseminate these types of systems.

- If an institutional mechanism, such as operation and maintenance by local cooperatives, is to be tested in this component, a testing plan, budgets and data on how the cooperatives will be located, funded, organized and monitored must be included.

INDUSTRIAL BIOGAS

- NEA

- Budget

Total	$164,000
USAID	$125,000
RTG	$ 39,000

- Work plan approved April 12, 1982

- Thru July 1984 (completion date)

The component is designed to demonstrate and evaluate small and medium scale biogas production in industry. It is also directed at training and at commercialization. Three industries will be selected as demonstration sites and biogas units will be designed and installed. The operation will be monitored and the use and results will be publicized.

- A detailed work plan is not available for this component. Many elements are also not settled, such as what type of application should be suggested and selected, should a bench scale plant be used, etc.

- Digestion is widespread even in Thailand and the application and demonstration of this technology should not be necessary. Internationally, this technology is well known. If this component is to be funded, the utility of the application should be large. There is not enough information on how large a market there is for industrial biogas units.

- Chula University has also done extensive work on biogas generation all the way to large scale testing. This compoment should be rethought and possibly involve others in Thailand who are working on this.

- Why was this component included at the small and medium scale if large scale is already demonstrated for the same type of wastes?

- The component should, at least, be limited to one or, at most, two demonstration sites. It would be best to build one unit at an industrial site and operate it for one year. On the basis of this and a survey of possible needs and uses for this technology, other demonstrations could be selected.

RESOURCE ASSESSMENT ON SOLAR AND WIND ENERGY

- Meterological Department

- Budget

Total	$270,000
USAID	$254,000
RTG	$16,000

- Work plan approved February 2, 1982

- Thru July 1984 (completion date)

The component has as its objectives to procure solar and wind measurement instrumentation and to collect data using these instruments. The component includes the use of U. S. consultants, training of Thai staff, equipment purchases and the development of wind and solar energy profiles for Thailand. The approved work plan is essentially that prepared by Dr. Michael Garstand, a U. S. consultant with some changes and deletions. The work plan has not been updated to reflect budgetary changes and deletions of major equipment and other activities.

- Much of the work has been delayed because the instruments for calibrating, etc., are not yet here.

- The work plan is very much the work of the U. S. consultant and while the Thai project people understand it, they have not changed it to reflect the project today (budget cuts and change by NEA).

- The newly proposed preparation of wind and solar profiles for Thailand must be planned and, if an output is expected by May, the planning must be completed soon.

There are several ways to complete this preparation of wind and solar profiles and decisions must be made soon. There seems to be a desire to follow the U.S. consultant's plan for this even though they don't feel comfortable with some of it.

This component should be continued but a rapid solar map of Thailand should be prepared immediately using a transform of the hours of sunshine data which is available. A preliminary map has been prepared and this should be reviewed, revised and used, at least as a project document.*

SOLAR PROCESS HEAT (DRYING & DISTILLATION)

- KMIT (King Mongkut's Institute of Technology, Thonburi Campus)
- Budget

Total	$192,000
USAID	$106,000
RTG	$86,000

- Work plan approved November 12, 1981
- July 1984 (completion date)

The project component includes crop drying and water distillation. Engineering design for small scale family size-crop dryers and water stills will proceed to village testing of demonstration units. Following this, a report will be prepared describing the tests, suggesting improvements and outlining a program for the future. Designs for both technologies have been developed under other funding and this project will test a single design for both technologies in different village settings. The other part of the component is the design and preliminary testing of a mid-size tobacco dryer.

- During discussions with Dr. Krissanapong and Dr. Sakarindar, a wide range of topics were covered. This component is one of several solar and wind projects underway at the university. The component is staffed mostly by people and students at the university. The staff feel that the funds are adequate to complete the goals.
- Not much detailed work planning has been completed. A general work plan is prepared. Issues, such as how to measure whether the technology is appropriate, how to estimate the extent of possible applications, etc., have not yet been solved.

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*See reference (11) in partial list of publications reviewed by team.

- The lack of solar insolution data or map is not yet a problem. They will need this data later to help consider the possible range of application.

- The villages identified as possible demonstration sites have not proved adequate so far; however, some of them may be used. The transitional survey team will be contacted to inform them the requirements for siting dryers and distillation units.

- They want to include an element to construct and test an ice box to produce 15 kg of ice by using solar thermal hot water technology.

The component people should expand their work planning to include more details on the protocol for monitoring, testing and measuring technology performance. Criteria and measures of success should be defined even though later on they may be changed. At the end of two years, I believe they will be ready to disseminate but they will not know enough to know where or how and will not have a dissemination plan. They will have some data necessary to start dissemination. They may need another period to move into dissemination.

The component is not based on any firm written estimate of market or need. There is an informal feeling of need and appropriateness.

The solar thermal ice making element is not well thought out yet. There needs to be a very detailed work plan before approval, and the component leader should do a literature search first or have META do one.

WATERLIFTING

- NEA

- Budget

Total	$390,000
USAID	$307,000
RTG	$83,000

- Work plan approved January 11, 1982

- July 1984 (completion date)

The component will test several water pumping technologies in rural settings. Photovoltaics for domestic water supply and small scale irrigation; biomass gasification for irrigation and windmills for water supply and irrigation are the technology-application combinations to be tested in several rural villages. Specifications for U.S. and Thai produced systems will be prepared, the equipment installed in several villages and tests

run to determine economic, technical and social appropriateness. The component is just starting and specifications are ready for bidding. Sites have not been selected, but component personnel are visiting candidates.

The component needs a better implementation plan than is now available. Many decisions are being made which affect the future of the component and the rationale and criteria used are not being documented. Much thinking about testing and operating problems and processes has taken place but this has not been formalized. The component leader is very knowledgeable but he does not have experience in testing technologies in the field.

Some TA has been used and possibly some more will be necessary when the units are being field tested.

IMPROVED CHARCOAL PRODUCTION

- Royal Forest Department
- Budget

Total	$312,934
USAID	$181,850
RTG	$131,084

- Work plan approved July 21, 1982

This component is designed as a first step in a long-range program to improve the overall efficiency of charcoal production in Thailand. It has established four major objectives:

1. Determine the most efficient charcoal production technology (kiln and method of operation) currently in use in Thailand for different scales of operation;

2. Initiate dissemination of these objects through demonstration projects;

3. Establish a long-term program for the development of more efficient charcoal production technologies, especially more efficient kiln designs;

4. Design and promote improvements in certain aspects of medium to large charcoal production operations.

These objectives involve an array of activities ranging from the collection and analysis of available data (including those from the Baseline Survey) to a series of carefully designed kiln tests at the RFD test site at Lam Rai.

NOTES AND COMMENTS

1. The current dissemination plan needs further development. the plan calls for a demonstration that involves bringing village and kiln operators to the test site and to demonstrate the efficiency of different technologies through actual hands-on practice. This approach is appropriate only if the only barrier to more efficient production practices is ignorance of better technologies.

2. The dissemination plan should be placed within the context of a long-term program to improve rural charcoal production in Thailand.

3. The component leader should be able to benefit from technical assitance in the development of a dissemination and evaluation plan to compliment the component's strength in the technical area. This technical assistance could be combined with that recommended for the Stove Improvement and the Regional Energy Centers components.

IMPROVED COOKING STOVE

- Royal Forest Department
- Budget

Total	$358,300
USAID	$207,550
RTG	$150,750

- Work plan approved July 21, 1981

The original work plan outlined four major activities for the component:

1. Develop a more efficient cooking technology, organized around modification of the traditional Thai bucket stove, under laboratory conditions;

2. Modify and adopt the technology through field tests in Thai villages;

3. Instruct rural craftsmen in the modified stove design;

4. Plan and initiate a long-term testing and dissemination program.

This design seems to have changed somewhat. Progress in the development element has shifted the emphasis to dissemination activities. Current

plans call for the fabrication of a sizeable number of stoves to be distributed to villagers in the pilot phase of the dissemination program, as well as for the involvement of larger stove manufacturers.

NOTES AND COMMENTS

1. Plans should be prepared for the long-term dissemination program and for the pilot phase -- a sketch plan for the former and a more detailed one for the latter -- to identify evaluation issues.

2. An assessment of market size and other relevant characteristics should be undertaken before stove manufacturers are brought into the project.

3. Technical assistance could be useful in preparing a dissemination and evaluation plan. This technical assistance could be combined with that recommended for the Charcoal Improvement and the Regional Energy Centers components.

REGIONAL ENERGY CENTERS

- NEA
- Budget

Total	$1,787,600
USAID	$458,600
RTG	$1,329,000

- Work plan approved January 11, 1982

The objective of this component is to establish four regional energy centers by the PACD (July 1984) and two more by 1986. These centers are to carry out five major functions:

1. Demonstrate ways of using renewable energy in rural areas.

2. Assist rural residents in developing and using appropriate systems;

3. Train extension workers, government officials, and rural residents;

4. Coordinate planning and implementation activities of local government agencies;

5. Collect data on needs and program performance.

At least initial efforts under these five categories focus on an area within 50 km of each center. Each center will consist of a central building and housing for its staff of seven officials, as well as demonstrations facilities for various technologies.

According to the original work plan, technology dissemination efforts were to start with biogas, rice husk pyrolysis, biogass gasifier, water lifting, efficient stoves, and improved charcoal making -- virtually all the technologies now forming project components. (The major omission in this list is solar drying and distillation.) Other elements of concern were village wood lots and oilseed plants. As in this case, the other components, training and data collection and approaches and methods of dissemination are not specified in the work plan.

NOTES AND COMMENTS

1. The design of dissemination projects or programs run by the Centers should be made explicit to facilitate evaluation.

2. The role of the Regional Energy Centers is dissemination efforts by individual components, if any, should be clarified.

3. Plans for the REC's should be coordinated with those for other components to take advantage of new results as they become available.

4. Technical assistance should be sought in the preparation of evaluation plans for alternative dissemination methods; this technical assistance could be combined with that recommended for the Charcoal Improvement and Stove Improvement components.

NATIONAL ENERGY INFORMATION CENTER

- NEA
- Budget

Total	$594,000
USAID	$356,000
RTG	$238,000

- Work plan approved August 5, 1981

The National Energy Information Center (NEIC) is designed to perform three major functions:

1. To serve as a comprehensive energy data center which will collect and provide statistical, technical, and other related data on energy resources, its potential, production, demand and supply, and related environmental, social and economic data;

2. To provide library service for reports, textbooks, journals, and other documents on energy and related subjects; and

3. To serve as a link between its users and energy related data and information organizations and data resources outside of the NEA.

The work plan calls for a permanent staff of about 8-9 individuals to handle a broad range of activities, including standard library activities, such as acquisition, cataloging, and computerized information retrieval. The NEIC is also expected to coordinate the Energy Master Plan data management activities, maintain specific data bases, and prepare reports required by NEA's Regulatory Division on a regular schedule. Center staff would also prepare ad-hoc analyses of data and projections in response to requests from appropriate officials.

NOTES AND COMMENTS

1. The scope of activities for the National Energy Information Center is ambitious. The work plan is too general to allow for an assessment of whether it is realistic. Information on expected size of library holdings, library use, volume of data bases, expected data base management activities and their frequency, or periodic or ad-hoc reports is lacking.

2. NEA is currently evaluating different options for the computer aspects of NEIC. For the library operations alone, purchase of an HP 3000 with the MINISIS System would appear to be the most economical option (a previous analysis which concluded otherwise was faulty, in that, among other things, it did not use salvage value estimates in calculating costs. Whether other options are better for the data base management activities cannot be answered without more information on the nature, scope and frequency of these activities. Decisions on the purchase or rental of computer equipment should be contingent on more detailed specifications of the expected task.

ENERGY MASTER PLAN SUPPORT

- NEA
- Budget

Total	$202,500
USAID	$132,200
RTG	$70,300

- Work plan approved August 5, 1981

VILLAGE WOODLOTS

- Royal Forest Department
- Budget:

Total	$949,322
USAID	$554,200
RTG	$395,122

- Work Plan Approved 8/6/81

The purpose of this component is to establish village woodlots as a source of fuelwood at the community level, by planting fast growing trees on any suitable lands available in the village, under the technical guidance of the Royal Forest Department. Under this project, four major activities are being carried out:

1. Establish criteria for the selection of land for the village woodlots.

2. Analyze the economic and social factors that help or hamper the success of village woodlots.

3. Determine the most suitable forms of woodlots under different conditions of land use, silviculture system, and management scheme.

4. Establish demonstration woodlots on selected sites.

So far, considerable progress has been made in this component, especially with respect to establishing community-owned woodlots on larger parcels of land. The component can already build on the experience of more than one year of operations, in planning and implementing additional woodlots.

While the nature of the component will not allow an assessment of the ultimate impacts of this approach to improving fuelwood supply and stemming the process of deforestation in Thailand, a number of interesting findings seem to emerge from the experience thus far, findings that would be of great use in the design of a national project. For example, the experience in at least one site suggests that villagers are more likely to treat the woodlots as theirs if they can be convinced to donate their labor, rather than receiving remuneration for the planting effort. (Unfortunately, this approach seems to conflict with a broader policy concern of promoting rural employment opportunities through programs such as the tree planting under the village woodlot component.)

Notes and Comments

1. The experience with specific approaches under particular conditions needs to be clearly documented. A suitable evaluation structure for interim evaluations should be designed. At present, the most valuable information seems to be available only in the form of trip reports and other scattered documents.

2. Because of resource constraints, observers in the villages who are currently reporting information on the progress of the projects also act as extension agents, helping the villagers with specific problems with their woodlots. While this information is extremely valuable, some thought should be given to complementing it by information gathered through non-participant observers.

3. To the extent possible, more systematic variations in the approach to establishing village woodlots and the settings chosen should be considered. The nature and extent of these variations should be part of the evaluation structure to be formalized.

SURVEYS

- NEA and META

- Budget:

Total	$431,300
USAID	$353,080
RTG	$78,220

- Work Plan Approved: DTEC/USAID approval 6/19/81; major portion of Baseline Survey completed before formal approval process was put in place.

The Survey component was originally divided into three major elements: a Baseline Survey to describe the conditions in villages prior to the introduction of new energy technologies, transitional surveys to collect data on the process of introducing such technologies and testing them in the field, and evaluation surveys to assess the impacts of new technologies on rural conditions with respect to energy supply and use, and with respect to the general economic and social situation.

The Baseline Survey was conducted in 1981 under the principal direction of the coordinating contractor, Meta Systems. In addition to describing general baseline conditions, the survey was an attempt to establish a fairly comprehensive data base on the nature of energy-using processes in rural areas, the resources available for different types of technologies, and some indications of the interest in alternative approaches (or the readiness to innovate).

The Baseline Survey represents a major accomplishment of this project. It covered some 1900 households in 50 villages in 10 provinces. In addition to interviews, enumerators also carried direct observation of processes and measurements relevant to determining resource availability. The survey compiled a considerable amount of extremely valuable information to guide component leaders in the design and adaptation of new technologies geared toward actual conditions in Thailand. It also demonstrated effective management techniques for data collection and analysis on a larger scale, which should have strengthened the institutional capabilities of the participating Thai organization.

Notes and Comments

1. The selection of the provinces and villages for the survey was judgmental, designed to cover a range of social and economic conditions, and to keep required travel for the supervisors to a minimum. As a result, the (statistical) error terms associated with certain parameter estimates from the pooled data are unknown. This problem limits the use of survey data in any macro-level analysis, i.e., in generalizations to rural Thailand as a whole. From the available evidence, the evaluation team could not determine the implications for the use of these data in the intended extension of the Energy Master Plan (EMP) model to the analysis of nonconventional renewable energy technologies in the rural sector.

2. The principal intended use of the data was by component leaders to perform their own analyses drawing on the raw data on computer, rather than summary tables in the reports prepared. To the evaluation team's knowledge, very little use has been made of this opportunity. Component leaders have used the information contained in the reports; several of them have indicated that the information was useful in a general sense. Further use of the raw data appears contingent on some "dissemination effort," bringing individuals thoroughly familiar with the survey data together with component leaders to discuss the possible use of these data in analyzing specific questions of interest to them. Without such an effort, the likely use of the data is negligible, especially because few component leaders have found suitable sites for their field tests and demonstration efforts among the villages included in the Baseline Survey.

3. Current plans for field testing and demonstration entail substantial data collection and analysis requirements to examine the context and impact of these efforts. In some instances, information akin to that in the Baseline Survey has to be collected for the sites under consideration by the component leaders. These needs combine with the ongoing needs of transitional surveys to delineate a substantial demand for data collection and analysis. Since more than 80 percent of the funds budgeted for this effort have been spent, the demand is out of proportion ot the resources available. Therefore, the evaluation team recommends to shift funds into this component, possibly from the EMP support component.

4. Efforts to reorganize the Survey component are currently underway, involving a detailed review of the relevant data needs of individual components, and an assessment of available data to meet those needs. The project should use this opportunity to develop a project-level data collection and analysis plan, with adequate consideration of each component's needs, the expected resource constraints, and the options for increasing the efficiency of the survey activities through proper scheduling and combination of subcomponents. This plan should be a high-priority item. Given the existing time constraints, we recommend to draw on U.S. technical assistance to prepare this plan; the individual(s) should have extensive experience in the development of evaluation plans for technology demonstrations, and in the organization and management of major data collection and analysis efforts.

SOLAR PONDS

A solar pond performs the same function as a solar flat plate collector except that it is applicable to large systems and includes a considerable measure of built-in heat storage.

A pond, normally 1-2 metres deep, has a salt concentration gradient imposed on it so as to create a density gradient, with the heaviest solution at the bottom. When the pond is heated by solar radiation, the heat is transferred to the bottom layer and temperatures in excess of 100°C can be achieved. The heat can be extracted by pumping the hot water under non-turbulent conditions from the bottom of the pond. The operation of the pond is such that diffusion of salt upwards from the more concentrated to the less concentrated levels is minimized, so that salt does not have to be added after the initial filling.

Because of the large mass of the pond, there is "built-in" storage -- at least for a week or two, -- and for deeper ponds the storage can be carried over the seasons.

Pond collection efficiencies are of the order of 15-25%, depending upon the cleanliness of the water: this figure is about half that of "flat-plate" collectors, but the cost per sq.m. for ponds is more than an order of magnitude lower, resulting in a very low cost per quantity of heat delivered. The ponds can be employed in power production, using low-temperature heat engines.

Because a pond cannot be tilted, the output during the year is less in winter than in summer, but this effect decreases as one gets nearer the equator. Pond operation and efficiency is also affected by rainfall and high winds.

TRAINING PLAN REVIEW

The original project emphasis on training as a key element has dissipated somewhat, largely as the result of delays in planning and approval procedures. A project-wide training plan -- an agreed-upon prerequisite of any training funds disbursement, particularly by DTEC -- was submitted only recently. It has been rejected by DTEC. Given the time remaining in the grant, long-term training is virtually precluded, unless relevant one-year programs can be identified.

DTEC has rejected the plan with the explanation that the plan has not been fully discussed with component leaders. Basically, it took the training requirements outlined by component leaders (although some did not submit any training plans), and allocated available funds more or less evenly across components, cutting back on training slots as required. That procedure entails a number of shortcomings that could hamper effective use of available training funds (or the mobilization of additional resources if needed).

The three major objectives of the Thai Renewable Nonconventional Energy Project delineate three areas of skill requirements that could be met through appropriate training:

- hands-on experience in the fabrication, installation, testing, operation and maintenance of nonconventional renewable energy systems;
- capabilities in the design and testing of dissemination methods aimed at technologies for rural areas;
- skills in energy information gathering and analysis, resource assessment, energy demand management and planning.

These three areas can be addressed through training programs that include academic training, short-term training programs, research internships, seminars and workshops, and working visits to relevant installations elsewhere.

Each one of these options can be used to address specific skill formation needs. How they should be used depends on a clear understanding of the training requirements as they relate to the tasks within the framework of the project, and responsibilities of the people involved beyond the project -- a precondition for effective institutional development. To assure that planned training meets the needs of the component leaders project management, NEA, and those of other institutions participating in the project, a somewhat cumbersome-looking process has been established. This process is outlined in Figure C, taken (as is Figure D below) from the recently submitted and rejected training plan.

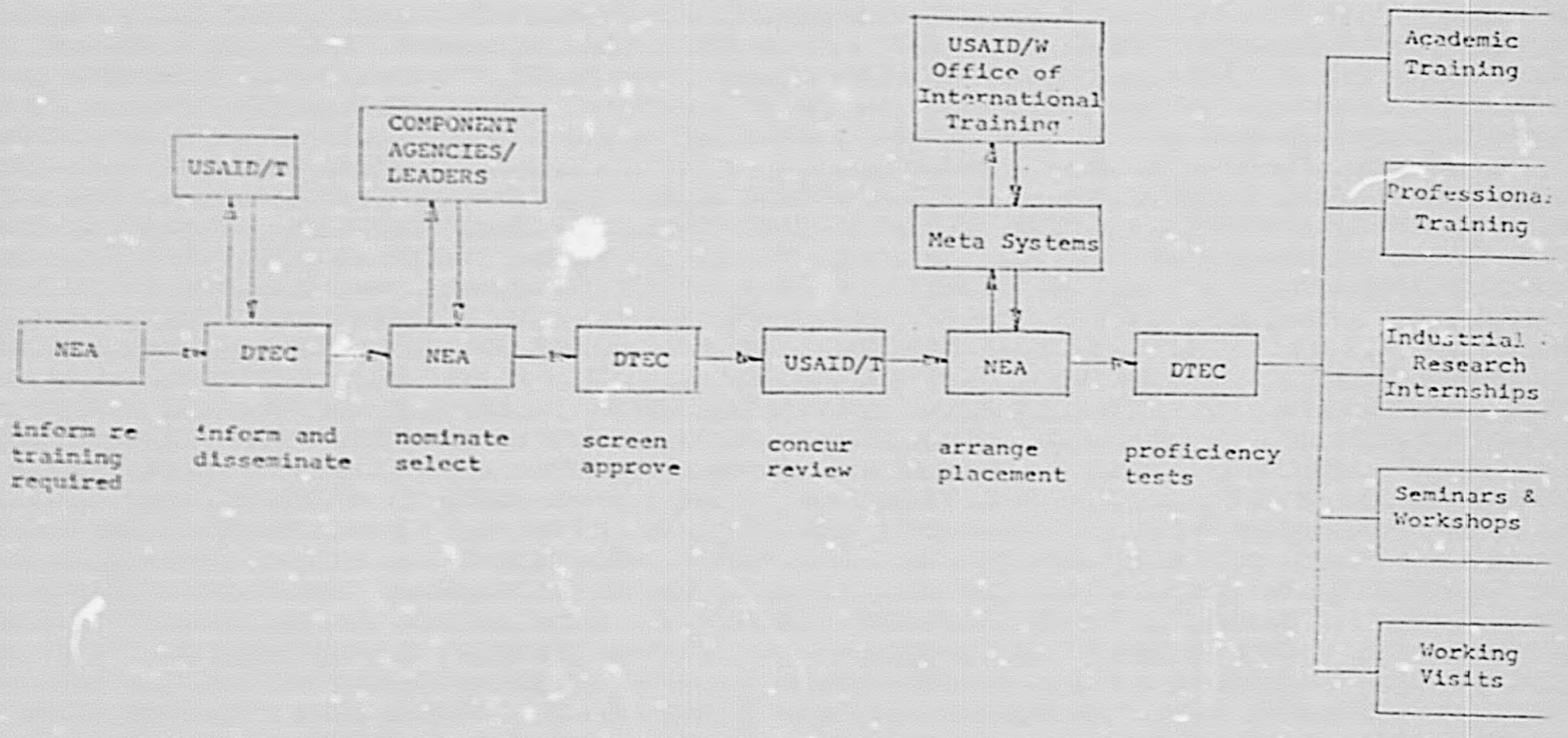
Actually, this process gives rather little attention to the most important step -- the determination of training requirements to enable NEA to inform DTEC and USAID of the training required. For the current training plan, this step involved canvassing the component leaders to obtain information on the amount and type of training they would like to see for the staff working on their component. The training plan summary shown in Figure D was then obtained by scaling back requests to bring total resource requirements in line with available resources. The objective of this exercise was to obtain an equitable distribution of limited funds.

This approach brings two major problems. First, it does not establish any project-wide training priorities. Project management may have to make choices in favor of providing training for some components and none for others. In certain instances, the desired skills can only be acquired through (directed) learning by doing, as in the case of survey methodology and management. In other instances, short-term academic training or intern-

FIGURE C

RENEWABLE NONCONVENTIONAL ENERGY

TRAINING FLOW DIAGRAM



ships may be the quickest and most efficient way to master a particular skill of value to the project and its environment, as in the case of library and information systems or data base management.

The second major problem with seeking equity is that it may lose the benefits of learning as a group. In other words, in some instances it is necessary to train a cadre of individuals working on a particular subject as a group to obtain the full benefits. Training only half the group may be totally ineffective. Thus, without knowing the exact nature of the training proposed and the use that will be made of the skills acquired in this manner, it is hard to say whether the existing training plan is reasonable, efficient, and adequate. (The training plan provides no explanation beyond the information shown in the summary.)

One general comment is in order, though. The project management should explore ways to combine technical assistance with in-country training. For example, the planning, preparation, and administration of the surveys could incorporate directed on-the-job learning through judicious use of technical assistance. The individual(s) providing the technical assistance should perceive their job as that of training and advising the component leader and his staff, rather than as an opportunity only to perform a particular survey-related task. Similar arrangements and procedures are possible in other components. The present training plan must be reassessed or at least evaluated in terms of its overall impact on the three major project objections presented on the first page. If this assessment and discussions between NEA, DTEC and component leaders results in an acceptable resolution a first phase plan can be implemented. A second phase training plan should also be prepared. This plan, also to be implemented rapidly, should consider in-

country training opportunities. Special attention should be given to training which will improve project management, technology demonstration, site testing, data analysis, technology dissemination and rural energy policy and strategy development skills.

FIGURE D

TRAINING PLAN SUMMARY

COMPONENT	TYPE OF TRAINING	PURPOSE OF TRAINING	NO. OF TRAINEES	DURATION	TENTATIVE LOCATION	EST. BUDGET ('000) USAID	DTEC
NEIC	Internship	Library/Info Systems	2	1 month	AIT-Bangkok	$ 4.0	$ -
	Internship	Data Base Management	1	4 months	Washington, DC	17.2	2.4
EMP	Internship	Modeling/Planning	2	4 months	New York	34.4	4.8
	Working Visit	Policy/Planning	2	0.5 months	Asia	2.0	1.0
NEC	Working Visit	Field Energy Centers	2	1.5 months	Asia	6.0	2.0
Survey	Professional	Methodological Approaches, Statistics	1	3 months	U.S. University	6.0	2.4
Solar/Wind	Internship	Calibration	3	1 month	U.S. Meteorology Lab	12.9	7.2
	Professional	Radiation, Wind Instrumentation	3	3 months	AIT-Bangkok	9.0	-
Waterlifting	Internship	Photovoltaics, Gasification, Wind	2	4 months	U.S. Universities, Firms	34.4	4.8
Stoves	Working Visit	Biogas Technology (Industrial)	2	2 months	Asia	17.2	2.0
Solar Drying	Internship	Process Heat Technology	2	1 month	Australia	8.6	2.0
Gasification	Internship	Gasification Technology	1	4 months	U.C. Davis, USA	17.2	2.4
Charcoal	Internship	Laboratory Training	1	6 months	Forest Prod. Lab, USA	25.8	2.4
Stoves	Internship	Stove Design/Technology	1	6 months	U.S. Institute	25.8	2.4
Pyrolysis	Professional	Rice Husk Utilization	2	4 months	(Not Available)	16.0	4.8
Woodlots	Working Visit	Fast-Growing Species	4	1 month	Asia	8.0	4.0
	Academic	Graduate Training with emphasis on:					
		- Energy Policy and Management	1	24 months	U.S. University	48.0	2.4
		- Industrial and Agricultural Waste Gasification	1	24 months	U.S. University	48.0	2.4
						$340.5	$49.4

EVALUATION OF TECHNOLOGIES AS CANDIDATES FOR PROJECT INCLUSION

The project has 8 major technology components and several of these include more than one type of technology. An evaluation of the appropriateness of those already included and others which can be candidates was requested in the evaluation team's scope of work. The principal criteria defining appropriateness were commercial availability, economic viability and potential for use in Thailand. The attached table summarizes the team's evaluation of a variety of renewable energy technologies and resources. The first half (top) of the table covers those elements now included in the project and the bottom half includes candidate technologies.

The team found that there were many groups in Thailand involved in research, development or application of renewable energy technologies. (See Appendix entry on Pertinent Renewable Energy Research in Thailand.) However, data on markets or needs for most of these technologies did not exist. There were also very few data on local economic viability. Because of this dearth of necessary information and the early state of work on the project components it was not possible to decide which technologies were most cost effective or appropriate for Thailand. On the basis of the attached table (matrix) however, it is clear that at least one new technology should be considered for inclusion. This technology, solar ponds, is a candidate for inclusion and its use in Thailand should be investigated.

Given the tentative nature of relevant information for Thailand, the matrix presents the team's judgments about the technologies using a number of criteria. These judgments are based on information gathered during the evaluation and our experience in the field.

Table A

CHARACTERISTICS OF MAJOR RENEWABLE ENERGY TECHNOLOGIES AND SYSTEMS*

Technology	Status: Thailand	Status: Other Countries	Short to Midterm Potential Impact on Rural Areas	Likely Ease of Adoption	Economic Viability	Actively Considered in Other Projects in Thailand
INCLUDED IN PROJECT						
o Microhydro	C	C	High	Easy	D	Y
o Waterlifting						
- Solar Photovoltaic	A	C	Low	Difficult	M[a]	N
- Gasification	A	B	Low	Difficult	M[b]	N
- Wind	C	C	Medium	Easy	D	Y
o Commercial/Industrial-scale Biogas	A	C	Low	Moderate	D	Y
o Pyrolysis (agricultural residues)	A	B	Low-Medium	Difficult	M[b]	Y
o Solar drying/distillation	A-B	C	Medium	Moderate	D	Y
o Improved cooking stoves	A-B	C	High	Easy	D	Y
o Improved charcoal production	A-B	C	High	Easy	D	Y
o Village Woodlots	B-C	C	High	Easy	D	Y

A - Research/testing
B - Demonstration
C - Commercially Available/ Full Scale Deployment

D - Demonstrated
M - Marginal
N/D - Not Demonstrated
[a] - isolated areas/small demands
[b] - not demonstrated for many biomass fuels

* These assignments and classifications are the opinions of the DSI evaluation team.

Table A

CHARACTERISTICS OF MAJOR RENEWABLE ENERGY TECHNOLOGIES AND SYSTEMS*

Technology	Status: Thailand	Status: Other Countries	Short to Midterm Potential Impact on Rural Areas	Likely Ease of Adoption	Economic Viability	Actively Considered in Other Projects in Thailand	Should Be Included
NOT INCLUDED IN PROJECT							
o Solar hot water	C	C	Low-Medium	Easy	D	Y	N
o Industrial/Commercial Energy Conservation	A-B	C	Low	Easy-Moderate	D	Y	N
o Village Biogas	B-C	C	Medium	Moderate	D	Y	N
o Alcohol Fuel Production	A	C	Low-Medium	Difficult	D	Y	N
o Solar Ponds	A	B-C	Low-Medium	Mod - Diff	D	N	Y
o OTEC	A	A-B	Low	N/A	N/D	N	N
o Waves/Tides	A	A-B	Low	N/A	N/D	N	N
o Renewable Energy Powered Electrification	A	B-C	Low	N/A	N/D	N	N

A - Research/testing
B - Demonstration
C - Commercially Available/ Full Scale Deployment

D - Demonstrated
M - Marginal
N/D - Not Demonstrated

* These assignments and classifications are the opinions of the DSI evaluation team.

DATA COLLECTION FOR DESIGN AND EVALUATION

Documenting the lessons learned in introducing and testing renewable energy technologies, and in developing and testing dissemination techniques represents a major concern of this project, at least for the components that have reached this stage. How do different technologies perform in the field when they are operated by rural households and industries? What factors influence their performance? What is the impact of their adoption by rural residents on the country's energy situation? What approaches work best in achieving the adoption of certain technologies by rural residents? These are the kinds of questions that require a careful analysis of the context for the introduction of technologies, and of the impacts achieved. This analysis is needed both at the component level and for the project as a whole. The documentation is also needed outside the project -- to make it possible for other groups in Thailand and abroad to understand why certain approaches worked better than others.

The task of documenting the lessons learned calls for a comprehensive design of the data collection and analysis efforts that are part of the project. Such a comprehensive design can provide suitable guidance to the component leaders, many of whom are not familiar with evaluation procedures for sociotechnical processes, and can assure that information from different components is comparable. Comparability is essential in tying the information together to assess different technologies and different approaches. Without a common framework, it becomes difficult to choose the appropriate technologies for particular situations, and to evaluate tradeoffs in terms of cost (or time or effort) and performance. For example, some technology

may be more beneficial to villagers than another one, but may require a longer-term program to lead to its adoption. Without a common analysis approach, which clarifies baseline conditions, inputs, and outcomes in comparable form, it becomes difficult to decide in favor of one or the other.

Up to now, the project has not benefited from any comprehensive plan for data collection and analysis. While substantial resources have been devoted to these activities, both in the Surveys component, and in the individual components, the lack of a common structure and design has diminished the value of the information produced so far, and may jeopardize the benefits of efforts currently underway or planned for the future. For example, some component leaders have found that there are no suitable candidates among the villages covered in the Baseline Survey. Thus, the transitional surveys, originally designed to monitor the introduction of particular technologies, are now often baseline surveys to identify conditions prior to the introduction of some particular technology. The available information suggests that these baseline survey activities are conducted on an ad-hoc basis, with design and approach reflecting the component leader's specific interests, and resources that happen to be available.

At this point, it is still possible to develop a common structure for context and impact analysis and data collection to enhance the value of the project as a learning process. Developing such a structure need not be a major effort. Rather, it should be a fairly simple process of establishing common data requirements, outlining approaches to meeting these data needs and providing guidance for the analysis to obtain comparable results across components. The discussion below sketches this process, following a brief

review of the information needs associated with two of the major objectives of the project, and an assessment of the current status of data collection efforts within the framework of the project. This assessment identifies a number of weaknesses and questions, especially pertaining to potential biases in the Baseline Survey data which may render generalizations from the survey results misleading.

Information Requirements

Information requirements with respect to the context and impact of the different technologies fall into two major categories, determined by the two major objectives of the project.* The first, "introducing and testing renewable energy technologies in rural areas," requires data on current technologies (hardware and processes), available inputs, such as unused or unuseable crop residues, and constraints, such as skills, cultural beliefs, or legal arrangements. This information is necessary to understand the ways in which a particular piece of hardware, embodying a certain technology, can interact with the users and their social and economic environment. For example, for the component "Improvement of Cooking Stoves" information on current cooking pattern as well as availability of labor for continuous stove monitoring is essential. The most efficient stove technology, in terms or energy consumption, may not be feasible, since its labor input requirements may be more than what a rural family can provide, given other requirements.

In other cases, a good understanding of the production process is required. For example, solar dryers or technologies using crop residues change

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* The discussion here applies only in very general terms to components more reasonably aimed at the completion of laboratory testing of some technology.

significant portions of the production process, reducing the costs of en inputs, utilizing wastes, or improving the efficiency of certain steps of the production process. The technology, including the hardware, must ther be designed as an integral component of the overall production process to facilitate its use. The success of such adaptation of particular technolo to specific conditions hinges on an adequate understanding of current processes and likely developments.

The second major objective, "developing and testing techniques for disseminating such technologies," builds on these data as a base for the evaluat of alternatives approaches to achieving adoption of the new technologies by rural households or industries. Until now, little thought has been given to the systematic design of dissemination efforts under the project. While component leaders may have plans for approaching the dissemination task, they rely more typically on taking advantage of opportunities as they arise, or leaving the specific approach to field agents.

The main issue for the implementing agent in the diffusion of innovation is the demonstration of the benefits to the user net of cost (both benefits and costs interpreted broadly). If the prospective adopter accepts the notion that the benefits outweigh the costs, including the cost of conversion, adoption will take place. Various methods can be used to get to this point by raising perceived net benefits. In some instances, it may be possible to do this through hands-on demonstrations. In other instances, it may be appropriate to reduce costs through (temporary) subsidies, or through arrangements with manufacturers to obtain the benefits of large-scale production. All of these options have been considered by component leaders; however, the design of the dissemination approach is usually insufficient to identify

the relative advantages of different methods. Simple quasi-experimental designs* of these efforts (e.g., systematic variation of approaches across the villages chosen as pilot sites) could provide better guidance for the design of national programs aimed at promoting new renewable energy technologies in the rural sector.

One of the key questions that needs to be answered before any dissemination approaches can be designed and tested relates to the major options for a nation-wide, on-going program. These options can be described in terms of the scope of such a program, the groups to serve as prime targets, and the major change agents in such a program. The last category is of particular importance. In some instances, the question has already been answered. For example, for the village woodlot component the principal agents of change will be provincial foresters. Similarly, for many of the technologies to be developed and adapted under this project, the Regional Energy Centers will be important change agents, although their geographic coverage is limited. One area of special interest is the involvement of the private sector. For example, the stove improvement component is planning on working through stove manufacturers. Similar approaches may be appropriate in other components, provided the potential market for a particular piece of hardware is commercially attractive. Thus, market assessment for a given technology becomes more than a means of evaluating its likely impact on the energy situation in rural areas. It also provides important inputs into the design of an appropriate dissemination strategy.

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* Quasi-experimental designs seek to apply experimental design principles to situations in which strict experimental controls are not possible, such as pilot programs involving any kind of social interaction.

Thus, the information requirements for the dissemination task relate to both the design of approaches and to their evaluation. Greater emphasis on this aspect of the overall project should yield a checklist of items that should be answered by the individual components and by the project as a whole.

The Energy Master Plan Support component in principle is designed to allow for some assessment of the macro-level picture for different technologies in the rural sector. Unfortunately, it is not clear from the information available whether the component asks the right questions. There is also some justification for concern whether the component can carry out the planned activities with the resources available in the time allotted. Moreover, even if the activities could be completed on schedule and produce the right kind of information, the quantitative assessments will come too late to be of much use in actual planning at the component and project level.

Status of Data Collection and Analysis

Thus far, several data collection efforts have been completed or are currently underway within the framework of the project. The major item is the Baseline Survey, begun in early 1981 and completed in the fall; the analysis reports were submitted in early 1982. In addition, several survey activities are currently underway under the general label of "Transitional Surveys." These survey activities relate to the introduction of community biogas digesters, the establishment of village woodlots, and the development of baseline data for specific technology testing and dissemination efforts initiated by component leaders.

The Baseline Survey was conducted under the direction of a Meta Systems consultant. It represents a major effort to collect and analyze data on the context of the project, the energy situation and related conditions in rural Thailand. It covered some 1900 households in 50 villages in 10 provinces (changwat).

The Baseline Survey has two objectives:

> "...to provide general data on village activities and energy use patterns which might be changed by the introduction of renewable energy technologies. This data was (sic) used for the selection of sites where the technologies would be demonstrated and for comparison with data to be gathered in evaluation surveys following the demonstrations.
>
> ... to provide basic research data for the participants in various components of the project." (BSR, Vol. 1, p. 1)

The first objective implies that the demonstration sites for the various technologies (presumably both for testing a particular technology, and for evaluating dissemination methods) were to be selected from among the 50 villages covered by the survey. As far as we can tell from the information available to us, the selection of the provinces and villages for the Baseline Survey was only marginally influenced by considerations of technology testing and dissemination. Part of this problem was the result of timing. By the time the survey got underway in early 1981, many component leaders had not yet drafted any adequate plans for technology development, testing and dissemination. As a result, some component leaders have found that none of the 50 villages are adequate as pilot sites for testing of technologies or dissemination methods. The limitations on coordinating the survey with other survey activities are also evident with respect to Regional Energy Centers. While the survey could have provided useful baseline data

for the REC's, none of the centers will be located in a province included in the Baseline Survey. Consequently, resources set aside for the Transitional Surveys, intended to monitor the actual demonstrations, are now being used to conduct baseline survey tasks in villages that appear more suitable for the implementation phase.

The survey has been useful to component leaders in understanding the typical technologies now in use in the villages surveyed, and the availability (and current alternate uses) of key inputs, primarily biomass resources. Unfortunately, it appears impossible to generalize from the results of the survey to the rural sector in Thailand, since sampling procedures do not allow for an assessment of the statistical validity of the results. As far as we can determine, the sample of villages (and of households in these villages) was selected through multi-stage procedures involving both stratification and clustering. However, because the procedure was judgmental, no assessment of error terms or potential biases in the parameter estimates derived from the survey results can be made. Thus, the information provided to the developers and adapters of renewable energy technologies, though valuable at the micro-scale, incorporates too much uncertainty to allow for reliable assessment of the macro-scale implications of certain approaches.

The survey activities that currently make up the Transitional Surveys are characterized by innovation and inventiveness in implementation, and ad-hoc designs. Resource constraints (the original budget for survey activities has been largely used up by the Baseline Survey) have forced component management to use survey procedures that rely on participants in the

dissemination process for data collection: individuals in the villages who assist in the establishment of village woodlots by helping villagers plant and maintain seedlings also prepare the reports that go into the analysis of methods, approaches and obstacles. This survey approach may make it difficult to obtain an impartial assessment of the factors contributing to success of failure of different methods. The problems associated with the "participant observer" in village-level studies are of course well-known; to some extent they are unavoidable in the context of this project. However, such problems should be recognized in the design of data collection and analysis plans. If this recognizion exists, it has not been documented adequately.

The discussions at the last workshop in Khon Kaen (August 27-29, 1982) suggested a broad range of data needs for different components at different sites. Plans are underway to examine these data needs, organize them, and develop a data collection plan from these requirements to guide the Surveys component of the project. The discussion in the following section is designed to contribute to this process by identifying several categories of issues.

Key Issues for a Data Collection and Analysis Plan

Building a data collection and analysis plan for the project as a whole from the requirements of individual components could consume considerable resources, bringing the whole arsenal of social evaluation research (focusing on technology transfer and dissemination) to bear on this problem. We believe the project has neither the resources nor the time to engage in such an approach. Moreover, the refinements that have been introduced in

recent years appear to have improved little in terms of the reliability of findings. Quasi-experimental research almost by definition is hampered by a host of problems inherent in the setting -- resource constraints which prevent working with a sufficient sample of sites to allow for any statistical analysis, absence of experimental controls which allows outside factors to influence the outcome of some pilot process, and sometimes necessary biases in the selection of pilot sites make it difficult to generalize from observed results, no matter how powerful the battery of design and analysis tools.*

More important is asking the right questions, and making sure that they are, if not answered, at least addressed in any field trial within the context of the project. We would, therefore, recommend the formulation of a common set of questions as the first step to a data collection and analysis plan for the remainder of the Nonconventional Renewable Energy project. Questions delineating information needs of technology development and adaptation also need to be answered for the design of the dissemination approach; they should cover the following types of issues:

- Objectives as they derive from current or prospective needs or opportunities;
- Nature of the process the technology under consideration is expected to change, replace, or augment;
- Availability of inputs required by the technology, including actual or potential alternative uses for them;
- Constraints on process changes caused by religious beliefs or cultural practices;

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* The researcher must also recognize strong political pressures against actual or perceived failures in demonstrations of new technologies. While useful lessons may be learned in trying an approach that doesn't work, attendant publicity may attribute the results to the particular technology itself, jeopardizing its perceived value and thereby its acceptance later on.

- Individuals, groups, localities, and institutions targeted as likely innovators or first adopters;

- Characteristics of other change agents, organizations or entities expected to play an active role in the on-going dissemination process, such as hardware manufacturers, or other central or local government programs;

- Nature of the adoption process, e.g., gradual (household by household or producer by producer) vs. some leap requiring the achievement of some social consensus before action takes place;

- Conditions under which a particular technology will be introduced, which describe the actual dissemination approach, e.g., nature and locale of demonstration and training (for innovators and first adopters and for followers), overt or indirect economic incentives (such as subsidized prices for any hardware), and related publicity;

- The universe in which the technology might be deployed and to which findings of the pilot efforts would be applicable.

The component leaders need to understand these issues to develop renewable energy technologies as part of a broader program to change household behavior and production processes in rural areas. This understanding must be documented to inform non-participants, and to synthesize approaches and findings at the project level.

Aside from existing knowledge and available data (including those from the Baseline Survey) component leaders require additional data collection, designed to meet their specific information needs, organized by issue. Some of that information required field activity, including structured observation and measurement as well as sample surveys. Presenting these component-specific data collection and analysis requirements within the framework of a comprehensive approach of putting new technologies in the field, including well-defined criteria for site selection, enables project management to

- assess the adequacy of the information base with respect to component and project objectives;

- examine tradeoffs with respect to cost and time;

- coordinate dissemination and data collection plans to take advantage of any "economies of scale" or scheduling opportunities;

- prepare a data collection and analysis plan for the project as a whole to state clearly what will be learned from this project, and how the data will fit into the overall energy data base to be organized and maintained by the NEIC. Such a project with data collection and analysis plan would of course be closely tied to the project-level work plan. This is the basis for a synthesis of project findings.

PERTINENT RENEWABLE ENERGY RESEARCH IN THAILAND

The Thai Nonconventional Renewable Energy Project is one element of a broad spectrum of activities in renewable energy in Thailand. The next few pages present a (partial) compilation of relevant research and demonstration projects. A quick analysis illustrates the relative emphasis on different areas:

Subject Area	Number of Projects
Alcohol	10
Gasification	5
Pyrolysis	2
Oil from plants	2
Stove Improvement	4
Fuel Wood	2
Biogas	6
Micro Hydro	1
Solar	31
TOTAL	64

However, this list is incomplete. A number of organizations which are active in the field (like the Asian Institute of Technology which recently received a grant of over $3 million from Germany, at least in part, to promote research and teaching on biomass), are not included. Although partial, the list does indicate the wide range of work underway in the field.

Energy Technology Status

Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS 1	2	3	4	5	6
	Biomass Energy								
National Research Council (Dr. Pradit Choeivichit)	1. Alcohol Mixing in Gas Fuel.	To study and develop application of alcohol as renewable energy for use with fuel oils for various engines.				X			
(Boonthom Thammachari).	2. Alcohol Production From Casava.	Study alcohol distill.process from agricultural products.			X				
Dept. of Industrial Works (Supported by National Sugar Council)	Alcohol Using for Vehicle Fuel.	To study the feasibility of using alcohol for sole fuel for vehicles.			X				
Faculty of Engineering Chula. University (Phunphon Saengbangpla)	1. Alcohol Using for Benzene Engine.	To test alcohol using for fuel in benzene engine.				X			
(Suwatthana Phuangphoeksuk)	2. Concentrated Alcohol from Sugar Yeast.	To seek method of concerntrated alcohol production, such as isopro. which may be used as good fuel for engine.				X			
Faculty of Agriculture Kasetsart University (Oraphin Phumin)	Alcohol Production From Flour.	To research alcohol production by using enzyme.	1979-1982						
Faculty of Science Chiang Mai University (Kamnoet Suphanwong)	1. Alcohol from Molasses Study.	To study the appropriate temperature and PH for production of alcohol.			X				

Remarks: 1. Data Study viability 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial Promotion

Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS 1	2	3	4	5
	Biomass Energy							
	2. 95% Ethyl Alcohol from Glutinous Rice.	To conduct preliminary study on distillary of alcohol from glutinous rice through traditional marination as well as continuous distillary process in packed column.		X	X			
KMIT (Thon Buri) (Morakot Tanticharoen)	Alcohol production Increase through Nitrogen Fixation by using Bacteria	To study and develop and increase alcohol production.						
Dept. of Agriculture (Chit Thatsanakul)	Alcohol & other substance Distillation From Rubber Tree Experiment.	To analyze the substance obtained from rubber tree distillation.	1980-1983			X		
Faculty of Engineering Prince of Songkha University (Withaya Chongcharoen)	Gasification From Rubber Tree charcoal.	To study gasification from rubber tree for engine.						
Faculty of Engineering Chula. University (Dr. Woraphat) (Supported by NEA & USAID	Biomass Gasification.	To study carbon monoxide generation process from various mat'ls easily avail.such as rice husk,wood,etc.for use as fuels in rural areas.	1982-1984	X				
Faculty of Science Chula. University	Rice Husk Gasification in Fluidize-bed.	To study gas production process by fluidized-bed combustion.	1980		X			
National Research Council (Boonthom Thammachari)	Gasification from Agricultural Wastes.	To use agricultural wastes as fuel for community.	1980	X				

rks: 1. Data Study 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS					
				1	2	3	4	5	6
	Biomass Energy								
pt. of Municipal Public rks	High Eff. Fuel Gas Stove.	To develop high efficiency gas stove from charcoal.			X				
yal Forest Department	Wood Gasifier.	To generate electricity for forest villages.					X		
ailand Institute of cientific and Techno-gical Research	1. Pyrolysis Rice Husk	Research				X			
r. Sermpol) upported by NEA & USAID)	2. Pyrolysis Rice Husk	To develop method of solid fuel production from rice husk for use, rural areas.							
setsart University amphaeng Saen) upported by NEA)	Jatropha Curcas Linn. oil plant, Renewable Energy to substitute Diesel at Village Level.	To develop plants avail. in abundance domestically into renewable energy for common use.	1982-1984	X					
ailand Institute of ientific and Technolo-cal Research	1. Peanut for Energy.	To produce oil from peanut for renewable energy.			X				
	2. Oil Plant for Energy.	Research oil plants as substitute for diesel fuel oils.			X				
culty of Engineering ula. University r. Kulthon Silapabanthoeng) upported by NEA)	Cyclone Stove Improvement Using Saw Dust. Rice Husk, Lignite and Oil Shale.		1979-1980			X			
yal Forest Department r. Aroon Chomcharn) upported by NEA & USAID)	Stove Improvement Study	To collect and improve cooking stoves for introduction to rural people for purpose of fuel conservation.		X					

emarks: 1. Data Study 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS					
				1	2	3	4	5	6
	Biomass Energy								
aculty of Engineering rince of Songkla University Suwat Thaiyana)	Stove Using Waste Materials for Fuel.	To use material wastes in a worthwhile manner and to seek economically appropriate cooking stoves.				X			
ept. of Agriculture	Economic Stove.	Research cook stoves using avail.fuel,reduce cost.					X		X
oyal Forest Department Komon Pragthong) Supported by NEA & USAID)	Village Woodlots.	Grow fast-growing trees for fuel wood,rural areas, & cut down on deforestation.					X		X
aculty of Science hula. University Chuchart Baramee)	Study of properties of wood that may be used as fuel.	To study general properties of Eucalyptus,Leucaena, Sakae, Katin Narong,etc. with emphasis on optimum heat of each.		X					

emarks: 1. Data Study 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS					
				1	2	3	4	5	6
	Biogas								
ational Energy Administra-tion	1. 32 units Demon. Family Scale Biogas digesters and 2 units Demon. Farmer Group Biogas Digesters.	To demonstrate and dissiminate of renewable energy (biogas) using status in rural area.	1980-1982				X		X
	2. 477 units Family Scale Biogas Digesters.	To promote the use of biogas to the interested people through assistance in construction and technique.							X
aculty of Education hula. University (Supported by NEA)	1 unit Demonstration 2 units Promotion Biogas Digester.	To demonstrate and dissiminate the use of biogas under the Village Development Project (villages nearby Refugees Holding Center).	1979-1981				X		X
ublic Welfare Dept. (Supported by NEA)	Floating Type Biogas Digester 2 units.	To promote the utilization of biogas, to increase the living level of rural poor.	1980-1981						X
gricultural Land Reform ffice (Supported by NEA)	Floating Type Biogas Digester 39 units.		1980-1981				X		X
ept. of Health	1. Dome Type (Chinese) Biogas Digester, 4 units community scale and 65 units family scale.	To demonstrate and promote Chinese type biogas digester which is low in cost and high in efficiency of gas.					X		X

Remarks: 1. Data Study 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS					
				1	2	3	4	5	6
	Hydropower-Village Level								
ational Energy Administra-ion	Turbine - Cross Flow Type	To study the phototype of turbines which are appropriate and workable to the area.	1980-1981				X		

narks: 1. Data Study 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

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Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS 1	2	3	4	5	6
	Solar Energy								
ational Energy Administration (NEA)	1. Air conditions using Solar Energy.	To study technical and economic feasibility of solar air conditioning sys. in local weather conditions.	2 yr.		X	X			
	2. Solar Power water pump System I-cycle Type.				X				
	3. Horizontal Type PV Heat Efficiency Testing								
	4. Solar Cell Water Pump System.	Performance of solar cell for water pumping in comparison with windmill.			X				
	5. Solar Water Heat System.	To promote and prepare specifications for guidelines in development of renewable energy use status.						X	
NEA (Supported by USAID)	Water Lifting Technology	To introduce water lifting technology by various forms of renewable energy such as solar, biomass, biogas, and wind, to the appropriate rural areas.		X					
KMIT (Thon Buri) (Dr. Prida Wibulsawas)	1. Development of solar air heaters for a cabinet type solar dryer.	To research and develop the simple and low cost of cabinet type solar dryer				X			
(Sukhon Art Rit)	2. Reversed Flat plate collector having Renewable energy Application.	To increase the eff. of single side flat solar plate.				X			
(Dr. Phichet Limsuwan)	3. Selective coating selection.			X					

Remarks: 1. Data Study 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

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Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS 1	2	3	4	5	6
SMIT (Thon Buri) Contd.	Solar Energy								
(Det Phutthacharoenthong)	4. Control device for Parabolic reflector.					X			
(Dr. Suradet Chantranurak)	5. Solar Pond.		2 yr.	X					
	6. Solar Water Heater with Latent Heat Storage.					X			
(Songkiat Kiatsirirot)	7. Slection of Appropriate Latent Heat Thermal Storage Medium.	To study and test the property of various substances for potential use.			X				
(Dr. Sakkarin Phumirat)	8. Temperature Range for Solar Electricity performence System of a Parabolic Trough-Focusing collector.	To study the efficiency and development for utilization.			X				
	9. Solar Autoclave.	To develop Solar Autoclave for substitution of Electric Autoclave by using local materials.	8 mo.			X			
	10. Solar Distillation "Regenerative" Type.	To study the distillation rate and efficiency of solar distillation unit	1 yr.			X			
	11. Alcohol Distillation by Horizontal Solar Cell (?).					X			

Remarks: 1. Data Sutdy 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS 1	2	3	4	5	5
KMIT (Thon Buri) Contd.	Solar Energy								
	12. Development of Solar Stills Having Acrylic Plastic covers.	To develop the cheaper solar stills by using acrylic plastic to replace glass.				X			
(Dr. Krissanaphong Kirtikara)	13. Relationship between Solar Radiation and some Meteorological Data.	To study and appraise the renewable energy potential.	1 yr.	X					
	14. Interrelationship among Total Radiation, Diffuse Radiation and Direct Radiation.			X					
(Dr. Prida Wibulsawas) (Supported by NEA & USAID)	15. Solar Drying Distillation.	To develop solar heat process and use for rural people.	2 yr.			X			
KMIT (Lat Krabang)	Research & Dev. of Solar Cell.	To research and develop solar cell using local available materials.			X				
Faculty of Engineering Chula. University (Dr. Wiwat Tanthaphanitkul)	1. Preli. Economic Study of Solar House.			X					
	2. Silicon Solar Cell.	To fabricate and appraise locally made solar cell proficiency.			X				
Faculty of Engineering Chula. University	Solar Tower System 3 kw.	To research and develop small scale electric generating system thru. solar heat process.			X				

Remarks: 1. Data Study 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

Agency/Responsible	Activity/Project	Purpose	During	PRESENT STATUS					
				1	2	3	4	5	6
	Solar Energy								
Chiang Mai University	1. Effects of Seasons and Tilt Angle on Evaluation of Solar Energy.			X					
	2. Tobacco Dryer	To develop solar tobaco dryer for tobaco which growing a lot in the North.			X				
Khon Kaen University	1. Solar Drying Box.	To research and develop for NE agricultural produce.			X				
	2. Solar Distillation.	To research and develop for helping NE rural people who are short of drinking water.			X				
	3. Solar Absorption.	To research and develop for use as air-conditioner.			X				
GAT	Solar Poer Plant 100 & 1,000 Kw.	To research and develop the solar process heat for electricity generating to substitute part of oil.			X				
ET Dept. (Supported by NEA & USAID)	Resources Assessment - Solar. - Wind.	To use as data for design and development, the application from solar energy.			X				

emarks: 1. Data Study 2. R&D 3. Demonstration at Imp. Agency 4. Demonstration at Rural Area 5. Commercial viability 6. Promotion

PARTIAL LIST OF PEOPLE DSI EVALUATION TEAM MET WITH

Khun Prapath Premmani (Deputy Secretary General, National Energy Administration)
Khun Sompongse Chantavorapap (Project Manager, NEA)
Mr. Thomas Johnson (USAID)
Mr. James Sloan (USAID)
Mr. Bruce Odell (USAID)
Khun Mintara Silawatshananai (Project Officer, USAID)
Dr. Basharat Ali (USAID)
Mr. Robert Vernstrom (Resident Coordinator, Meta Systems, Inc.)
Mr. John Arnold (Consultant, Meta Systems, Inc.)
Khun Manoth Suksabjarem (Department of Technical and Economic Cooperation)
Khun Kittipan Kanjanapipatkul (Department of Technical and Economic Cooperation

Component Leaders

Dr. Aroon Chomcharn (Royal Forest Department): Stove Improvement
Charcoal Improvement
Dr. Oran Rutanaprakarn (NEA): Water Lifting
Khun Pongsa Pornshaiwiseskul (NEA): National Energy Information Center
Dr. Woraphat Arthayukri (Chulalongkorn University): Biomass Gasification
Dr. Krissanapong Kirtikara (King Mongkut's Institute of Technology): Solar Drying and Distillation
Khun Kriengkorn Petchbutr (NEA): Energy Master Plan Support
Khun Supot Tadyu (NEA): Surveys
Khun Komol Prakthong (RFD): Village Woodlots
Khun Soranee Sangmit (Meteorological Department): Solar/Wind Assessment
Khun Prakarn Bunchueydee (NEA): Industrial Biogas
Khun Sawad Hemkamon (NEA): Micro Hydro
Khun Preecha Ploypatarapinyo (Thai Institute of Scientific and Technological Research): Pyrolysis of Rice Husks
Khun Pairaj Woravej (NEA): Regional Energy Centers

PARTIAL LISTING OF PUBLICATIONS REVIEWED BY DSI TEAM

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2. Thailand Papers on Energy, Presented to the Economic and Social Commission for Asia and Pacific Committee on Natural Resources, 8th Session, 27 October - 2 November 1981, Bangkok, Thailand, prepared by Thai Delegation.

3. Thailand - Renewable Nonconventional Energy, USAID Thailand Project Paper, July 1979 (and annexes).

4. Thailand Energy Master Plan Project Draft of Final Report submitted to NEA, RGOT, ADB & UNDP by R. Nathans Association, Inc., et. al., February 1982 (9 Vols.).

5. Baseline Survey Report (BSR), Renewable Nonconventional Energy, Project for NEA & USAID by Meta Systems, Inc. and Thai Consulting Company, Ltd.

6. Alternate Energy Development Plan of Thailand, 1980-1989, NEA, Bangkok, Thailand.

7. NEA Act BE 2496, Bhumipol Aduldej R., 5 January, signed Field Marshal P. Pibulsonggram, Prime Minister (18 pp) (1953).

8. Initial Renewable Nonconventional Energy Technology Monitoring Report, prepared for NEA & USAID by Meta Systems, Inc., January 1982.

9. Thailand Energy Situation 1980, NEA, (32 pp).

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11. The Availability of Solar Energy in Thailand by Dr. R. H. B. Exell and Kaya Saricali for the J. F. Kennedy Foundation, Thailand, Bangkok, Thailand, February 1976 (85 pp.).

ABBREVIATIONS

AID/W	Agency for International Development, Washington, D. C.
AIT	Asian Institute of Technology, Bangkok
ASRCT	Applied Scientific Research Corporation of Thailand
BOB	Bureau of the Budget
CDD	Community Development Department, Ministry of Interior
CSC	Civil Service Commission
CU	Chulalongkorn University
DMR	Department of Mineral Resources
DOA	Department of Agriculture, MOAC
DOE	US Department of Energy
DTEC	Department of Technical and Economic Cooperation
EGAT	Electricity Generating Authority of Thailand
EMP	Energy Master Plan
KMIT	King Mongkut's Institute of Technology
MOAC	Ministry of Agriculture and Cooperatives
MSTE	Ministry of Science, Technology and Energy
NEA	National Energy Administration
NEIDCT	National Energy Information and Documentation Center for Thailand
NESDS	National Economic and Social Development Board
NSO	National Statistical Office
PEA	Provincial Electricity Authority
PID	Project Identification Document
REC	Regional Energy Center
RERIC	Renewable Energy Resources Information Center
RFD	Royal Forest Department

Abbreviations Continued

RTG	Royal Thai Government
USAID	US AID Mission, Thailand
TISTR	Thailand Institute of Scientific and Technological Resources

Currency Equivalents

U.S.		Thai
U.S. $ 1.00	=	Baht (฿) 23.00
U.S. $ 0.04	=	Baht (฿) 1.0

Area Equivalents

1 rai	=	0.16 hectare (40 x 40 meters)
1 hectare (ha.)	=	6.25 rai

GENERAL IMPLICATIONS OF FINDINGS

This project evaluation has presented some unique issues and project specific problems; however, a large number of the findings were not new or different from what we have seen elsewhere. This repeated appearance of certain issues and and problems in AID and other international lending agency funded renewable energy projects is the subject of this section of the report. The following paragraphs briefly identify and describe some of the major and frequently encountered problems which were discovered during this evaluation.

Although this evaluation and the TRNE project serves as a basis for this part of the report it is far from the sole example. The problems and findings presented are not only not unique to this project, they are also found at varying levels of severity. This chapter does not present the overall status of the TRNE project nor does it fairly reflect the importance to the project of each issue discussed. This chapter presents the evaluator's experience with and learning from a large number of renewable energy projects. We strongly recommend that the complete evaluation report be read before this section and feel that the specifics of this project will help the reader understand one facet of some of these problems.

Overly Ambitious Timing and Scheduling

The TRNE project paper did not provide enough time to start this project or in fact almost any technology project in Thailand. Neither typical project initiation delays nor those one would normally expect to encounter when starting a new type of project were anticipated or planned for. AID personnel must temper the enthusiasm of consultants, project paper preparers, and host

country specialists with realism about how long it takes to start up any technology-oriented project. This type of problem is very common to major renewable energy projects but it should be preventable in the future. A lack of understanding of the details of RE projects should no longer be an excuse and the history of AID projects is sufficient to define realistic timing expectations.

Unrealistic Performance Expectations for Project Elements

Throughout the course of this and other projects component plans continue to contain unrealistic performance expectations. The specific details of what each component or subproject will accomplish and how long this will take are frequently not thoroughly documented to allow an independent observer to understand and question the assumptions made by the implementor. Some of the typically encountered unrealistic expectations include:

- taking relatively unproven technologies from testing to commercialization or widespread dissemination in one project;
- performing technology tests in reasonably uncontrolled and unfamiliar surroundings such as villages or rural locations and not planning for major set-backs or problems;
- conducting subprojects without having prepared detailed operation (work) plans;
- testing technologies by emphasizing engineering details and minimizing social, cultural, political and environmental analyses and considerations.

Inadequate or Partial Work Planning

Technology-oriented RE projects frequently tend to treat work planning as a one-time effort and this effort is directed at producing general plans

of utility to management and progress monitoring needs. The difficulty, expense and hard desk work associated with thorough work planning often deters AID, host country project managers and implementors from producing detailed work plans. However, it is the DSI evaluation team's strongly held feeling that this lack of thorough work planning is often a major factor in component failure.

The arguments and rationale supporting the preparation of limited work plans are legion; however the need for and utility of thorough work plans is easy to demonstrate. Renewable energy projects, especially technology oriented ones, which involve design, construction and testing of technologies are complicated and often involve tasks which implementors have not previously performed. A work plan is not something which must be religiously followed; rather, it is a suggested approach which can and should be changed over time. When an engineer builds a structure or civil work or piece of machinery a detailed set of drawings, specifications and background design calculations are prepared and then used to guide purchasing, construction, and start-up. Once the project is completed a set of "As Built" drawings are prepared and these are used to guide operation and maintenance of the completed project. Even if the project is simple and has been performed before by the engineer it is not started or completed without preparing and using plans and specifications. No one questions the need or utility of this process and the specific plans and specifications.

A detailed work or operational plan is exactly the same to a major project task as the plans and specifications are to construction. They are necessary and when the implementors are unfamiliar with elements of the com-

ponent they are indispensable. We do not want to make too much of the analogy, but do want to strongly make the point that we believe that thorough work planning is not only cost effective but it is an almost necessary precursor of success.

Coordination and Technical Assistance Deficiencies

The importance of long-term on-site coordination and short-term technical assistance to project success is also highlighted by this and numerous other RE project experiences. Even in very developed developing countries renewable energy technology and major project management experience is scarce. A project coordinator and short-term technical assistance can make up for this scarcity. The stumbling block to and problems with acceptance of this are not so much in understanding or acceptance of this but in finding long- and short-term personnel who can perform well enough to be perceived as worth their costs. U.S. and foreign TA is very expensive in terms of cost per hour; however the value of this input, if it is timely and on target, is worth the expense. The quality of the people used for these purposes, both technically and culturally, must be in proportion to their costs. If AID is going to encourage or require U.S. TA and long-term coordination on RE projects, and we believe that coordination and short-term TA is most often necessary, it must be sure that this is also understood and costs accepted by the host country project management personnel. In host country contracts AID should directly and heavily involve country personnel in the consultant selection and contracting process. If at all possible the host country should handle the selection and contracting with AID assistance and active participation. We have found that it is better to confront and address possible

problems up front than to wait until later in the project to discover and have to solve contracting and working relationship problems.

Other Findings of General Importance

In addition to the above four major areas there are several less significant but still worth mentioning common issues. The list below itemizes these to identify them but does not explain or analyze their impact. A reading of this evaluation and others, particularly the Philippines Nonconventional Energy Development Project Evaluation*, can supplement this.

- Technology and major country resource assessments are frequently planned but then eliminated, delayed or diminished to the point of making them of limited utility. Good and reliable data are often lacking and at the end of a project this lack becomes critical.

- Institution building and personnel training is made an overt overall project goal, but then this becomes fragmented and dominated by component specific desires.

- Overall project work planning often becomes a sum of component plans and the integration becomes a final summing up of individual results rather than a continuing and purposeful project objective. At the end of a project frequently the sum of the parts is not as large as was or should have been expected.

- Project evaluations are scheduled but often done internally or not at all because of delays and slowness of accomplishing goals. This situation should be a stimulus for rather than a deterrent to timely evaluation.

- The AID expectations and agendas in terms of outputs, accomplishments and the nature of the project process are often not made explicit but they have a major impact on the nature and conduct of projects. These givens should, as much as possible, be made known and discussed early in project agreement negotiations and again during project start-up.

In closing, it is worthwhile to quote from the previously referencee Philippines evaluation.

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* Philippines NonConventional Energy Development Project: An Evaluation Prepared for USAID/Manila and the Philippines Ministry of Energy, the Center for NonConventional Energy Development by Development Sciences, Inc. December 1981.

"In general, the team feels that any renewable energy project which deals with even just one technology demonstration or renewable energy resource development program should (consider) the above recommended project elements. The second key to success, however, is people. If the country and project is staffed with people who understand and accept the project paper philosophy and subprojects and these people are capable of handling the project, the chances of success are excellent. We believe that this is now the case in the Philippines (and Thailand) and, by implementing the recommendations of this report, success should be achievable."

The Energy Master Plan (EMP) is a major effort to explore Thailand's energy future and energy policy options for the remainder of this century. Funded by the Asian Development Bank and UNDP at a level of over U. S. $1 million, the project has been underway since early 1980, involving a consortium of consultants working with NEA staff. The EMP is based on a comprehensive mathematical model (in both a linear programming and a simulation mode) derived from the Reference Energy System.

The principal objective of this component is to expand the EMP optimization/simulation model to allow for the evaluation of the potential impact of the renewable energy technologies on the energy sector in particular and on national development in general. The component was also intended to investigate the possibility of supplementing the EMP model to incorporate the assessment information in a more disaggregate way. Finally, the component includes an effort to develop a general village-level energy use and production model, using linear programming techniques to examine the impacts of alternative technologies, energy pricing policies, and specifications of consumer demand under conditions characteristic of different geographical regions, resource endowments and social structures.

NOTES AND COMMENTS

1. The potential contribution of this component to the project is jeopardized by delays in the completion of the EMP, and by possible weakness in the existing data base.

2. It is difficult to tell from the available documents just what information will be generated, and -- more importantly -- how it will benefit other component leaders or project management in their planning.

3. Unless more detailed model and software designs already exist (documentation is lacking), the schedule outlined in the operational plan for FY 1983 appears extremely difficult to maintain.

4. Given these problems, the component should be reexamined with a view toward reallocating the resources, including technical assistance. Alternatives considered should include the development of simple tools for component leaders to carry out the macro-level analysis necessary for their dissemination plans, and the strengthening of the survey component to improve the project's evaluation capabilities.

Tools or analysis methods that should be considered should enable component leaders to estimate the number of potential adopters of a particular technology by region of the country, the number of likely adopters under different assumptions about the dissemination efforts, and the impacts of the adoption in terms of fuel saved, fuel replaced, or fuel supply increased.

This information is useful not only for assessing the effectiveness of different dissemination approaches to compare them to their costs, but also to establish a basis for commercialization -- to indicate the likely market size of interest to private sector suppliers.

A separate approach is needed for these technologies, as compared to the more traditional market-focused analysis of demand and supply in the conventional energy sector, because nonconventional renewable energy technologies typically generate demand and supply simultaneously. Thus, the analytical tools should focus on the impacts of technology adoption -- which requires concepts and techniques different from those of traditional macro-level energy planning.