

AN EVALUATION OF THE SMALL  
DECENTRALIZED HYDROPOWER PROJECT  
PROJECT NO. 936-5715

PRESENTED TO  
USAID ENERGY OFFICE

By

John J. Cassidy  
Wayne A. Fernelius  
Robert L. Kinsel  
Francis R. Campbell

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## I. Introduction and Summary

The evaluation team was assembled by AID to review NRECA performance in the Cooperative Agreement signed May 1, 1980. The program, which had been in effect for nearly two years at the time this evaluation started, specifically called for NRECA to strengthen its technical capabilities and skills related to the development of hydropower projects, generally of one megawatt or less, with special attention to facilities of 1 to 100 kilowatts. The intent was to make available to AID missions and developing country governments hydropower specialists, energy economists, engineers and social scientists for project identification, site selection, resource surveys, project design, demand forecasts, investment and operating cost estimates, and analysis of economic, social and technical factors relevant to small hydropower systems. The full text of the Statement of Work provided to the evaluation team is included as Appendix I to this report. Sections of the report involving conclusions, discussion and recommendations have been organized in accordance with the Problems and Issues to be Addressed by the Team as enumerated in the Statement of Work.

The team first met on April 6, 1982 at the NRECA offices. William Eilers presented the scope of work and presentations were made by Samuel Bunker, Administrator, International Programs Division; Dr. David Zoellner, Program Manager; Paul Clark, Training and Information Specialist; Bard Jackson, Principal Engineer; Allen Inversin, Micro-Hydro Engineer.; and Elizabeth Graham, Assistant Training and Information Specialist. A list of the NRECA material given to the Evaluation Team is included as Appendix 2 of this report.

After the April 6 meeting, the evaluation team adjourned to study the material presented by NRECA. The team reconvened on May 3-5, 1982 in AID offices in Rosslyn. During May 3 the following AID staff presented their individual observations relative to NRECA's program:

- o Mark Ward, Africa Bureau, AID
- o Carolyn Coleman, Near East Bureau, AID
- o Tom Robinson, Latin America and Caribbean Bureau, AID
- o Tom O'Keefe, Bureau for Science and Technology, AID
- o Stephen Klein, Policy Planning, AID
- o Jack Fritz, National Academy of Science (formerly Energy Office, AID)

An informal discussion was held with Allen Jacobs, Director, Office of Energy, AID. Dr. David Zoellner came to the AID office in the afternoon of May 3 to answer specific questions from the team.

This report contains the team's evaluation and also describes the interviews and other material on which the evaluation is based. Conclusions were formed and are enumerated in Section VIII. Specific recommendations, based on those conclusions are set forth in Section IX.

## II. Summary

In general, the evaluation team felt that NRECA had made significant accomplishments and that the overall thrust of their program has been good. Their staff is enthusiastic

and articulate but lacks expertise and actual experience in the design of hydropower systems and in economic analysis and social evaluation; the cooperative agreement expressly requires NRECA to strengthen its expertise. We strongly recommend that the program be continued under the management of NRECA with at least the initial rate of funding. Specific recommendations for changes and improvements are set forth in Section IX.

### III. Purpose and Methodology of Evaluation

The original project design called for an independent evaluation after 18-24 months of project activity which would focus on the quality of the survey arrangements to assure they were carried out in accordance with the goals of the program; reports were to be examined and USAID field missions contacted.

The project was approved in August 1979, and a Cooperative Agreement with the National Rural Electric Cooperative Association (NRECA) signed on May 1, 1980. The current evaluation is, therefore, in timely accord with the original Project Paper.

The evaluation task, as described in the Statement of Work, was to see "how well the project is meeting its stated purpose and is thereby assisting developing countries in efforts to identify and develop decentralized waterpower resources as alternatives to imported fossil fuels, contribute to a meaningful increase in indigenous energy supplies, and extend electric power to rural areas." The following section on Problems and Issues conforms to the Problems and Issues as identified in the work statement.

The evaluation was carried out by a four-person team consisting of John J. Cassidy, Chief Hydrologic Engineer, Bechtel Civil and Minerals, San Francisco; Wayne A. Fernelius, Civil Engineer, Planning Policy Staff, Bureau of Reclamation, Washington, D.C.; Robert L. Kinsel, Mechanical Engineer, U.S. Army Corps of Engineers, Washington, D.C.; and Francis R. Campbell, Chief, Analysis and Evaluation Division, Office of Program in AID's Science and Technology Bureau. The team assembled in Washington, D.C. on April 6 to review the evaluation scope-of-work, hear presentations by NRECA staff, and to begin to go over program documents and descriptive materials. The team reassembled in Washington, D.C., May 3-5 to review the material with staff from AID Regional Bureaus and planning organizations, with the NRECA Project Director, and to discuss the material among themselves.

### IV. Problems and Issues

#### I. Appropriateness of Project Activities to the Project Purpose

NRECA project activities were determined to be generally good and meeting a definite developing country need. The NRECA thrust has been a catalyst promoting development of small hydroelectric programs less than 1 MW in size. For projects with larger potential, however, NRECA should offer advice on obtaining assistance from experienced U.S. agencies and private firms. Because of its established contacts, NRECA will be in an excellent position to provide such advice.

The workshops on small hydro have been appropriate since they provide a valuable information service and assist in technology transfer. Because small hydro utilizes a renewable and often overlooked resource, the program is both timely and appropriate. The fact that NRECA has received many requests for technical assistance from AID

missions is adequate proof that the program is meeting a need. Almost unanimous favorable ratings from workshop participants and AID missions indicates that there is a demand for NRECA's efforts.

## 2. Effectiveness of Technical Assistance

A review of program documents and discussions with NRECA and AID personnel indicates that the program has been valuable and has provided needed assistance to the developing countries. However, the technical assistance has not always been effective and at least one economic analysis demonstrates a lack of experience. Reports have not always included information and data necessary to make a determination as to the need for small hydroelectric projects. Technical assistance reports for site identification and prefeasibility lack adequate project definition and conceptual design. Realistic and accurate cost estimates cannot be prepared without a conceptual design including an estimate of construction quantities and a list of major equipment items required. When comparing the NRECA project reports with others, such as those from the United Nations, skilled and experienced evaluation techniques are noticeably lacking in the NRECA reports. However, more recent NRECA reports have shown improvement in technical capability but still lack necessary details of the sites.

This deficiency appears to be a lack of technical guidance from NRECA. A well-prepared guide to site identification and prefeasibility studies would aid the team.

## 3. Performance of NRECA Team

NRECA has performed very well in adhering to the Scope of Work, has acted promptly in assembling teams, and in general, reports have been furnished on time.

The teams have not always been outfitted with the necessary equipment for a field investigation. Also, to conduct a site-selection or prefeasibility study, it is imperative that the team include an experienced hydro engineer and a person with experience in economic analysis. Other specialities should be included as needed.

The Bangladesh report is an example of a good report except in the economic analysis of the project. NRECA should have recognized that very low-head projects (less than 15-20 feet) are very difficult to justify economically. The high benefit-cost ratio should have been questioned by NRECA.

The lack of technical education and experience in hydropower on the NRECA staff is the "weak link" which limits their ability to produce a higher quality product. This lack of expertise also limits their ability to judge the capability of consultants assisting in the program.

## 4. Effectiveness of Workshops

The overall effectiveness of these workshops cannot be judged at this time since their main purpose is to "promote use of small hydro power in the LDC's". Development of small hydro may occur several years after the workshop. Despite the lack of a measure of the current effectiveness of the workshops, we believe they are a very useful method of promoting interest in the development of hydropower. Responses indicate that some participants later assumed greater responsibility for hydro development in their own countries.

NRECA is to be commended on the quality of workshops since it is recognized that a tremendous amount of work is required for success.

Allis-Chalmers Corporation has indicated a desire to participate in workshops and we believe other U.S. manufacturers and consulting firms should be invited to participate. Announcements of workshops should be publicized in magazines such as "Hydro-Power" and "Hydro-Wire."

NRECA should make an attempt to develop a program for LDC managers and policymakers. Without their support it is difficult to implement programs like SDH.

#### 5. Development of Resource Materials

NRECA has prepared several documents on the methodology of specific assessments (hydrology, prefeasibility studies, environmental, and country assessments).

The methodologies are weak in some areas. The documents on the environmental issues and prefeasibility studies are lacking in specific guides as how to proceed with needed studies and do not show examples of experience with similar issues in other river basins. The documents need to show the primary issues that may be expected in a less developed country and what steps need to be taken to evaluate those specific issues. Also, steps need to be included to resolve or mitigate those issues.

The environmental methodology document extensively discussed issues relative to reservoirs, yet mini-hydropower would probably involve insignificant reservoirs or very likely no reservoir at all. The fishery aspect may be one of the most important environmental issues when a barrage of almost any size is utilized, but the fishery discussion is very weak in the document.

The prefeasibility document needs more of a step by step procedure on how to conduct a prefeasibility study. A broad approach needs to be taken in the prefeasibility methodology document. A good example of a methodology document on prefeasibility except for being site-specific, would be the "Site Selection Methodology for Small Hydroelectric Power Plants for the Dominican Republic."

#### 6. Magnitude of Sites

The maximum size of hydroelectric powerplants to be evaluated by NRECA should be limited to the 1 MW-and-under size range. Considerable talent and potential support is available from governmental agencies and the private sector to investigate and develop the larger hydro sites. A definite need is evident for an evaluation of sites under 1 MW and continuation of a specialized program such as the NRECA program appears to be the most logical approach.

NRECA consideration of sites with potential greater than 1 MW should be limited to general country-wide assessments to ensure a comprehensive assessment and development of the most economical size powerplant.

#### 7. Training

The review team believes that training should be one of the more important objectives of NRECA. Intensive courses should be developed which are oriented toward the practical side of small hydropower development.

NRECA has developed a proposal for intensive training of LDC engineers at an American university. The proposal is reasonable and the program would be appropriate. However, training should combine a program of possibly two weeks in the United States at a university with hydropower laboratory training facilities with additional time in a foreign country with an on-going hydropower program, such as in Pakistan. Smaller, more specific training could be held in each host country or at a facility located close to a group of host countries in order to reach as many interested people as possible.

## 8. Funding

The review team believes that the existing budget has been and is adequate to perform the work required or intended by the Cooperative Agreement. Past performance indicates sufficient funds were available for satisfactory accomplishment of the work. Future funding, as proposed by AID, appears adequate to proceed with the program but would need to be increased to provide for intensive training. Additional funding may be worthwhile to continue or possibly expand the workshops since it is believed that the workshops are the most valuable method of providing for SDH technology transfer.

AID should encourage host countries to assist in funding the SDH program through use of local currencies or counterpart funds available through AID missions.

## 9. General

Table I shows the comparative elements of the Project Paper (PP), the Cooperative Agreement, and what has been accomplished to date by NRECA. The lack of performance measures (or, in AID design terms, "quantifiable indicators") would normally make a judgment of success somewhat difficult -- as indeed it does in this case since the Project Purpose was not established to facilitate measurement. On the other hand, the Cooperative Agreement cites a slightly different project purpose than the PP, and, although again lacking quantifiable indicators, NRECA has produced significant progress in the relatively short time span of two years. Perhaps it has concentrated too much on quantity, as team evaluations of quality might indicate. Established, reasonable and measurable standards of performance and output would help NRECA balance quantity and quality.

TABLE 1  
ANALYSIS OF OBJECTIVES VIS-A-VIS CURRENT STATUS

PROJECT PAPER	COOPERATIVE AGREEMENT	CURRENT STATUS
<p>Project Purpose: To develop a methodology for implementation of SDH systems to provide electrical power in rural areas.</p>	<p>Purpose: To strengthen the technical capacity of NRECA in the identification, design and implementation of small-scale, decentralized hydroelectric power projects, generally of 1 MW or less. Special attention to be given to units of 1-100 kW. Funding for capital costs are not authorized.</p>	N/A
<p>Status at End of Project (no numbers specified)</p> <ul style="list-style-type: none"> <li>-Trained host country nationals in SDH</li> <li>-Purchase of U.S. components or existence of local industry manufacture</li> <li>-Influenced development as a result of inexpensive electricity</li> </ul>	<p>No equivalent category in Cooperative Agreement</p>	<p><u>NRECA Accomplishments to Date</u></p> <ol style="list-style-type: none"> <li>1. <u>Assistance to USAID &amp; LDCs</u> 8 country assessments completed; 11 additional are anticipated.</li> <li>2. <u>Project Identification</u> At least 3 country specific projects have been recommended.</li> <li>3. <u>Site Selection and Project Design</u> 6 countries (Morocco, Thailand, Zaire, Rwanda, Dominica, Liberia) have had, or are in the process of having, specific projects designed.</li> <li>4. <u>Development of SDH Data Base</u> NRECA has:               <ol style="list-style-type: none"> <li>a. published a directory of equipment manufacturers.</li> <li>b. published one case study (Pakistan) and is working on one for Nepal.</li> <li>c. published 4 methodology studies.</li> <li>d. published 3 special studies on management, site evaluation and economic planning.</li> </ol> </li> <li>5. <u>Training</u> <ol style="list-style-type: none"> <li>a. developed a proposal for a 6-week multi-disciplinary program to take place at a U.S. university.</li> <li>b. conducted three regional workshops.</li> </ol> </li> </ol>
<p>Output (no numbers specified)</p> <ol style="list-style-type: none"> <li>1. Training of host country nationals in SDH</li> <li>2. Operative units in the field</li> <li>3. Technology transfer information</li> <li>4. U.S. capability in SDH development for LDCs</li> </ol>	<p><u>Specific Activities</u></p> <ol style="list-style-type: none"> <li>1. Administration and sub-contracting for assistance to USAIDs and LDCs</li> <li>2. Project identification (in collaboration with USAID and LDCs)</li> <li>3. Site selection and project design - at least one site in each geographic region</li> <li>4. Development of SDH data base-survey of existing SDH facilities to determine state-of-the-art. Assemble data base. Prepare manuals, bulletin (no numbers specified)</li> <li>5. Training - training for graduate engineers at university centers and at government institutes; both academic and "hands-on" training will be considered.</li> </ol>	

## V. Presentations by NRECA Staff

This section presents a summary of presentations by NRECA staff on April 6, 1982 and of further discussions with Dr. David Zoellner on May 3, 1982.

April 6, 1982

Mr. Samuel Bunker, Administrator, International Programs Division, gave a brief introduction to the National Rural Electric Cooperative Association (NRECA). He pointed out that NRECA has a long history of providing services to the U.S. cooperatives. The International Programs Division has worked with AID for 20 years in helping to promote, establish and train personnel for cooperatives in 40 developing countries. It was because of this long history that AID elected to enter into a cooperative agreement with NRECA to carry out the SDH program.

Paul Clark, Training and Information Specialist, presented a brief summary of the material given to the evaluation team for review. The complete list is included as Appendix 2 of this report.

David Zoellner, Program Manager, presented a brief summary of the SDH program as conducted by NRECA. Under the cooperative agreement, NRECA was not to provide capital funding for projects, but was to:

1. Provide project management services
2. Provide project identification services as requested by AID missions
3. Conduct prefeasibility studies as requested by AID missions
4. Provide site selection for feasibility systems
5. Develop a data base and state-of-the-art report including an evaluation of equipment manufacturers
6. Develop methodologies for use in assessment and design.

To date NRECA has developed a "talent bank" of resumes for 100 people who have a particular expertise experience in small hydro. It has sent Technical Assistance teams to 12 developing nations at least half of which are going ahead with SDH programs. NRECA has conducted workshops in Quito, Bangkok, and Abidjan which have presented a mix of theory and practice. Participants in workshops have come from many countries in the general regions. Because it feels that more intensive training is needed, NRECA has developed a proposal for an intensive training program which would be held at the University of Minnesota's St. Anthony Falls Hydraulic Laboratory. The University of Minnesota was chosen because of their large hydraulics laboratory, equipment for turbine testing, and proximity to an operating hydro plant.

NRECA staff members have been active in preparing papers on small hydro, participating in conferences on hydropower, and in developing source books and methodologies.

Allen Inversin, Micro-Hydro Engineer, presented some of the 2000 slides NRECA has collected which illustrate actual small hydro plants in various areas of the world.

Bard Jackson, Principal Engineer, described the activities of 12 Technical Assistance teams which have been sent to developing countries at the request of AID missions.

Elizabeth Graham, Assistant Training and Information Specialist, described the proposed intensive training program, which if funded by AID, would be conducted at the University of Minnesota by university faculty, NRECA staff, and outside specialists.

In a question and answer session the evaluation team learned that NRECA has received many requests for service from AID missions. The requests have been sporadic and initially were very general. Later requests have been more specific. Experience has shown that design of the technical assistance program proceeds best when a NRECA staff member visits the mission after a preliminary exchange of questions and answers. During that visit a program is developed for the Technical Assistance activity through joint efforts of host-country nationals, AID, and NRECA. Activities have varied from country-wide assessments for hydro potential to technical review of projects which are already under construction. The technical assistance team is briefed on the country before they leave Washington, D.C. A draft report is prepared and left with the mission when the team leaves. Missions are asked to share in funding by paying for internal travel whenever possible.

Considerable time must be spent by NRECA on follow-through to requests. Sometimes the request is for specific information which can best be furnished by a manufacturer. In those cases NRECA recommends a source. Oftentimes the request is for a higher technology than the SDH program needs.

The level of expertise in developing countries varies greatly. NRECA has attempted to formulate the workshops to train trainers who will transfer technology once they return to their country.

Participants in the workshops are usually recommended by the missions and NRECA accepts those recommendations.

NRECA would like to expand their charge to consider plants greater than 1 MW because they find it inconvenient not to consider larger plants in country assessments and prefeasibility studies. Capital funding for the larger projects may also be more in line with interests of the international funding agencies.

Projects are under way in Panama and in Peru. It will be 2 to 2 1/2 years before a project in Peru is on line.

Limited data is a real problem in most developing countries. NRECA has attempted to consider this in selecting teams by trying to choose team members accustomed to working in developing countries.

NRECA has a good background in the management of power systems. This expertise will be used as is possible, but current efforts in technical assistance have not included operation and maintenance emphasis.

Samuel Bunker feels strongly that practical training is best done in the host country.

NRECA technical assistance teams have encountered hydro projects that have failed in Dominica and Rwanda. They have attempted to find out why those projects have failed. It is difficult to identify potential load but Technical Assistance teams always attempt to do so.

On May 3, 1982, Dr. David Zoellner was asked to meet with the evaluation team to answer any questions. This section is a summary of Dr. Zoellner's comments.

### 1. Developing Country Experience

One reason NRECA was selected by AID was its long experience in rural electrification projects with AID. Its member systems' resources were available for SDH in training, management, and technical assistance. Therefore, NRECA could apply its expertise in managing the program and building up its experience in SDH in LDCs.

So far there hasn't been much opportunity for NRECA to utilize its expertise in management systems and productive end-use planning and they have been hesitant to push on this. Therefore, NRECA's real strength has not had an opportunity to come into full play on the project. However, NRECA is beginning to integrate site-specific expertise with management experience.

### 2. Personnel Requirements

NRECA recognizes staff need for a person with strong civil engineering background in SDH, e.g. on site design. They are weak in this area now. There is a problem in recruiting good people with uncertain future funding. The same holds true for recruiting a hydrologist.

NRECA wants to replace Dan Boyle with a civil engineer and would like to hire someone who could combine knowledge of agricultural engineering with hydrologic experience. The NRECA talent bank is good and continuing to grow. Alan Jacobs feels NRECA staff should all be engineers who can serve on teams, not be simply managers. NRECA feels the primary task of NRECA is management of experts teams. NRECA doesn't want to try competing with engineering firms by placing highly paid technical experts on staff.

### 3. Micro-Hydro Projects

NRECA should look at the potential of larger, (i.e. more than 1 MW installations) because many host countries feel that sites of 5 to 7 MW are more important with some grid-connected and some off-grid. The problem of national energy supplies competes with small, isolated systems. Can SDH possibly displace kerosene and diesel consumption in rural locations? Small systems can feed the grid and some larger systems may not be grid connected. Because of AID constraints, NRECA has not looked at many promising sites. What is a good break-point? The answer may be to consider what the state utility or country itself feels is important.

### 4. Additional Methodologies

NRECA feels they need a good economic methodology geared to the unique nature of the work NRECA is doing in SDH. The methodology on centralized vs. decentralized management of small hydro needs to be revised and expanded.

Review of methodology reports is sought from AID staff and outside groups. Tudor Engineering did a review of the country assessments and prefeasibility studies methodologies. NRECA plans to update and review the methodologies on an annual basis. NRECA is not satisfied with the present economics and management methodologies.

## 5. Budget for NRECA

With an increased budget, NRECA would not necessarily serve more countries, but would be in a position to provide more in-depth assistance, requesting co-funding by missions wherever possible. NRECA would like to explore other sources of funding, e.g. from AID missions or other donors such as multinational donor agencies. For example, NRECA could respond to RFP's in Business Commerce Daily.

## 6. Expanded Sources of Talent

NRECA has not sought technical help from other agencies but is using two TVA senior staff members on the SDH team going to Sudan this week. NRECA feels strongly it should stay with site development projects to their completion instead of being limited to preliminary stages and paper production.

## 7. Relationship with Host Country Counterparts

NRECA attempts to use counterpart organizations in host countries to aid in conducting site assessments whenever possible. Local people know sources of data and have valuable knowledge on subjects such as sources of water.

## 8. Costing SDH Projects

Cost per kilowatt of constructed small hydro plants is difficult to generalize since the situation varies so much from site to site and from country to country. Evaluation teams have found ranges from \$1,000/kW, which is very low, to \$3,000-\$4,000/kW, including civil works costs which can vary considerably according to amount of local voluntary labor. The challenge is to develop power plants which offer an acceptable balance between cost and system reliability.

## 9. Issue of Minimum Head

Heads less than 12 feet are generally not considered feasible. Even 20 feet is small and results in large equipment and high cost.

## 10. Planning Workshops

Dr. Zoellner explained that AID regional bureaus and missions decided to try workshops in their regions based on the success of the initial Quito workshop. The second and third workshops evolved from demand.

## 11. NRECA Talent List

Member systems, staff recommendations, and requests at annual and regional meetings of NRECA have been used to identify talent. Letters have been sent to potential sources and AID has referred people to NRECA. NRECA has not advertised in trade journals. Skills sought have included technical, language competence, LDC experience, AID background. Shortages in talent exist for end-use planners, management experts, and energy economists. NRECA's International Programs Division has a talent bank which can be tapped for SDH.

## VI. Interviews with AID Staff

The following interviews were conducted on May 3 in AID offices in Rosslyn:

### 1. Mark Ward, Africa Bureau

Mr. Ward felt that in general the NRECA SDH Program was effective and well received. More emphasis should be placed on training and social services. It may be well to expand efforts to plants larger than 1 MW because larger plants presumably produce jobs and income. Workshops should concentrate on proven technology.

### 2. Carolyn Coleman, Near East Bureau

The experience with the NRECA team in Morocco had been good. Some criticism of this team's activities had been received. A change in scope of work caused some problems. However, the team's recommendations were being followed and the program was going ahead. She felt that the Florida training program was not emphasizing hydro nearly enough. Further intensive training is needed. The Near East subsidizes fossil fuels so highly that hydro developments have an artificially high cost. A definite emphasis should be directed toward decision-makers in the developing countries to establish SDH programs with national support.

### 3. Tom Robinson, Latin American and Caribbean Bureau, and Tom O'Keefe, Bureau for Science and Technology

Community-sized micro hydro projects need to be able to pay at least operation and maintenance expenses or the project will fail. Dominica has had physical problems with landslides and floods damaging plants. Although power for light bulbs is certainly desirable, each project should also provide enough power for some light cottage industry in order to generate some economic growth. A small project can be a real savior to an economically stressed region. An education program is needed in the regions to help the people and the country leadership develop some understanding of how much they can accomplish with a given amount of power. Community involvement is very important. AID has been in the business of helping the poor and it is vital to sell a developing country on the importance of carrying out a SDH program for potential improvement of regional economies.

### 4. Steve Klein, Policy Planning

Mr. Klein felt that the upper level of size of hydro plants to be considered was very important. Small hydro is a very much overlooked resource. He felt that NRECA had clearly been asked to develop an expertise in economic analysis and social science but had not done so yet and this expertise is very important in project analysis. The end use of the power is very important. The availability of electricity in a community will not necessarily, in itself, lead to economic developments. The economic benefits to the community must be considered before developing the hydropower resource.

### 5. Jack Fritz, National Academy of Science, Formerly with AID Energy Office

Mr. Fritz had been AID's manager for the SDH program with NRECA. He felt that in general NRECA had done a commendable job but that improvements were needed. The workshops have been the best efforts probably because the target countries have had a hand in determining the programs. The Methodology reports need definite improvement. The one on hydrology and the one on Social Evaluation are reasonably

good but the others are much too general for the practical use intended. He felt that the country assessments have also been of variable quality with the ones for Peru, Togo and Dominica being reasonably good. He felt that NRECA has spent more than enough funds posturing themselves to operate alone, but such was specified in the scope of the cooperative agreement. The lack of experience in hydro design, planning and assessment has hurt NRECA efforts. He would recommend more emphasis on developing Methodology reports and more peer review of the completed reports. He recommended that NRECA possibly cooperate with an engineering company to provide the needed technical expertise.

## VII. Evaluations from AID Missions and U.S. Workshop Participants

### 1. AID Mission Evaluations of NRECA Technical Assistance Teams

Cables with detailed questions were sent to eleven A.I.D. Missions which used NRECA technical assistance during the initial two years of the cooperative agreement and substantial responses were received from nine countries.

In nearly all countries, Missions and host countries governments felt the teams had been carefully selected and were well qualified, fulfilled the scope of work and that the NRECA studies were professional and well-received. Most felt the teams were responsive to Mission guidance and provided useful advice in developing small waterpower capabilities. It was felt that teams were sensitive to LDC development realities. A number of Missions stated they intended to make further use of NRECA.

Some Missions indicated that lack of language competence and specific experience in developing countries made team contributions less effective. Zaire reported NRECA contract personnel, while qualified in their disciplines, lacked specific experience for the assignment. The A.I.D. Mission in Morocco objected to the performance of a contract team member on grounds of poor preparation, no language competence, lack of necessary field equipment, and failure to provide a draft report before the team departed. The Mission said the report was submitted five months after the team left. The Bangladesh Mission felt the two-week period for the team in country was too short and complained the team did not provide satisfactory economic cost-benefit analysis. The Mission said its recalculations of benefit/cost ratios produced by the team had resulted in substantially reducing these ratios.

### 2. AID Mission Evaluations of Regional Workshops

Missions were requested by cable to assess the value of the workshops organized by NRECA in Latin America, Asia and West Africa. They were also asked to query host country hydropower specialists from their countries who participated. Cable replies were received from 22 Missions.

#### Quito, August 1980

The reaction was generally very positive. Participants said the workshop experience was directly applicable to work in rural areas, was conducted on a high technical level and, in some cases, resulted in initiation of new projects. Some participants said the workshop helped to advance their careers, helped establish continuing contacts with professionals in other countries and helped to advance their understanding of the potential of small hydropower for their country. Individual technical papers were well regarded and published workshop proceedings have proved very useful in providing data for future use.

Some who attended felt there was too much emphasis upon training, research and studies, with too little focus upon project implementation to utilize the skills developed. Some said a field trip should have been incorporated. One felt the presentations tended to be "romantic" and therefore less useful to technically-oriented participants. Another suggested the workshop should have included consideration of medium-sized hydropower and utilization of water for other purposes such as irrigation.

### Bangkok, June 1981

Missions and participants agreed the meeting afforded a valuable opportunity to exchange experiences, discuss problems in small hydropower and to provide insights into the potential of small hydro. Some pointed out that the workshop provided an opportunity for direct contact with suppliers of hydropower equipment and offered a useful overview of hydropower development throughout Asia. An Indonesian noted that the meeting pointed up the complexities of designing and implementing small hydropower projects.

Some Missions felt the quality of presentations could have been better, that logistics suffered from lack of effective planning, and that discussions on the relative benefit of capital-intensive and labor-intensive methods of hydropower project development were lacking. Some indicated that important issues such as investment criteria, kilowatt-to-dollar cost comparisons and social and economic acceptance problems in rural areas should have been discussed. Others felt field visits should have been included, that copies of design data used in presentations should have been circulated, and that strategies for long-term planning and integrated rural development, including year-round power supplies, should have been covered. One Mission said there should have been more discussions of A.I.D. project-related concerns and more attention to economic and organizational considerations. One recommended improved coordination between lectures to avoid repetition. Another felt the presentations should have been at a higher technical level.

### Abidjan, March 1982

Missions and participants were overwhelmingly positive in their praise of the workshop. There was consensus that it was well planned and organized, timely, provided much useful information, afforded constructive interaction with other professionals, and had generated interest in developing small hydropower in several African countries. At least two participants reported the workshop led to assignments of greater responsibility for them. There was particular enthusiasm for the case study, which involved teams of participants visiting an actual small hydro site and preparing design recommendations for installations of varying sizes.

Among reservations expressed were that more time was needed for discussion, too much was presented in too short a time, and that there was no opportunity to talk with U.S. equipment suppliers. One participant felt more time was needed for site visits and that the workshop was too short, one had wanted more background on construction methods and costing, and another colleague felt the workshop was not an appropriate venue to emphasize equipment.

### 3. Assessment of Workshops by U.S. Panel Members

Letters were sent to a number of U.S. specialists who participated in one or more workshops as members of panels or speakers presenting papers. Five replies were received, including Norman Crawford, President of Hydrocomp; Ray E. Holland, Industrial Adviser, Intermediate Technology Industrial Services; D. L. Miller, Area Manager for Asia, Allis-Chalmers; Mark Henwood, President, Henwood Associates; and Richard T. Fera, Director, VITA Operations in Latin America, Caribbean, Asia and the Pacific.

All agreed that the planning, organization and facilities were excellent and that NRECA did a superior job of organizing and executing the workshops. The quality of the

proceedings published for the Quito workshop was given high marks. It was felt that developing country participation was very good, including participants active in planning, building and operating small hydro sites. Resource persons invited were assessed as excellent to outstanding. It was felt that workshops fulfilled the need for promoting cooperation and communication between decision-makers and engineers from countries of the region. There was much interest in U.S. technology. Small working groups were thought effective in covering subject areas of specific interest.

The resource specialists felt that future workshops should devote less time to social and political problems and more to planning, financial and engineering topics. Greater attention should be given to the details of how to build projects and avoid pitfalls, requiring careful selection of resource persons. One specialist felt the Bangkok workshop "lacked depth in technical resource persons despite the presence of some outstanding specialists." Others felt there should be more participation by resource persons and speakers from developing countries. Another felt there should be better representation of U.S. technology, including those who were more representative of U.S. consulting engineer firms and the hydropower machinery industry. One noted that copies of papers were not available prior to or during the conference. There was a recommendation that copies of NRECA small hydro studies should be distributed at the workshops and that NRECA's resources be described in order that countries could make use of them. It was suggested that it might be more effective to allocate funds for pilot projects that would serve as working examples of small hydro projects for future development.

## VIII. Conclusions

The following conclusions were developed after having considered the material presented to the evaluation committee, the presentations by NRECA/SDH staff, discussions with AID staff, and a period of questioning with Dr. David Zoellner, Program Manager for SDH. In forming the conclusions the committee attempted to consider the Objectives of the Evaluation as prepared by William Eilers, the Energy Assistance Policy of AID, and the scope and objectives of the cooperative agreement between AID and NRECA.

The list of conclusions follows the order in which Problems and Issues to be Addressed by the Team are presented in the Statement of Work given to the Committee.

### A. Appropriateness

1. The overall program developed by NRECA is good and is meeting a need.
2. The thrust of NRECA's program is well directed at present.
3. The workshops have been highly successful, extremely well received by missions and participants alike and have evolved from a symposium to a true workshop.
4. Some of the presentations in the workshops have been overly broad and others have been overly technical.
5. There appears to be a need for some applied research relative to SDH systems although specific areas have not been defined. NRECA could identify specific needs for research.

### B. Effectiveness of Technical Assistance

1. Responses of AID missions and evaluations submitted by former participants give strong indication that the Technical Assistance Teams have been effective. The fact that 12 of the countries visited by NRECA teams have continuing programs may also be a real credit to the program. Some countries had already begun SDH programs and NRECA teams have furthered their efforts.
2. It is too early to evaluate effectiveness at this time; true effectiveness of the efforts may not be obvious for years.

### C. NRECA Team Performance

1. Although NRECA has assembled a list of more than 100 resumes for their SDH talent bank, it is not obvious that technical assistance teams have the necessary technical competence. It is difficult for NRECA to rank and classify experience for the talent bank with no one on the NRECA staff having had such experience.
2. Teams appear to have been assembled promptly and for the most part have handled their assignments efficiently and prepared reports in a timely manner.

3. Reports have been generally good. However, inclusion of more general information on climate, hydrology, energy utilization and site characteristics would be very desirable. Photographs of sites are also very desirable and should be included in all reports. Reports lack, to some degree, considerations that would be made by a person with experience in hydro plant design.
4. Teams have not always been outfitted with rudimentary but necessary equipment such as altimeters, tapes, clinometers, cameras, and perhaps portable velocity meters.

#### D. Effectiveness of Workshops

1. The workshops seem to have been effective in helping developing countries to form programs and in training participants.
2. Workshops have lacked adequate participation by U.S. manufacturers and consulting firms.
3. Field trips and case studies added significantly to the effectiveness of workshops.

#### E. Development of Resource Materials

1. The methodologies prepared have been the weakest part of NRECA's efforts. In general the methodology reports are so general as to be almost useless for a specific site. Notable exceptions are Hydrologic Estimates for Small Hydroelectric Projects and the special study "Evaluating Electrification Experience: A Guide to the Social Evaluation of Small Hydroelectric Units in Less Developed Countries." In particular the latter publication provides a format, pattern and case study example which is highly desirable in this type of publication.
2. The report "Environmental Methodologies for Small Hydropower Plants" is not applicable to small hydropower plants and does not provide a methodology. It lists many environmental concerns which are associated with large dams but never with small hydro plants, most of which would never involve even a small dam. It would appear that the contractor had never prepared an Environmental Impact Analysis and may very well never have seen a small hydro plant.

#### F. Magnitude of Potential Power Sites

1. Engineering and technology are well developed for sites with potential above 1 MW and source books developed by the U.S. Department of Energy and the U.S. Army Corps of Engineers cover the engineering for such sites. In addition there are U.S. agencies and private engineering firms, which are available to undertake design for these larger sites where greater investment is possible.
2. Technical material for small sites, where adaptation of local trades and materials is essential, does not exist, but can effectively be developed by NRECA for each site.

## G. Training

1. Except for the workshops developed by NRECA no other training efforts have been conducted.
2. Current funding (\$800,000/year) will not allow for additional training programs.
3. Training programs would be valuable, particularly where they can emphasize the innovative aspects of engineering for small hydro systems such as those that have been utilized in Pakistan.
4. A timely proposal for a training program has been developed by NRECA. However, a training program conducted entirely in the U.S., such as that proposed, might slight the development of lesser technology.

## H. Funding

Funding has generally been adequate but will not allow for an intensive training program.

## I. Project Design and Measures of Performance

The Project Paper (PP) is vague about the type and number of accomplishments which AID hoped to achieve under this project. The Cooperative Agreement has a slightly more detailed description of the types of activities to be undertaken, but (except for suggesting that at least one "Site Selection and Project Design" take place in each of AID's Geographic regions) it is as vague as the PP in quantifying the outputs and accomplishments.

## IX. Recommendations

### A. Staff

1. NRECA should hire a person with hydro experience to review reports, review technical methodologies, interview and recommend consultants, as well as participate on Technical Assistance teams.
2. NRECA should include staff with experience in economic analysis and social sciences.
3. The size of the NRECA staff is adequate for the current program.

### B. Workshops

1. Workshops should be continued and should include field trips and practical case studies to make them truly a workshop as opposed to a symposium.
2. Workshops should include more participation by U.S. manufacturers and consultants.

### C. Methodology Reports

1. Methodologies should be more specific in context, include examples, and a format which, when completed, will insure that all required information has been addressed.
2. Reports should be specifically devoted to practical applications for SDH plants.
3. Reports should be much more thoroughly reviewed by persons with experience and expertise in the field.
4. More care should be taken in selecting individuals or firms to prepare methodologies.

### D. Technical Assistance

1. The types of assistance provided have been good, but the thrust should now emphasize improvement in quality. Reports should include more detailed site information.
2. Team members should be outfitted with basic tools such as hand level, altimeter, tape, clinometer, camera, and perhaps a velocity meter.

### E. Size of Sites

1. NRECA should continue to emphasize their thrust toward sites less than 1 MW in size. However, country assessments and prefeasibility studies should identify larger sites when they could be part of the total potential.

## F. Budget

1. NRECA should be allowed to use alternate funds to help finance workshops or in-country travel related to SDH tasks.

## G. Incorporating Federal Assistance and Industry

1. NRECA should continue to manage the SDH program but should attempt to utilize assistance from other U.S. entities such as the USBR, U.S. Army Corps of Engineers, TVA, and private firms with proven expertise.

## H. General

1. NRECA should consider centralized as well as decentralized sites where generation of power would still meet the objectives, or benefit the target groups of AID.
2. NRECA should devote part of their program toward education of decision-makers in developing countries to gain national political and financial support for SDH programs.
3. A detailed independent evaluation of the SDH program should be made at the end of the 4th year to determine if the program is meeting its goals, what aspects of the program have been effective in developing on-going SDH programs, and whether central funding by AID should be continued.
4. NRECA should not engage in research activities but should be encouraged to make recommendations for research.
5. Acknowledgment of AID sponsorship should be included in all proceedings and reports.
6. AID should thoroughly review the SDH project design to clearly identify scope and objectives and to develop quantifiable measures of achievements.

APPENDIX I

Statement of Work Given to the Evaluation Team  
by AID

# EVALUATION OF SMALL DECENTRALIZED HYDROPOWER PROJECT

PROJECT NO. 935-5715

## STATEMENT OF WORK

### Background

Small hydropower is a well-established technology and among the most promising renewable energy technologies for developing countries. A.I.D. signed a cooperative agreement with the National Rural Electric Cooperative Association on May 1, 1980 approved a five-year, life of project cost of \$4.5 million, \$1.5 million was authorized for obligation to the project for the initial two years. A total of \$2.224 million has been funded to NRECA for continuation of the program through July 31, 1982.

The stated purpose of this program is to strengthen the technical capacity of NRECA in the skills related to the identification of hydropower projects, generally of one megawatt or less, with special attention to hydropower facilities up to 100 kilowatts. The intent was to make available to A.I.D. missions and developing country governments hydropower specialists, energy economists, engineers and social scientists for project identification, site selection, resources surveys, project design, demand forecasts, investment and operating cost estimates, and analysis of economic, social and technical factors relevant to small hydropower systems. Associated with these activities were to be workshops, case studies, and limited training. There was an agreement with the A.I.D. Regional Bureaus that responsibility for introducing and financing hydropower pilot projects, demonstrations or adaptation tests of the technology in developing countries would rest with these bureaus, the field mission and developing countries themselves.

An internal management review, which included representatives of A.I.D. four geographic bureaus, was conducted on July 31, 1981 at NRECA. The general conclusion of this review was that NRECA's activity was proving very useful. There was enthusiasm for continuation of the project. A.I.D. authorization of the project requires a mid-course evaluation to cover the initial 18-24 months of operation as a prerequisite to obligation of FY 1982 funding.

### Objective of the Evaluation

To appraise how well the project is meeting its stated purpose and is thereby assisting developing countries in efforts to identify and develop decentralized waterpower resources as alternatives to imported fossil fuels, contribute to a meaningful increase in indigenous energy supplies, and extend electric power to rural areas.

PROBLEMS AND ISSUES TO BE ADDRESSED BY THE TEAM

Problems and Issues

1. Appropriateness of project activities to the project purpose. Does the current mix of technical assistance to host countries and missions, in the form of resource assessments, pre-feasibility and feasibility studies, preparation of PIDs, detail and review of equipment specifications, workshops, preparation of methodologies and case studies constitute the optimum means of achieving the project purpose? Should additional activities such as research and training of LDC participants be considered? Which of the above elements should be reduced or eliminated.

2. Effectiveness of technical assistance. How does the quality of surveys, resource assessments, feasibility studies and other technical assistance compare with comparable studies prepared by other consultants and organizations such as UN teams and private consultant firms? If studies have not led to action by host countries or missions, it is because NRECA studies have been inadequate?

3. NRECA team performance. Have NRECA reports adhered to the scope of work, been completed in accordance with established timetables, and reviewed satisfactorily by the team with host government officials and missions? Was selection and quality of team members appropriate? Was sufficient time allowed to perform assigned tasks properly? Were report recommendations presented clearly? Were they realistic?

4. Effectiveness of Workshop. Three major regional workshops have been conducted by NRECA: Quito, Ecuador, August, 1980; Bangkok, Thailand, June, 1981; and Abidjan, Ivory Coast, March, 1982. Have these meetings been effective in advancing the project purpose? Was selection of participants appropriate? Was the subject matter covered well-suited to LDC needs? What were the most effective components of workshops, e.g. case studies involving team participation, lectures, field trips? Did workshops lead to projects in participating countries?

5. Development of Resource Materials. NRECA has prepared documents it believes are important to backstop field efforts: methodologies for national surveys, prefeasibility assessments, hydrological analyses, environmental appraisals, inventories of U.S. and LDC turbine manufacturers, data on equipment cost and performance, special studies on subjects such as finance of decentralized hydropower, and development of a state-of-the-art micro-hydropower source book for design and operation of civil works facilities, equipment selection and site layout, and system management. Are these resource materials important to further the decentralized hydropower program? Are the materials prepared of high quality? How useful have these been in supporting NRECA and LDC studies?

6. Magnitude of Sites. The initial focus of the program was to be upon installations in the 100 KW range, with a maximum not to exceed 1 MW. As the program developed, it became clear some LDCs and AID missions wished to include sites up to 10 MW or higher. S&T/EY in recent months, has indicated that

NRECA should direct its efforts more to sites that promise to significantly increase a country's total energy supply, placing less emphasis upon micro-hydro. Development of smaller, isolated sites will be costly even if they serve a population in remote villages, government outposts, small farms, and cottage industries. Is it feasible to both develop micro-hydropower and focus upon larger-scale decentralized waterpower sites?

7. Training. The cooperative agreement makes reference to training activities which may be designed and conducted by NRECA. Training in small hydropower is included as a one to two-week unit within the 15-week program of training in alternative energy technologies supported by A.I.D. at the University of Florida, Gainesville. Is more comprehensive, in-depth training needed for developing country personnel? What level of individuals need training of this kind? Should NRECA establish its own LDC training activity or use an established program, such as the intensive, one-week summer course for engineers the St. Anthony's Falls Hydraulic Laboratory at the University of Minnesota? What curriculum in decentralized waterpower will best serve LDC interests?

**APPENDIX 2**  
**Listing of Material Submitted by NRECA to the  
Evaluation Team**

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### Selected Publications:

### Country Reports

1. Zaire: A Proposed Small Hydropower and Rural Electrification Project
2. Bangladesh: An Assessment of Small Hydropower Potential
3. Dominica: An Assessment of Small Hydropower Potential
4. Liberia: Evaluation of the Yandohun Micro-hydro Project
5. Tunisia: Small Scale Hydro Potential: A Fact Finding Visit
6. Sierra Leone: Report to USAID/Freetown on Mini-hydropower
7. Morocco Trip Report
8. Small Decentralized Hydropower in Rwanda
9. Togo Small Decentralized Hydropower Study
10. Peru Project Paper
11. Site Selection Methodology for Small Hydroelectric Power Plants (Dominican Republic)
12. The Viability of an AID Financed Small Hydro Program in the Dominican Republic
13. Governor Selection for Small Scale Hydroelectric Plants in Thailand

### Methodologies

1. Hydrologic Estimates for Small Hydroelectric Projects
2. Prefeasibility Studies of Candidate Mini-Hydro Sites
3. Environmental Methodologies for Small Hydropower Projects
4. Country Assessments for Mini-Hydro Potential

### Case Studies

1. Micro-Hydropower Schemes in Pakistan

### Special Studies

1. Centralized vs. Decentralized Management of Small Hydropower
2. Evaluating Electrification Experience: A guide to the Social Evaluation of Small Hydroelectric Units in Lesser Developed Countries
3. Evaluating Electrification Experience: A guide to the Social Evaluation of Small Hydroelectric Units in Lesser Developed Countries: Appendixes

### Workshop Proceedings

1. Small Hydroelectric Powerplants: An Information Exchange on Problems, Methodologies, and Development (Quito, 1980)
2. Bangkok Workshop Papers
3. Abidjan Workshop Materials

### Directories

1. Directory of Sources of Small Hydroelectric Turbines and Packages
2. Catalogue Des Fournisseurs Des Mini-Turbines et Groupes Hydroelectriques

### APPENDIX 3

#### NRECA Summaries of Country Reports Resulting from Technical Assistance Team Activities

## Togo

In April, 1981, NRECA/SDH sent a three-man team to conduct a major, country-wide feasibility survey of small hydropower potential of Togo. The team, including a hydrologist, a small-hydro electrical engineer, and a socio-economist, selected a number of potential sites and evaluated them based on technical and economic criteria. The NRECA/SDH principal engineer assisted in on-site team coordination and field evaluation.

Tasks accomplished by the team during the survey included: a. hydrological study of drainage basins; b. identification of sites with appropriate hydrological and topographical features; and, c. comparison of sites based on potential capacity, annual energy production, proximity to grid and/or advantageous loads, social considerations, and problems in site development.

Based on the above, the team concluded that mini-hydropower will not play a major role in Togo's energy profile. Nonetheless, out of ten potential sites, two with favorable conditions were chosen for detailed prefeasibility studies including preliminary cost estimates and calculation of their internal economic rate of return. In addition to these sites, others not visible from the documents used might be worthy of further consideration and development.

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Requesting Cable	-	Lome 5579
Response Cable	-	State 042665
Team Member	-	Walter Lawrence
	-	Toby Lanou
	-	Paul Kirshen
Duration in Country	-	3 weeks
Mission Contact	-	John Lundgren
Evaluation Cable	-	
Follow-up	-	None

## Zaire

NRECA/SDH provided technical assistance to a group of individuals from the northwestern United States that raised money to install a small hydro unit in Nundu, Zaire for a church hospital. In addition, the staff located possible sources of additional funding for the project.

In March, 1981, NRECA sent two engineers to Zaire to assist the AID Mission in evaluating several proposed small hydro projects. Their assessment was aided by the SDH principal engineer who assisted in coordination and field evaluation. The engineers visited sites throughout the country, which were generally found to be feasible, and assessed the possibilities for a national small hydro program. At the end of the assignment, the team left a report with the Mission outlining options available to AID for a small hydroelectric project. The options ranged from financial assistance at selected sites to a massive, multi-donor program involving institution building, training, and introducing productive uses of electricity.

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Requesting Cable	-	Kinshasa 02263 dated March 3, 1981
Response Cable	-	State 031340
Team Members	-	Joseph Howe
	-	Song Omkar
Duration in Country	-	4 weeks
Mission Contact	-	Mr. Lee Braddock
Product	-	Project Recommendation Report
Evaluation	-	Letter of 10/7/81
Follow-up	-	Project Paper

## Rwanda

In November, 1981, a two-man team, including the SDH Program's principal engineer, travelled to Rwanda to conduct a detailed study on one micro-hydro site at Kaviri Falls and initial assessment of nine undeveloped sites. This work was performed through the AID Mission for Rwanda's Center for Energy Research.

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Requesting Cable	-	Kigali 02927
Response Cable	-	State 298664
Team Member	-	Bard Jackson - John Topik
Duration in Country	-	3 weeks
Mission Contact	-	Gene Chiavaroli
Product	-	Preliminary Engineering
Evaluation Cable	-	None
Follow-up	-	Conduct site rehabilitation

## Peru

In July, 1980, NRECA/SDH sent a team of Spanish-speaking specialists to Lima, Peru to assist the AID Mission in formulating their project paper for a program in small-scale hydropower development. The program was designed to promote rural and regional social and economic development through reasonably-priced hydro-generated electrical energy and to provide technical assistance to the mini-hydro program within the Ministry of Energy and Mines.

The NRECA/SDH team consisted of an economist, a social scientist, an engineer, and two environmental specialists. Their task was to develop the following sections of the project paper: a. project activities; b. prefeasibility methodology; c. feasibility methodology; d. economic analysis; e. institutional analysis; f. social analysis; and, g. environmental analysis. In addition, the team helped supervise preparation of feasibility studies for two mini-hydro sites that ELECTROPERU, the Peruvian national electric authority, proposed to develop.

The team worked for more than five weeks in Peru. Based on the information provided by the team, the project was approved for FY 80 funding. The project proposed to lend the Government of Peru US\$9 million to finance feasibility studies, civil works, equipment, and local distribution systems for approximately 28 small-scale hydroelectric installations in the 100 to 1,000 kW range. In addition, a grant of US\$1 million was included for institutional assistance, prefeasibility studies, and a program for productive uses of electricity.

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Requesting Cable	-	Lima 4393
Response Cable	-	
Team Members	-	Donal O'Leary - Cora Shaw - Willy Flores - Glen Cada - Frank Zadroga
Duration in Country	-	5 weeks
Product	-	Project Paper
Evaluation Cable	-	Lima 7597
Follow-up	-	

Panama

In November, 1980, the SDH Program's principal engineer traveled to Panama to review the status of two micro-hydro demonstration sites. He provided technical advice on the electrical distribution design, project schedule, and program management.

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Requesting Cable	-	N/A-Request from Lynn Sheldon to Jack Fritz
Response Cable	-	
Team Members	-	Bard Jackson
Duration in Country	-	1 week
Product	-	Trip Report - Two microhydro installations
evaluation Cable	-	None
Follow-up	-	U.S. Tour

## Thailand

The AID Mission in Bangkok requested NRECA/SDH technical assistance for prefeasibility investigations of potential small hydro sites throughout Thailand. There were 25 sites identified for consideration.

The 25 sites were characterized according to physical characteristics and potential demand structure. From this ranking, six sites were chosen for prefeasibility studies according to the following criteria: a. priority of area development; b. potential for productive uses; c. replacement of existing diesel-generating sets; d. lack of potential for grid connection; e. favorable benefit to cost ratios; and, f. potential for co-financing.

The NRECA/SDH members of the team included a small hydro engineer and an institutional advisor who manages one of NRECA's member rural electric systems. The team conducted prefeasibility studies on the six sites selected. The studies were conducted in such a manner that they could be incorporated in the Mission's project paper and be proposed for financing through AID.

NRECA/SDH also provided the services of an electro-mechanical engineer whose duties included working with engineers from the National Energy Administration and helping them select appropriate equipment. Of particular concern was the selection of appropriate governors (mechanical or electronic) and determining the potential for their manufacture in Thailand.

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Requesting Cable	-	
Response Cable	-	
Team Members	-	Jack Hicks
	-	Charles Lusk
	-	Everett Hoskings
Duration in Country	-	3 weeks
Mission Contact	-	Rod McDonald
Product	-	Governor Selection Report
Evaluation Cable	-	None
Follow-up	-	Project Paper

## Bangladesh

At the request of the AID Mission in Dacca, NRECA/SDH sent a two-man team, including a hydrologist and a small hydro engineer, to Bangladesh in October, 1981. The team assessed the potential for small hydro in Bangladesh and looked at particular applications of low-head installations during a three week stay. The team visited four areas where small, low-head hydroelectric projects are feasible and should be pursued, recommended six sites for prefeasibility studies, and conducted a prefeasibility study on one barrage.

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Requesting cable - Dacca 3924

Response cable - State 01219

Team Members - John Topik  
- Al Mercer

Duration in Country - 6 weeks

Mission Contact - Dennis Zvinakis

Product - Country Survey Report

Evaluation Cable -

Follow-up - Conduct recommended studies

Dominica

*me*

In September, 1981, at the request of the AID Mission in Barbados, the SDH Program's principal engineer travelled to Dominica to develop a scope of work for a small hydro team. The three-man team, including a small hydro engineer, a civil engineer, and an economist, evaluated the potential for small hydro development in Dominica during their three-week stay in November. The team identified several possible sites and conducted on-site prefeasibility studies to assess potential for providing decentralized rural electrification.

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- Requesting Cable - Bridgetown 5357
- Response Cable - State 276619
- Team Members
  - Walter Lawrence
  - Keith Oberg
  - Jeff Folts
- Duration in Country - 3 weeks
- Mission Contact - Alex Sundermann
- Product - Prefeasibility Analysis
- Evaluation Cable - None

## Dominican Republic

NRECA/SDH sent a team to the Dominican Republic for five weeks during June and July, 1981 to assist the USAID Mission in preparing the small hydro component of its Energy Conservation and Resources Development Project. The team consisted of a small hydro engineer, an institutional advisor, and a socio-economic analyst.

The small hydro component focused on consolidating and building existing institutional capabilities in designing, constructing, and operating small hydroelectric plants in the Dominican Republic. The team developed a country-specific methodology to set priorities and select suitable candidate sites for AID funding as demonstration projects.

The team wrote a report providing the information necessary for AID funding for a project. The report included technical, economic, financial, social, environmental, and institutional analyses of the sub-project. In addition, it contained two site-selection studies conducted by professionals from the Dominican Republic using the methodology developed by the team.

The team found that small hydro is an extremely attractive option for the Dominican Republic now for both oil displacement and new capacity additions. There are approximately 40 potential sites identified in the Dominican Republic with the possibility of many more as the Government begins to seriously consider the future role of small hydro in its overall energy picture.

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Requesting Cable	-	Santo Domingo 2651
Response Cable	-	State 132303
Team Members	-	Donal O'Leary - Cora Shaw - John Bogart
Duration in Country	-	5 weeks
Mission Contact	-	Allen Merrill
Product	-	Project Paper -- Feasibility Methodology
Evaluation Cable	-	Santo Domingo 6108
Follow-up	-	Training by VITA

## Morocco

In August, 1980, AID/RABAT requested the immediate services of a small-scale hydro specialist to assist the Mission in reviewing the Moroccan country assessment performed by a large engineering firm. The Mission felt that the firm was oriented toward large-scale civil works and needed to be guided toward smaller-scale projects. Within a week, NRECA/SDH contracted the services of a mini-hydro specialist and flew him to Morocco.

After two meetings with the engineering firm, AID engineers, and representatives of the Government of Morocco, the large, "Grand Coulee" types of civil works were deleted from the project. Since the smaller structure improved the economic feasibility of the hydroelectric program, AID/RABAT continued with the program. Three potential sites were identified for development and site data was collected. In November, NRECA sent an engineer to Morocco to supervise a survey team which developed the site profiles and preliminary layouts.

In October, 1981, NRECA sent two small hydro engineers to work with local consulting firms and representatives of the Office National de l'Electricite and the Centre de Developpement des Energies Renouvelables in prospecting for sites in Ouarzazath Province and to review any potential interference of a proposed small hydro scheme at Argbalou-N-Kerdous with the existing irrigation system.

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Requesting Cable	- Rabat 7318
Response Cable	- Telcon A. Jacobs - G. Bricker
Team Members	- Allen Inversin - Ken Grover
Duration in Country	- 2 weeks
Mission Contact	- Mark Ward - Gary Bricker
Product	- Site Assessments
Evaluation Cable	-
Follow-up	- Preliminary Engineering

Liberia

NRECA was requested to evaluate continued AID funding of a Peace Corp project in upper Liberia.

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Requesting Cable	-	Letter from Eilers 1/20/82
Response Cable	-	State 310670
Team Member	-	Allen Inversin - Walter Lawrence
Duration in Country	-	1 week
Mission Contact	-	
Product	-	Site Evaluation (not completed - 3/6)
Evaluation Cable	-	None
Follow-up	-	None

Cape Verde

NRECA was requested to conduct a country survey of SDH potential in Cape Verde. Since the potential was so small, this study was conducted in Washington and forwarded to the mission.

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Requesting Cable	-	Letter 6/18/81
Response Cable	-	Letter 7/28/81
Team Members	-	Bard Jackson - David Rubin
Duration in Country	-	0
Mission Contact	-	Hugh Smith
Product	-	Country Survey Report
Evaluation	-	None