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PROJECT ASSISTANCE COMPLETION REPORT
RENEWABLE NONCONVENTIONAL ENERGY PROJECT
A.I.D. PROJECT NO. 493-0304

The Renewable Nonconventional Energy Project (RNEP) was completed on October 31, 1984. The majority of the Project components achieved the goals and seem well worth the financial investment. Those few components that resulted in decisions to scale down goals or not to proceed, or failed to meet initial goals, were valuable in the lessons they provided for future activities.

1. The National Energy Information Center has been organized and equipped, and is functioning. Its staff has been increased, its data base enlarged, and has become a part of the Energy Policy and Planning Division of the National Energy Administration (NEA).
2. Four Regional Energy Centers, one each in the North, Northeast, Central, and South, have been created, staffed, and equipped, and have been doing excellent work disseminating information developed during the project and since. Workshops and training sessions have been held on fabrication and use of improved cooking stoves and improved charcoal kilns, and on planting and caring for seedlings in village and private woodlots. Two additional centers have been established by RTG budget: one in the North and the other in the Northeast.
3. Support for the Energy Master Plan has helped to develop economic models that have already been found useful in national planning.
4. Under the Village Survey component, valuable data have been collected that will continue to be useful for future studies. The collection includes valuable information on household fuels, industrial fuel use, agricultural practices, water supply, specific fuel characteristics, and market data.
5. Four Microhydroelectricity installations were completed in isolated areas. Hydroelectricity is not only economically more practical than diesel-generated electricity in these situations, it is also financially more attractive to the poorer residents of the villages served than grid power, in those cases where the Provincial Electricity Authority line has reached the village. While the electricity supplied by these installations to villages otherwise not likely to be served by the national grid in the foreseeable future may not loom large in the national economy, the benefits far outweigh the cost of electrical energy produced. Besides providing the benefits of electricity to isolated villages, the installations have fostered a cooperative spirit that is having beneficial effects on broader village development problems. By virtue of their participation in construction of the installations, and the

cooperatives they have formed to operate, maintain, and repair the complete systems, the villagers have acquired skills - organizational, financial, managerial, technical, mechanical - whose value is difficult to overestimate. Furthermore, the results of activity under this component have stimulated greater investment in small hydroelectric installations on the part of the Royal Thai Government, and have helped stimulate a domestic industry in manufacturing the necessary equipment.

6. Water-lifting demonstrations took place, with mixed results that nonetheless contained valuable lessons. While the windmill pumping project failed because of mechanical problems and inadequate involvement of the villagers, a photovoltaic water-pumping installation has demonstrated its technical practicality in relieving villagers of an onerous task. To day, water-lifting technology by solar photovoltaic, gasifiers, and small windmill is still on-going.
7. Under the Biomethanation Systems component, a study of biogas from industrial wastes water was conducted, with the result that several alcohol distilleries are investigating the feasibility of these installations to treat their waste streams. In addition, the National Energy Administration was negotiating with a commercial firm to produce biogas from industrial waste water.
8. The Solar Thermal Processes activity resulted in the performance of experiments on solar-drying techniques as planned, with results that provided a better understanding of the economic feasibility and the marketing problems involved. In view of current costs, solar crop drying has not had significant impact in Thailand, and does not seem likely to have in the future except a few solar drying of timber for furnitures and solar distillation of water for schools.
9. Biomass Gasification is an existing commercial operation in Thailand that could probably benefit from some continued research. Under this component, research and development were conducted at three universities, comparing the economic feasibility and assessing the status of various techniques. Twelve units of various sizes were built and operated and the information gathered has improved the knowledge base for expanded industrial use of this technology in Thailand and elsewhere. The private sector in Bangkok has manufactured various scales of wood waste biofuel gasifiers and sold them to four factories for producing gas which can substitute around one hundred liters of oil per hour.
10. Work under the Village Woodlot component was carried out by the Royal Forest Department, with over one million trees planted in seven Provinces in the Northeast. Many private plantations have sprung up, stimulated by the project, and trees have been planted in home gardens, along fence rows, and between paddy fields. Forests are growing where none grew before, and there is a new appreciation of the environmental value of these trees among many rural residents.

The number of trees being planted is still rising, and the only problems seem to be the uncertainty of ownership rights and the eventual use of the trees. However there are some schools now growing fast growing trees in the school territories and selling the trees for support of school lunch program.

11. Charcoal production techniques have been investigated and improvements instituted to increase the efficiency of production. As a result of promotion and training begun under the project and still continuing, private producers are starting to construct the improved kilns.
12. In cooperation with the National Energy Administration, the Royal Forest Department succeeded in developing an improved cooking stove that uses twenty-five per cent less charcoal - fifty per cent less according to the many users - than the traditional model in use in Thailand. The wood-fueled stove developed under this project has an even greater efficiency improvement over its traditional counterpart. This development has sparked the creation of village groups - most of which are owned and operated by women - that are manufacturing and selling the new stoves, the adoption of the new design by manufacturers of traditional stoves, and the organization of a new company devoted to manufacturing, and improving the design of, the new stove. Several thousand of the stoves have already been sold, and the prognosis for accelerated sales is promising. Public interest in the new stoves seems to be growing, and the World Bank is preparing a major effort to accelerate and expand dissemination of the new model.
13. An assessment of solar and wind resources has been performed and the data collected will be useful for some time.
14. Experiments were performed on pyrolysis of rice husks that provided useful information by use of which the process can be evaluated. Pyrolysis of rice husks is not seen as a useful technology, particularly in view of the more practical gasification processes that exist, and the successful briquetting of the husks that has been developed. A Thai private engineering firm has manufactured various different types of rice husk gasifiers ranging from 90 - 220 KVA, and has installed them at its rice mill in the Central region. In addition, the same firm has designed and sold gasifiers to 21 rice mills in the Central and Northeastern regions.

To summarize, of the 14 components that comprised the project as implemented, 4 were found already to have had significant beneficial and continuing impact on the welfare and economy of rural Thailand. These were:

Regional Energy Centers
Microhydropower
Improved Cooking Stoves
Village Woodlots

Work on 5 others was found to have significant potential impact on both the rural and national economies:

National Energy Information Center
Energy Master Plant Support
Village Surveys
Improved Charcoal Production
Solar/Wind Resource Assessment.

For the rest of the components:

Water Lifting Technology -- further photovoltaic or windmill water pumping schemes should be pursued by the Government only after careful economic and technical comparisons among all systems available.

Biomethanation Systems -- review of the commercial proposal for treatment of industrial wastes, with biogas as a useful by-product, by a disinterested outside expert should be seriously considered. Future community biomethanation systems should be undertaken only with assurance of public understanding and willingness of villagers to participate.

Solar Thermal Processer -- pending changes in energy-pricing and environmental policies, RTG should encourage the use of solar crop dryers only for industries where they are currently commercially viable. Without stricter, and enforced, government standard on the quality of dried foods, interest in this process and possible export market are not likely to expand. For tobacco curing, it could assist by encouraging research in reducing the cost of systems that displace fuel wood or lignite.

Biomass Gassification -- RTG should consider continuing support for research on some gasification technologies, and on improving the thermal efficiency of rice-husk gasification. The Government could help accelerate private initiatives in this field by relaxing its rules against purchasing electricity generated by the private sector.

Pyrolysis of Rice Husks -- continued support of pyrolysis projects aimed at commercialization is not recommended.

The one area in which the RNEP falls short of original expectations is in the area of training. The longer term utility of the Energy Master Plan depends on the informed responsiveness with which it is adjusted to changing conditions and data. Toward this purpose two types of training were included under this activity: (1) long-term academic training in selected energy problems of relevance to Thailand and (2) seminars, workshops, and special courses directed to energy policy, planning and management needs. Unfortunately, there was no long-term academic training during the project life at all. The disbursements for seminars, workshops, short-term training and observational tour in the United States and the third world countries were only U.S. \$ 98,880 or 10.5% of the original financial plan in the project paper (U.S. \$ 940,500).

Some failures were due to bureaucracy and red-tape, others were regulations, language proficiency tests, etc. strictly required by the cooperating agency - the Department of Technical and Economic Cooperation (DTEC). Fortunately, DTEC delegated its authority to the implementing agencies of each component to procure scientific equipment themselves with tax clearance by DTEC. Exceptionally, DTEC agreed that those implementing agencies directly advance/disburse/reimburse grant funds from USAID. Though by all means, it increased USAID Finance Office's workload, the rewards were worthwhile.

There were 14 components under this Project involving 9 agencies. The extension of the PACD of this Project was for only 4 months for completion of two components (Pyrolysis of Rice Husk and Biomass Gasification), training, commodity procurement, printing of accomplishment reports, and a final workshop. The reports, totaling 19 volumes, have been distributed to renewable energy concerned agencies all over the world.

One major accomplishment of the Project was the extensive utilization of available local experts from various universities, institutions, and retired RTG officials. Over 30 Thai experts were recruited.

The above are perhaps lessons to be learned from the RNE Project. The inputs to the Project were essentially equipment and technical assistance. The outputs were manifested by reducing imported energy resources, arresting environmental degradation due to deforestation, increasing energy efficiencies and creating increased income opportunities in rural areas. At the end of the Project, RTG institutional capacity to perform and sustain energy policy planning had been developed and various types of renewable energy technologies had been introduced, tested, and disseminated to some extent. However, the continuity and further development of the renewable nonconventional energy activities will primarily depend on conventional energy (oil prices) and commercial viability. The Project was initiated during the rise of oil prices while it ended during the fall of the price. While the decrease in oil prices has benefited the whole, this has slowed down the further active development and replication of the activities. Consequently, for the time being, several RTG renewable energy activities (wood-fired power plants, cooking stoves and charcoal kilns), to be financed by EEC or IBRD, have been shelved. Furthermore, whether or not the Government is going to relax rules against the power producer (the Electricity Generating Authority of Thailand) regarding purchases of electricity generated by the private sector will determine the extent Thailand can promote and accelerate private initiatives in bioenergy systems and technology field.

Nevertheless, the project has demonstrated which technologies should be integrated (woodlots, charcoal and cooking stoves), be continued (cooking stoves) or not be continued for the time being (pyrolysis of rice husks).

On the whole, the Renewable Nonconventional Energy Project has been highly successful in the meeting its original objectives.

- This Project has played a very important role in alerting the National Energy Administration (NEA) and other branches of the Royal Thai Government (RTG) to the importance of and possibilities for utilizing various renewable, nonconventional energy resources. It has forced individuals within the RTG to understand and recognize these less well known energy resources and the part each can play in helping to solve both present and future energy problems confronting Thailand.
- This Project is unique in its successful attempt to link together the various activities related to supply and demand of energy so as to optimize the use of all energy resources.
- This Project has developed, and proven the viability of, several technologies and systems which can make significant reductions in both the important petroleum and the decimation of the forests in Thailand.
- An important by-product of this Project is the development of indigenous expertise among the component leaders, their associated staff, and their technical assistants which can be expanded and drawn upon in the future for solving energy problems.

The information generated from this Project can serve as a basis and a tool for broader community development programs and projects throughout Thailand.

Therefore, we conclude that this Project has been successfully completed. No further monitoring or evaluation needs have been identified. While AID can be proud of the role it played in developing and implementing this Project, it is now up to the Thai Government and the Thai people to successfully apply the knowledge gained from this Project.

The following is a financial summary of the Project:

	<u>\$,000</u>
AID Grant	4,375.5
UNDP	710 *
ADB	300 *
RTG Budget	<u>3,150</u>
Total	8,535.5

* The UNDP and ADB contributions are for Energy Master Plan Study.



U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
USAID THAILAND

CABLE: USAID THAILAND

Telex: 87058 RPS TH

Telephone: 252-8191

USAID/THAILAND
Box 47
APO San Francisco 96346-0001

International Address:
USAID/Thailand
37 Soi Petchburi 15 (Somprasong 3)
Bangkok 10400 Thailand.

ACTION MEMORANDUM FOR THE ACTING MISSION DIRECTOR

DATE: June 17, 1988

THRU: PDS, Mr. Willy D. Baum, Director *WDB*
A/DD, Mr. Douglas J. Clark *DJC*

FROM: PDS/ENG, Mintara Silawatshananai, Chief Engineer

SUBJECT: Renewable Nonconventional Energy Project (RNEP) Completion Report

Background:

The Renewable Nonconventional Energy Project (AID Project No. 493-0324) was completed on October 31, 1984. AID Handbook 3, requires the preparation of a "Project Assistance Completion Report".

Discussion:

The attached Project Assistance Completion Report follows the guidance for preparing such reports as contained in Handbook 3, Chapter 12 Appendix 14A. It includes among other things, a brief review of project accomplishments, a statement of lessons learned in implementing the project, and a summary of donor contributions.

Recommendation:

That you signify your acceptance of this completion report by signing below.

Accepted: *[Signature]*

Rejected: _____

Date: 6-17-88

PDS/ENG:Mintara:sc:6/17/88

Clearance:PDS:Baum:dft:6/14/88
PRO:Willis:dft:6/14/88
FIN:Hammer:ley:dft:6/15/88