DEFINITIONAL MISSION

AMBODIROKA, MADAGASCAR
REDUCED-SCALE HYDRO-ELECTRIC PROJECT

Final Report

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Submitted To:

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AMBODIROKA, MADAGASCAR REDUCED-SCALE HYDRO-ELECTRIC PROJECT DEFINITIONAL STUDY

EXECUTIVE SUMMARY

In response to solicitation by the Trade and Development Program (TDP) of the U.S. Department of State, Development Sciences Inc. (DSI) provided expert services for the Definitional Study of the Ambodiroka, Madagascar Reduced Scale Hydro-Electric Project under IQC Contract PDC-5730-I-00-6111-00, Delivery Order No. 02.

The DSI team of experts was composed of:

Dr. Maurice Albertson, PhD, Professor of Hydraulic Engineering, Colorado State University - Energy Resources Analysis

Mr. John P. Mello, MBA, financial analyst and DSI Vice President for Marketing and Operations - Energy Pricing Policies

DEFINITIONAL STUDY RECOMMENDATION

The objective of this Definitional Study was to evaluate the desirability of conducting a full-scale Feasibility Study of the Ambodiroka Hydro-Electric Project.

The team held extensive discussions with representatives from the Malagasy Ministry of Industry, Energy, and Mines (MIEM), Jiro Sy Rano Malagasy (JIRAMA, the national electric and water utility), World Bank, TDP, U.S. Embassy/ Antananarivo, U.S.-A.I.D. (REDSO/EA and Madagascar Mission), as well as Malagasy engineering and industrial companies. Provided by JIRAMA, reports from previous studies of proposals for the Ambodiroka site were evaluated. The team also traveled to the site to conceptualize the physical emplacements and to evaluate their feasibility.

On the basis of its evaluation of information collected from the above activities, the DSI team reports its recommendation that a full Feasibility Study of the Ambodiroka Reduced-Scale Hydro-Electric Project should be conducted.

Extensive engineering, economic, and financial study already has been conducted on various hydropower proposals for this site. Voluminous reports from these earlier studies are available. The DSI team's technical evaluation of the reduced scale concept found no technical aspect of the project to preclude further feasibility study. Economic and financial evaluation of the reduced capacity proposal revealed that data currently available support this project concept over the larger capacity proposal. However, additional detailed analysis also is recommend in these areas. Major revisions to energy policies and rate schedules are in progress at JIRAMA, in response to World Bank recommendations, which will affect the project's financial justification. Financial analysis conducted during a Feasibility Study will contribute to more accurate demand and revenue forecasts as well as to determining the most appropriate generating capacity level to recommend for Phase I of the project. The DSI team also found that important potential exists to integrate the technical and economic design of the project in order to maximize and broaden its positive economic impact.

TDP FEASIBILITY STUDY FUNDING CRITERIA

Development Priority of the Host Government

According to MIEM representatives, the government of the Democratic Republic of Madagascar (GDRM) places high priority on substituting lower cost hydropower capacity for diesel generation which involves foreign exchange expenditure for imported fuel.

Several development economics features apply to the Ambodiroka hydro project. Foreign exchange expenditure for diesel fuel imports necessary to run the installed 27MW capacity in the city of Mahajanga would be eliminated if hydropower is installed. A portion of Mahajanga's current diesel requirements is sourced domestically, hence this quantity then could be available for export for foreign exchange. Alternatively, the introduction of hydropower to the Mahajanga region would permit transfer of a portion of the city's existing diesel capacity to introduce electricity to new locales, thereby expanding the project's economic benefit through a broadened electrical infrastructure.

MIEM's Director of Energy indicated that the ministry would send its written endorsement to pursue the evaluation of the reduced capacity concept for this project in response to a written request from the U.S. Commercial Attache. This correspondence now should be available at the U.S. Embassy/ Antananarivo.

Procurement Potential from U.S. Suppliers

Assuming a total TDP Feasibility Study budget of $350,000, the minimum recommended 75 times U.S. procurement potential equals $26.3 million. The NRECA-STS Pre-feasibility Study estimated total budget for Alternative III equals $27.4 million.

The DSI team finds that the TDP guideline would be exceeded as the Ambodiroka facility is expanded to its expected 40MW capacity. The following table describes those elements of the referenced budget estimates that would represent U.S. sales, meeting TDP's procurement criteria for Feasibility Study funding.

Project Component	% U.S. potential	Cost est. /15MW ($000)@	Incremental cost est./40MW ($000)@
Equipment	80	1,760	2,933
Substation	80	160	270
Transmission line	80	9,600	6,800*
Shipping & insurance	75	38	63
Design & cons't. mgm't.	75	1,935	3,225
Total est. U.S. sourcing potential		13,493	13,291

@ Constant 1986 dollars.
* Assumes additional transmission line extension beyond Phase I specifications.

The base U.S. procurement potential of $13.5 million, plus the cost for expansion to 40MW of an estimated additional $13.3 million, represents a total potential U.S. sourcing for the project of $ 26.8 million as compared to the TDP minimum 75 times criterion of $ 26.3 million.

Funding Availability for the Project

JIRAMA officials concurred with World Bank preliminary budgetary planning for expansion of Madagascar's capacity during "Energy I." More detailed analysis of funding availability will be a Feasibility Study objective. Current planning is presented in the following table:

Funding Source**	$ Million
I.D.A.	15.0
Official sources (co-finance)	8.1
Local borrowers' contribution	7.6
Total budgetary planning	30.7

** Source: World Bank

TECHNICAL EVALUATION

Introduction

The assumption has been made that the technical aspects of this mission are to provide a critique of the feasibility of hydropower proposals made in the studies whose list follows:

Study Firm	Year
Electricite de France	Mars, 1959
Electricite de France	Mars, 1960
Montecatini-Edison	1969
Electricite de France	1979
Coyne et Bellier	Mars, 1981
Coyne et Bellier	Nov., 1982
Coyne et Bellier	Mars, 1985
Coyne et Bellier	Jui., 1985
Coyne et Bellier	Fev., 1986
NRECA-STS Enertech	Apr., 1986

Comments are provided regarding these reports as well as other observations as deemed appropriate.

The earliest reports made available to this team by JIRAMA are by Electricite de France (EDF), dated Mars, 1959 and Mars, 1960. The reports outline a comprehensive development plan for both the Betsiboka and Ikopa rivers, totalling 2,180MW and 5,600MW respectively. Specifically for the Ambodiroka site, 300MW are proposed using dams and storage reservoirs upstream. The Ambodiroka dam, 3km. upstream from the outlet works is 30m. high, with turbine head of 125m. and discharge through the turbines at 280cms.

The ability to provide 280cms. depends on maintaining the storage capacity in the upstream reservoirs. However, with a heavy sediment load in the Betsiboka River, it is quite likely that the storage capacity will be reduced to a fraction of the initial storage. Furthermore, there is no possibility that this amount of power could be consumed in the foreseeable future.

Another brief and general report, dated Janvier, 1969, was prepared by Montecatini-Edison (M-E) of Milan, Italy. This report recommends an installed capacity of 730MW for the Ambodiroka site with a 50m. high dam, turbine head of 155m., and maximum discharge through the turbines of 600cms. Like the EDF plan, the need for this electrical capacity will not develop for decades. Nevertheless, these reports demonstrate the impressive potential hydropower capacities for Madagascar to develop to cover its electricity needs.

The Coyne et Bellier (CetB) reports are voluminous and somewhat repetitive, but do provide valuable data, information, and ideas. The NRECA-STS report utilizes much of the CetB data and arrives at similar proposals, but with significant differences.

The Site

The Ambodiroka site on the Betsiboka River is exceptional for its drop in river elevation of approximately 70m. within a distance of about 1km. The location also is easily accessed from National Route 4 (RN4). Although other river sites exist that offer excellent characteristics, it is important that Madagascar develop each of these sites to its maximum potential.

Long-term View

Demand for electricity in the Mahajanga-Ambodiroka service area has been declining in the past few years. This trend appears to be temporary, however, as higher demand levels have been registered during past periods of improved economic conditions. Consequently, plans for the development of the Ambodiroka site should consider the maximum justifiable capacity to provide for long-term expansion. Since the average flow for the Betsiboka River is 270cms., through storage and use of flow for power generation it would be theoretically possible to generate 120MW of steady power. A lower, steady level of uninterrupted power output also is possible with storage available for peak power exceeding 120MW. Pursuasive reasons exist to plan at this point in time for output levels of less than 120MW (refer to reports: EDF 1959 & 1960; M-E 1969). However, those same reasons argue for a near-term capacity that exceeds the 10MW level of Mahajanga demand in 1985.

In view of the foregoing analysis, this report urges Malagasy officials and those who advise and support them to conduct near-term planning for the Ambodiroka site so that the long-term hydropower and economic potential of the Betsiboka River are ensured. That planning should take into consideration the following issues that are directly associated with this project:

1. Eventual larger increases in hydropower production at Ambodiroka and elsewhere in the river basin
2. Flood control
3. Irrigation
4. Sediment control
5. Water supply - both domestic and industrial
6. Downstream navigation
7. Agriculture, pisciculture, livestock raising
8. Recreation

The remaining comments in this Technical Section are based upon these assumptions.

The Present View

The city of Mahajanga at the present time has an installed diesel generating capacity of 27.7MW. These generators are expensive to operate and maintain, hence the interest in developing the Ambodiroka hydropower potential with transmission line to Mahajanga. With Mahajanga demand declining in recent years to the 1985 level of 10MW, a Phase I capacity for Ambodiroka of greater than 15MW cannot be justified by existing data. Nevertheless, sufficient margin for peak demand and for gradual demand growth should be reflected in the Phase I design.

Appropriate Technology and Foreign Exchange

Madagascar currently suffers from the combination of a domestic recession, severe balance of payments deficit, and chronic foreign exchange reserve shortages. Additional capital investment decisions must seriously consider the incremental affect on the GDRM's ability to service the investment costs. In the case of the Ambodiroka hydro project, it is recommended that the foreign exchange impact be reduced to its lowest possible level. This objective may be achieved by emphasizing appropriate technology in the conceptualization, design, and construction of the project. The following action areas are noted:

1. Project construction should be Malagasy labor intensive, rather than imported labor or capital intensive.

2. Malagasy sourced, renewable materials should be used to the maximum possible extent.

3. The concept of appropriate technology should be incorporated into the operation and maintenance of the installation. This concept also should emphasize the immediate and long-range environmental, social, and economic impacts of the project.

4. The appropriate technology concept should be applied specifically to the requirements, conditions, and specifications of the Ambodiroka facility rather than being generally applied.

Review of the Most Recent Studies

CetB Study

The first CetB report of 1981 proposed a 40MW plant based on a projected demand growth over a twenty year period. It also proposed the head race and power house to be located along the left river bank without provision for desedimentation from the flow. The 1982 CetB revisions included sediment control and provide more technical detail. CetB's 1985 report revised the economic and financial analyses. This report showed a steady reduction in Mahajanga's demand from 67.6GWh in 1981 to 49.5GWh in 1984. It forecasts demand at 16MW by 1990 and 24MW by the year 2000. CetB also provided a modified design in 1985. The proposal includes a power house with three turbines of 14MW each, two of which were to be installed in the initial project phase for a total capacity of 28MW.

CetB's design is safe, but extremely expensive particularly in view of comments made above on the most desirable production capacity and the least investment cost. Specific comments on the CetB design follow:

1. Upstream dikes and diversion works designs can be simplified and changed to masonry construction. It also is possible to build the dikes in stages since the minimum water requirements are increased when each new generating unit is installed in the power house.

2. Other guide walls, spillways, and gate structures could be simplified and changed to masonry for local fabrication and/or construction.

3. Sluiceways could be greatly simplified with masonry construction and radial gates designed so that they may be fabricated locally.

4. The raceway upstream from the penstock is an expensive design which could be economically built with vertical walls of masonry utilizing local labor. Its length also could be considerably shortened.

5. The power house design is more elaborate than necessary. It could be greatly reduced in size and built of masonry above ground with an external crane. This would be a less costly approach.

6. The initial installation and operating phase should include one 14MW unit rather than the two units as recommended by CetB.

The CetB Scale Model Study

CetB's 1985 report includes hydraulic scale model studies of the Ambodiroka site under a variety of flow conditions: 1,000cms, 5,000cms, 10,000cms, 20,000cms, 25,000cms, 30,000cms, and 33,000cms. The report also includes modifications to the proposed civil structures. These studies were in two parts. First, the flood flows below and above the existing highway bridge were simulated. Second, sedimentation dynamics were studied with a settling basin to prevent sediment from entering the head race leading to the turbines.

These studies indicated that that flood flow of 33,000cms would pass safely under the highway bridge and that the CetB-proposed settling basin design would be adequate.

It is the DSI team's judgement that further model studies may not be necessary.

NRECA-STS Enertech Study

The NRECA-STS pre-feasibility recommendations include three general alternatives: two on the left bank and one on the right bank. Comments on these alternatives follow:

1. The right bank offers the advantage of the simplest installation. But it may not be the least expensive.

2. Dikes in the river to direct flow show that "protection" is provided by boulders and rubble. This protection would be quickly washed away in a large flood. Therefore, these dikes should be of masonry construction with anchors into the bedrock. The stability of the existing masonry bridge piers (50+ years old) clearly shows how masonry construction will withstand water erosion and the abrasive effect of rocks and boulders moving in flood waters.

3. Consideration should be given to building the walls of the sediment basin and canals in stages, increasing their height and water carrying capacity as more generating units are added to the power house in the future.

4. Consideration also should be given to permitting inundation of civil works for short periods of time, providing stand-by diesel capacity for when hydropower is off-line during extreme floods. This would save considerable initial capital investment costs.

5. The substation in Alternative 3 may not be situated high enough to prevent inundation under design flood conditions.

6. The facility should provide for 3 generating units, instead of only 2 units. One generating unit should be installed in the first phase, with additional capacity added as a function of increasing demand.

General Comments

The following general comments apply to all previous studies and to future considerations for this project.

1. The dikes used to direct and control the flow from upstream from the highway bridge should be considered as part of a larger project to be built in the future. For this reason, a diversion weir should be studied for further control of water into hydropower plants located on either the right or the left bank. The weir would be needed only during low flow levels. Therefore, any diagonal dikes built for the first project phase should be designed so that they are sufficient for the 30m3/s minimum flow. Their height may be increased as necessary in the future to correspond to installation of additional generating units in the power house.

2. Smaller settling basins should be considered based on the settling velocities of the predominant sediments carried in the river. Length, width, and depth of the basin should be given more careful study.

3. Serious study needs to be given to the CetB scale model data to determine water surface profiles on each side of the channel for different sizes of floods. Since the rapid elevation drop of the river bed in the vicinity of the bridge serves as a control, the model provides an accurate measurement of surface elevations - except for the bulking caused by air entrainment and except for mist and spray.

Competitiveness of U.S. Firms

The regard held for U.S. consulting firms by Malagasy representatives appears to be at least equal to that of other firms worldwide, including French firms. Similarly, U.S. manufactured products are considered to equal or to excel those from other countries. As illustration, Ste. H. Fraise et Fils managed by Mr. John de Jager and distributor of Caterpillar, Goodyear, and other U.S. products, is among the most successful in Madagascar.

More specifically for the Ambodiroka hydro project, U.S. consulting firms are among the most qualified in the world for looking at all aspects of the project as described in this report. There are firms well qualified for the feasibility study as well as for the design and construction stages of the project. The obstacle to overcome will be to entice these firms, which have the unique combination of abilities required, to submit proposals.

U.S. suppliers can be very competitive for project supplies, materials, and equipment. Several U.S. manufacturers could supply the turbines appropriate for the project. Strongest competition is likely to come from the French firm, Neyrpic in Grenoble, as well as from Japanese and German firms.

Suppliers from other companies are likely to compete for the generator and exciter, unless the generator and turbine are to be supplied integrally. There is likely to be broad based competition for transformers and other electrical equipment such as switching gear, transmission cable, instruments, and control systems and units. The U.S. has an exceptionally strong position for the governors that control turbine operation as supplied by the Woodward Governor Co. Other items such as construction equipment and supplies also may be sourced from many different suppliers.

In summary, U.S. suppliers should be highly competitive for essential subsystems and components in this project as it develops over the years ahead. That competitive position can be well enhanced with strong support from TDP, FCS, and U.S. Department of State, EXIM Bank and other such organizations. The first step will be to obtain a truly outstanding firm to conduct a comprehensive feasibility study on the project design.

ECONOMIC AND FINANCIAL EVALUATION

Introduction

In its review of the considerable volume of economic and financial data developed to date, the DSI team focused its attention on the CetB revised financial evaluation dated Mars, 1985 and on the NRECA-STS pre-feasibility report dated April, 1986. These to reports contain the most extensive, recent data available.

CetB Economic and Financial Revision

The original 40MW proposal's economic and financial analyses (1981) were revised due to variances between early assumptions and economic performance in the 1981-84 period. Based on forecasted electricity demand growth for Mahajanga city (70-80% consumption by the SOTEMA textile complex) and world oil prices (in constant French Francs), the original proposal produced an internal rate of return varying between 12.3 to 27%.

The revision took into account the 18% decline in GWh sold by JIRAMA to the Mahajanga service area. It considered also: 1) the impacts of fuel price increases vis. the U.S. dollar/Malagasy Franc rate of exchange, 2) postponed construction of previously scheduled cement plants in the zone, and 3) failure to evaluate the impact of distributing Ambodiroka hydropower to smaller population centers along the route of the Mahajanga transmission line. After up-date of unit costs for installation and construction, modernization of the existing Mahajanga diesel capacity vis. development of Ambodiroka's hydro potential (to 28MW) produced an economic return varying between 11.3% and 19%. Financial analysis of the hydropower proposal, itself, produced the following indices:

IRR	13.7 to 17.5%
ROA	8%(+) after 4-5 years
Payback	8 years (-)

The CetB revision reports on two other aspects of the project with important financial implications. The original analysis assumed that no alternative market would exist to absorb the residual fuel used by Mahajanga's installed 25.7MW diesel capacity once it is deactivated. The Ste. Malagache de Raffinage (SMR) indicated, however, that likely markets exist. Therefore, the anticipated economic loss due to failure to sell the fuel was reconsidered. The revision also covered the option of modernizing the existing diesel capacity at Mahajanga. However, given the considerable age and diverse output ratings of these generators, comparative analysis of the hydro installation vis. the costly modernization proposal produced an IRR of 16% for the hydro option.

Comment

The basic and revised CetB studies provide abundant data for use in the feasibility study. Specific attention must be paid to accurate demand data. JIRAMA-supplied demand data for the Mahajanga service area clearly demonstrate the SOTEMA textile complex's predominant role in the 130 times increase in demand for the 1962-1983 period. Implicit economic and financial risks of a demand profile with so dominant a single client do not appear to have been fully considered in the sensitivity analyses conducted. For example, SOTEMA's demand is held constant in the forecasts after 1990. It is recommended that forecasted levels of GWh unit sales and unit prices be fully reviewed in order to properly justify the Phase I Ambodiroka capacity rating that will be recommended by the feasibility study.

NRECA-STS Enertech Pre-feasibility Economic and Financial Analyses

Limited economic and financial analyses were reported within the scope of the Pre-feasibility study. Emphasized in this case were the demand-justified alternatives of continued diesel capacity in Mahajanga, installation of the proposed 26.5MW hydro capacity (phase one of the CetB 40MW proposal), and installation of a reduced scale, phased hydro capacity of approximately 14MW. World Bank-supplied data forecasts Mahajanga consumption at 72.5GWh in 1995 and 103.8GWh in 2010, as contrasted to the CetB estimates of 108.3GWh and 242.1GWh, respectively. The NRECA-STS demand figures correspond more closely to current expectations, according to JIRAMA.

The pre-feasibility study approaches high/low voltage, residential/commercial electric rates from the perspective of break-even analysis. Pricing should receive particularly close attention during the feasibility study for several reasons.

First, the income stream will play a vital role in the capacity rating that will be considered appropriate to recommend for Phase I.

Second, in response to World Bank guidelines, JIRAMA is in the process of developing revised, consolidated rate schedules.

Third, JIRAMA analysts express informed uncertainty about the price elasticities implicit in their rate revisions. Considerable resistance is expected to proposals for higher commercial rates. A fall off in residential demand is expected due to higher tariffs. JIRAMA's financial flows also will be affected by bad debt provision for late-paying government parastatals.

Fourth, with SOTEMA as Mahajanga's major consumer, unit prices used in financial calculations should reflect realistic rate weightings according to the percentage of total electricity consumed.

Finally, realistic provision should be made for increased industrial demand that may result over time from the installation of lower cost Ambodiroka hydro-power in the Mahajanga service area to the extent that rates and revenues can be localized to that zone.

Comment

The NRECA-STS pre-feasibility economic and financial analyses provide a preliminary justification for the reduced scale Ambodiroka project. Several observations growing out of the DSI team's review may be helpful to in-depth analyses conducted during the feasibility study. General discussion with JIRAMA officials indicated that a 5% factor for inflation and 10% discount rate may not accurately reflect real rates. As illustration, Malagasy franc medium-term local borrowing rates are as high as 28%. Great care should be taken in arriving at a composite discount rate that reflects component borrowing terms for the project (e.g.: relationship between IDA terms, other donor agency terms, and Malagasy government/JIRAMA costs). Similarly, the inflation multiplier used to forecast revenue and cost relationships should be based on reasonable assumptions about internal and foreign exchange-related inflation factors in Madagascar.

General Observations

The following information was collected during this definitional evaluation which may be helpful for the feasibility study.

1. Under the World Bank's "Energy I" project for Madagascar, approximately $600,000 have been identified as necessary to rehabilitate Mahajanga's existing diesel capacity.

2. A thorough inter-GDRM agency and donor group inquiry vis. development projects proposed for the Mahajanga region will improve the data base for economic analysis.

3. An inter-GDRM agency evaluation of projects that may be integrally associated with installation of hydropower at Ambodiroka would enhance the project's overall economic viability. Action areas such as up and downstream irrigation, agriculture, pisciculture, livestock, broader scale rural electrification, flood protection, siltation control, river navigation, population redistribution and encouragement of indigenous industrial relocation or development to the region will hold special interest.

4. JIRAMA's preliminary rate revisions are expected to be available by January, 1987.

5. Sensitivity analyses should be as broadly focused, yet detailed, as possible.

6. Economic return from the project may be enhanced through transfer of part of Mahajanga's existing diesel capacity to electrify new sites. This will enable the financial analyses to be conducted from a project-specific perspective as well as from an overall JIRAMA Mahajanga service area operating finances.

7. Greater sourcing of components and labor from Malagasy sources will improve the foreign exchange flow management and long-term financing costs as well as provide greater value-added to the local economy.

8. At the request of the U.S. Ambassador and the A.I.D. Mission Director, the team was requested to mention in its report the desirability of providing key JIRAMA personnel with the opportunity to experience first-hand U.S. hydro-electric and electrical equipment manufacturing capabilities. The objective of this exposure is to enable JIRAMA to take their design and equipment decisions based on current awareness of U.S. supply capabilities. It is the request of the above U.S. officials and of the DSI team that relevant agencies with an interest in this project consider means and methods at their disposal for enacting this orientation objective.

FEASIBILITY STUDY
TERMS OF REFERENCE

REQUEST FOR PROPOSAL

Ambodiroka Reduced Scale
Hydro-electric Project

I. Geographic and Institutional Setting

1.1 Geography

Madagascar, the world's fourth largest island with a surface area of 587,041 square kilometers, is situated in the Indian Ocean to the east of Africa and separated from it by the Gulf of Mozambique. The country is nearly entirely situated in the tropical zone. With its capital in Antananarivo, Madagascar is considered as a French-speaking nation.

There are two principal seasons:

a. the rainy season (Nov. to Apr.) also is the hot season (summer)
b. the dry season (May to Oct.) also is the cool season (winter)

1.2 JIRAMA

Madagascar's electric power industry is nationalized by JIRAMA. The Jiro sy Rano Malagasy (JIRAMA) was created in October 1975. Although a parastatal, the company operates according to the commercial corporate code and is responsible for electricity generation and distribution as well as for potable water. Installed electric generation capacity is at 185MW, of which 104MW is hydroelectric. Total output in 1985 was approximately 330GWh.

1.3 Feasibility Study Context

The Ambodiroka hydro-electric installation is designed to cover electricity demand for the Mahajanga service area which now is served by 7 diesel generators (total installed capacity 27.73KW). Consumption by SOTEMA, principal industry in the region, was at 56GWh or 70% of total regional demand in 1985.

The Ambodiroka site is located approximately 200km. southeast of Mahajanga, at the intersection of the Betsiboka River and National Route 4 which links Mahajanga and Antananarivo.

The site previously has been the subject of the following hydroelectric studies which are available for inspection at JIRAMA offices:

STUDY FIRM	YEAR
Electricite de France	1959
Electricite de France	1960
Montecatini-Edison	1969
Electricite de France	1979
Coyne et Bellier	1981
Coyne et Bellier	1982
Coyne et Bellier	1985
Coyne et Bellier (rev.)	1985
Coyne et Bellier	1986
NRECA-STS Enertech	1986
Development Sciences Inc.	1986

1.4 Previous Studies Background

1.4a Electricite de France (EDF) Study

The earliest reports made available to the DSI team by JIRAMA are by Electricite de France (EDF), dated Mars, 1959 and Mars, 1960. The reports outline a comprehensive development plan for both the Betsiboka and Ikopa rivers, totalling 2,180MW and 5,600MW respectively. Specifically for the Ambodiroka site, 300MW are proposed using dams and storage reservoirs upstream. The Ambodiroka dam, 3km. upstream from the outlet works is 30m. high, with turbine head of 125m. and discharge through the turbines at 280cms.

The ability to provide 280cms. depends on maintaining the storage capacity in the upstream reservoirs. However, with a heavy sediment load in the Betsiboka River, it is quite likely that the storage capacity will be reduced to a fraction of the initial storage. Furthermore, there is no possibility that this amount of power could be consumed in the foreseeable future.

1.4b Montecatini-Edison Study

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capacity will not develop for decades. Nevertheless, these reports demonstrate the impressive potential hydropower capacities for Madagascar to develop to cover its electricity needs.

1.4c Coyne et Belier (CetB) Study

The first CetB report of 1981 proposed a 40MW plant based on a projected demand growth over a twenty year period. It also proposed the head race and power house to be located along the left river bank without provision for desedimentation from the flow. The 1982 CetB revisions included sediment control and provide more technical detail. CetB's 1985 report revised the economic and financial analyses. This report showed a steady reduction in Mahajanga's demand from 67.6GWh in 1981 to 49.5GWh in 1984. It forecasts demand at 16MW by 1990 and 24MW by the year 2000. CetB also provided a modified design in 1985. The proposal includes a power house with three turbines of 14MW each, two of which were to be installed in the initial project phase for a total capacity of 28MW.

CetB's 1985 report includes hydraulic scale model studies of the Ambodiroka site under a variety of flow conditions: 1,000cms, 5,000cms, 10,000cms, 20,000cms, 25,000cms, 30,000cms, and 33,000cms. The report also includes modifications to the proposed civil structures. These studies were in two parts. First, the flood flows below and above the existing highway bridge were simulated. Second, sedimentation dynamics were studied with a settling basin to prevent sediment from entering the head race leading to the turbines.

These studies indicated that that flood flow of 33,000cms would pass safely under the highway bridge and that the CetB-proposed settling basin design would be adequate.

The original 40MW proposal's economic and financial analyses (1981) were revised due to variances between early assumptions and economic performance in the 1981-84 period. Based on forecasted electricity demand growth for Mahajanga city (70-80% consumption by the SOTEMA textile complex) and world oil prices (in constant French Francs), the original proposal produced an internal rate of return varying between 12.3 to 27%.

The revision took into account the 18% decline in GWh sold by JIRAMA to the Mahajanga service area. It considered also: 1) the impacts of fuel price increases vis. the U.S. dollar/Malagasy Franc rate of exchange, 2) postponed construction of previously scheduled cement plants in the zone, and 3) failure to evaluate the impact of distributing Ambodiroka hydropower to smaller population centers

along the route of the Mahajanga transmission line. After up-date of unit costs for installation and construction, modernization of the existing Mahajanga diesel capacity vis. development of Ambodiroka's hydro potential (to 28MW) produced an economic return varying between 11.3% and 19%. Financial analysis of the hydropower proposal, itself, produced the following indices:

IRR	13.7 to 17.5%
ROA	8%(+) after 4-5 years
Payback	8 years (-)

The CetB revision reports on two other aspects of the project with important financial implications. The original analysis assumed that no alternative market would exist to absorb the residual fuel used by Mahajanga's installed 25.7MW diesel capacity once it is deactivated. The Ste. Malagache de Raffinage (SMR) indicated, however, that likely markets exist. Therefore, the anticipated economic loss due to failure to sell the fuel was reconsidered. The revision also covered the option of modernizing the existing diesel capacity at Mahajanga. However, given the considerable age and diverse output ratings of these generators, comparative analysis of the hydro installation vis. the costly modernization proposal produced an IRR of 16% for the hydro option.

1.4d NRECA-STS Study

The NRECA-STS report utilizes much of the CetB data and arrives at similar proposals, but with significant differences.

Their pre-feasibility recommendations include three general alternatives, two of which would be situated on the left bank and one on the right bank.

Limited economic and financial analyses were reported within the scope of the pre-feasibility study. Emphasized in this case were the demand-justified alternatives of continued diesel capacity in Mahajanga, installation of the proposed 26.5MW hydro capacity (Phase One of the CetB 40MW proposal), and installatiuon of the reduced-scale, phased hydro capacity of approximately 14MW. World Bank supplied data forecasts Mahajanga consumption at 72.5GWh in 1995 and 103.8GWh in 2010, as contrasted to the CetB estimates of 108.3GWh and 242.1GWh, respectively. The NRECA-STS demand figures correspond more closely to current expectations, according to JIRAMA.

The pre-feasibility study approaches high/low voltage, residential/commercial electric rates from the perspective of break-even analysis.

II. Feasibility Study Objectives

The previous installation study for a 40MW capacity (3 generators) now is considered inappropriate considering the current economic recession and slower demand growth. Consequently, the present feasibility study is expected to:

2.1 Evaluate the feasibility of a hydro-electric installation at Ambodiroka, taking into account new electricity demand forecasts, to supply the city of Mahajanga and vicinity.

2.2 Justify financial decisions leading to the establishment of the Request for Proposal for the Detailed Design phase of the project.

III. Description of Services

The services to be delivered by the selected consultant will be in two parts.

3.1 Phase One

The consultant will conduct all preliminary studies which will permit the evaluation of the technical, economic, and financial feasibility of all of the proposed project alternatives.

3.1a Examine all previous Ambodiroka hydro-electric studies.

3.1b Establish demand forecasts for Mahajanga and vicinity for a twenty year period.

3.1c Justify the change in scale and capacity rating for the project.

3.1d Identify the different installation alternatives that are technically feasible to construct.

3.1e Document the different technical problems posed by the basic project conditions, notably topographic, geologic, hydrologic, and hydraulic.

3.1f Prepare a summary technical, economic, and financial study for each installation alternative and a construction cost estimate for each.

3.1g Propose the most feasible alternative.

3.1h Optimize the rating charateristics of this alternative.

3.1i Furnish an interim report (6 copies) which will be jointly review by the consultant and JIRAMA.

3.2 Phase Two

The consultant will conduct all in-depth studies to demonstrate and justify the technical, economic, and financial feasibility of the optimal design alternative that is identified in Phase One. The consultant notably will:

3.2a Optimize and finalize the characteristics of the selected design alternative, in particular justifying the scale of the works and demonstrating their stability particularly vis. floods (according to criteria approved by JIRAMA).

3.2b Justify equipment characteristics and specifications.

3.2c Conduct the in-depth economic and financial studies for the selected design alternative. The economic study thus defined must permit the development of an equipment plan for the Mahajanga region. Accordingly, the study will evaluate the following alternatives:

A. The selected project design alternative from Phase One.

B. The equivalent diesel alternative.

3.2d Conduct financial variance analyses for the 3.2c alternatives in terms of internal rate of return (IRR) for data variations such as demand, investment costs, fuel prices.

3.2e Develop a summary evaluation of the foreign exchange requirements for a twenty-year period and analyze the project's impact on the national balance of payments (value added, foreign exchange, etc.)

IV. Conduct of the Study

The consultant will involve JIRAMA directly in the execution of the studies. JIRAMA will be involved in particular:

4.1 To define study objectives and methodologies, as well as for the technical and economic parameters to be used.

4.2 In the key stages of the feasibility study, notably identification of the basic options and of the project concepts.

4.3 The consultant must make provision for the effective participation of JIRAMA personnel in development of the studies as well as in field work. A certain number of JIRAMA personnel, as a training process, must be incorporated into the consultant's working team.

V. Working Language

The working language for the feasibility study is French. All official communications must be in French. Among the consultant's personnel in the field there must be at least one person capable of speaking and reading French fluently. Unofficial communication preferably will be in French, but English also may be used.

The preliminary final report will be provided in 6 copies with the final report established in 12 copies, both in French and English with distribution to be specified in the feasibility study contract.

VI. Instructions to Bidders

Bids will be received by the Ministry of Industries, Energy and Mines who will conduct the evaluation and selection of the prime contractor consulting firm.

The feasibility study contract will be established between the Government of the Democratic Republic of Madagascar, Ministry of Industries, Energy and Mines, and the consulting firm selected as prime contractor. While not a party to the contract, TDP reserves to right to review and approve the contact prior to its initiation and prior to the disbursement of any related funds. All standard U.S. government contract terms with respect to competitive bidding, equal opportunity, use of U.S. flag carriers, etc. must be included in and apply to the contract.

Bids will be submitted in the "triple sealed envelope" procedure. Bids must be presented in French and English.

6.1 Bidders will submit in three envelopes information permitting the evaluation of the bid according to the following criteria and their respective order of priority:

A. Enclose in the first envelope vitae and professional qualifications of key personnel proposed to conduct the feasibility study detailing their experience and aptitude in their areas of responsibility as well as their knowledge of conditions in Madagascar or a similar country. This envelope also must include descriptions of the consultant's experience in accomplishing similar such feasibility studies with descriptions and reference information on recent proposals and contracts executed for work of this kind.

B. The second envelope will include a description of the methodology proposed for the work schedule and work plan, demonstrating familiarity with the tasks involved and with producing the information required upon which the necessary project decisions will be based.

C. Bidders will submit a third, interior sealed envelope containing the financial bid set out in two formats:

1. Total contract bid price.

2. Total contract bid price showing the following details:

   a. Total costs in foreign exchange and in Malagasy francs.
   b. Unit costs for all cost categories.
   c. Detailed cost estimates for travel and lodging (including total costs for any international travel required of JIRAMA personnel to the consultant's U.S. offices).

6.2 Bidders will take into consideration that the funding grant for this feasibility study makes provision for up to 20% of the total contract price to be paid for technical and engineering services provided by Malagasy consulting firms as subcontractors to the prime consultant. JIRAMA qualifies as an eligible subcontractor firm to provide certain technical services in Madagascar to the prime consultant.

6.3 The consultant will complete the feasibility study within a period of six months from the date of the official notification of acceptance of bid. Work will begin as soon as possible after official notification, which start date will be specified in the contract.

6.4 Bidders will note that the Ambodiroka Reduced Scale Hydro-electric Feasibility Study Terms of Reference and Request for Proposal include an integral informational Terms of Reference Annex.

6.5 Announcement of the selected firm will be made 30 days after the bid closing date. Unsuccessful bidders will be notified. Contractors' bids must be valid for at least 90 days. Selected firm must be prepared to begin work no later than 15 days after contract is 1) signed and, 2) approved by TDP. Bidders will submit their proposals to the following address within 60 calendar days after the official appearance of the Request for Proposals (RFP) in the Commerce Business Daily:

Jiro sy Rano Malagasy (JIRAMA)
Direction des Etudes Economiques et
de la Plannification
19 rue Rainitovo
B.P. 200
101 Antananarivo
MADAGASCAR

Attention: M. Majilo Ratsimiebo,
Directeur

Telephone: 261-2-23457
Telex: 222.35

VII. ADDENDUM

7.1 Frequency in Madagascar is 50Hz.

7.2 Preferred standard transmission voltage is 186KV.

7.3 Materials standards for electrical equipment to be proposed must be compatible with French standards which predominate for existing installations.

7.4 Specific bid selection criteria:

A. Previous professional experience and quality of skills to conduct hydropower feasibility studies
B. Specialized experience and technical competency of personnel to work in analysis, planning, and design of small hydro (50MW or less) installations and for understanding/use of appropriate technology
C. French language capabilities [fluency required for chief engineer/team leader & economist/fin. analyst]
D. Experience of firm & personnel working in developing countries
E. Capability to fulfill quality & timing of services per TORS
F. Past performance on government or commercial contracts vis. cost control, work quality, and compliance with TORS/scope of work

INFORMATIONAL ANNEX

TERMS OF REFERENCE
REQUEST FOR PROPOSAL

Ambodiroka Reduced-scale Hydro-electric Project
Feasibility Study

The following information and guidelines for the subject feasibility study were developed during the technical and economic/financial definitional study of the reduced-scale concept. The recommendations made here are to be considered by the feasibility study and are neither comprehensive nor exclusive. The recommendations are made to complement, rather than to detract from, what is the feasibility study's principal focus which is the viability of the reduced-scale Ambodiroka hydro-electric installation, itself.

I. GENERAL OBJECTIVES AND ASSIGNMENTS FOR THE FEASIBILITY STUDY

1. To determine the feasibility of a hydro-electric project at the Ambodiroka site on the Betsiboka River.

2. To determine in general terms the most effective plan, layout, and design for the Ambodiroka Project.

3. To study and analyze all technical, economic, and financial aspects of the project.

4. To provide information required by funding agencies to determine levels of support for the project.

5. To analyze and explain the various technical aspects and problems anticipated as a result of analyzing geologic, topographic, hydrologic, and hydraulic data available from the numerous previous studies.

6. To consult with and to integrate JIRAMA staff into the feasibility study in its entirety.

II. SPECIFIC ASSIGNMENTS

1. To analyze in detail all previously conducted studies for the Ambodiroka site.

2. To propose a new plan, layout and general design for the first phase of a long-range hydro-electric development program at Ambodiroka.

3. To study both present and future development potential at the Ambodiroka site, including:

   a. Phased development of the site so that no preceding phase precludes full realization of the site's potential in subsequent phases.

   b. Possibility of installing additional run-of-river power installations at the site in the future.

   c. Possibility of adding water storage upstream to provide releases required to increase minimum flow required by future site expansion.

   d. Long-range multiple uses of the Betsiboka waters for flood control, irrigation, downstream navigation, and sediment control.

   e. Optimum utilization of the Ambodiroka site both with and without upstream storage.

   f. The need for proper sediment control and flushing, both in the upstream raceway and the downstream river channel.

4. During review of the studies previously conducted on the site, careful attention must be paid to:

   a. Minimum flows at the site on a probability basis.

   b. Maximum flows and a determination of probable maximum floods for 10 years, 100 years, and 1,000 years.

   c. Determination of average annual flow.

   d. Site flow conditions both during low flood and peak flood flows - including the sediment load for minimum and maximum discharges.

5. Special study must be given to sedimentation in the Betsiboka and at the Ambodiroka site with a view toward short and long-term solutions and emphasizing the following issues:

   a. Origin of the sediments within the watershed with special attention to tributaries which are the heaviest sediment contributors.

b. Size analysis and concentrations of sediment based on existing data carried into the river from different discharges and for different seasons of the year. (Any measuring equipment must be provided by the prime-contractor in order for new measurement studies to be conducted.)

c. Sizes of sediment and quantities passing the Ambodiroka site as related to the water hydrograph.

d. Sedimentation impact on the Betsiboka delta, Mahajanga Harbor, and future development of the Mahajanga city region.

e. Various sedimentation control designs to minimize the amount of sediment entering the Ambodiroka turbines.

f. Flushing of sediment from the settling basin, the resulting deposit of this sediment in the downstream channel near the power house and the flushing of this sediment farther downstream so as not to cause a back-water effect and raising of the tailwater at the power house.

6. To study, analyze, and propose designs for all features of the recommended project, including:

a. Diversion of water during low flow into the raceway to the turbines.

b. Raceway design.

c. Design of sediment control works, including settling basin and the flushing system and equipment.

d. Forebay to the penstock.

e. Penstock(s).

f. Gates and valves required for flow control and for protection of equipment and the system.

g. Turbine(s) and draft tube(s).

h. Pressure release valve(s).

i. Governor(s), turbine control equipment and instruments.

j. Generator(s) and exciter(s).

k. Power house, exit channel, and afterbay.

l. Complete substation at the power house and at Mahajanga, including the transformers, switching gear, and control equipment.

m. Flood protection works.

n. Servicing and maintenance procedures, including power house hoisting equipment.

o. Complete transmission line from power house to Mahajanga substation and distribution to locales along the cable route.

p. Telecommunications between power house and substations.

7. Prepare economic and financial analyses for the project, including:

a. Detailed analysis of electricity demand for the city and region of Mahajanga and surrounding region, from an historical perspective and with 20-year forecasting.

b. Detailed cost estimates for all project components and for each project alternative to be proposed.

c. Detailed analysis of rate structures to determine an appropriately weighted average rate that reflects the proportion of actual and forecasted commercial/residential demand mix.

d. Assess potential for new demand from macro-economic, regional, and JIRAMA corporate growth perspectives.

e. Conduct full variance analyses for each design alternative and for comprehensive financial/economic variables.

Conditions now applicable:

- Revision and consolidation of electric rates, with projected impact on price elasticities and forecasted GWh consumption over project life.

- Recent devaluations/depreciation of the Malagasy franc.

- Internal inflation.

- Consolidated demand forecasts based on assembly of data for all development projects which may have an economic effect on the Ambodiroka demand situation.

- Economic value of "side effect" commercial or govenmental development investments in the Mahajanga service area triggered by less costly hydropower at Ambodiroka (i.e. assessment of an economic development model driven by a hydropower accelerator or multiplier)

- Economic and financial impact from transfer of a portion of existing Mahajanga diesel generating capacity to new locations in the country (reflect the economic value in sensitivity analyses).

- World fuel price sensitivity analysis for impacts on JIRAMA revenue.

8. To give special study to recommendations that can be made to increase the amount of indigenous involvement in civil construction, metal fabrication, installation and testing of electro-mechanical equipment with particular attention to:

   a. Fabrication of cross-flow turbines.

   b. Fabrication and erection of transmission towers, high tension lines, substations, transformers, and switching gear.

   c. Installation and testing of turbines, generators, governors, and all other power house equipment and instrumentation.

   d. Installation of diversion works, dikes, canals, flumes, gates, and other control works, both manual and automatic.

   e. Fabrication of control equipment such as gates and valves for manual or automatic operation.

9. To conduct the two-phase feasibility study as specified in the terms of reference/request for proposal with consideration given in the interim and final reports to the following:

   a. Layouts and drawings with suggested design details for all main project features.

   b. Comprehensive description of all data utilized in reaching the feasibility study recommendations, including topographic, geologic, hydrologic, and hydraulic components.

   c. Complete cost estimates, with quantities and unit costs, for all project components.

   d. Clear and concise technical, economic, and financial recommendations, including complete references.

e. Presentation of financial data in formats acceptable to potential financing sources with complete reference and assumption data for duplication of analyses by third parties.

DRAFT ANNOUNCEMENT
COMMERCE BUSINESS DAILY

Trade and Development Program, Room 309, SA-16, IDCA, U.S. Department of State, Washington, DC 20523.

R - FEASIBILITY STUDY FOR THE REDUCED-SCALE (APPROX. 15MW) HYDRO-ELECTRIC GENERATING PROJECT ON THE BETSIBOKA RIVER AT AMBODIROKA, DEMOCRATIC REPUBLIC OF MADAGASCAR. Approx. value: $320,000. In conjunction with Jiro sy Rano Malagasy (JIRAMA), the national electric utility, contractor will perform the technical hydrologic, engineering, economic, and financial analyses comprising the full feasibility study. Work conducted principally in Madagascar, with provision for sev'l wks in U.S. Scope of Work provides for flwg. tasks: PHASE I. 1) analyze hydrologic data for min/max flows & time variations; 2) analysis optimal site location; 3) route flows thru channels for surface elevations @ different flood flows; 4) sediment analysis including concentrations & total loads for various discharges; 5) recommend optimal equip. specs. based on expert knowledge; 6) analysis of power production/consumption patterns for forecasting; 7) determine hydropower priorities & construction sequencing per priorities; 8) prep. prelim. project layouts & designs including substations & 250km. transmission line; 9) determine methods to minimize foreign exchange and equip. import requirements & maximize utilization of Malagasy labor, equip. & supplies; 10) analyze complementary 20-yr. proj. life integration of phased hydropower expansion with potential irrigation, agriculture, livestock, and other industrial development in Mahajanga region; 11) conduct detailed fin. analyses of electric rates now under revision for price elasticities & revenue impacts; 12) analyze foreign exch., local currency, and project financing costs with views toward local currency and Balance of Payments impacts; 13) fully involve JIRAMA engineering, financial, and mgmt. staffs in feas. study to effect transfer of expertise; 14) develop feas. study recommendations as basis for RFP/TORS for Pre-Design Study; 15) prep. interim recommended design & feas. study report for joint review with JIRAMA. PHASE II. 1) prep. project justification for recommended design & output rating; 2) prep. cost estimates and justify recommended equip. specs.; 3) est. thorough econ. & fin. justification for recommended project concept & design including sensitivity analyses (DCF/ROI, ROA, IRR, Payback) for variances in demand, investment costs, comparative fuel prices, etc. Up to 20% of contract value is potential set aside for payment from prime to Malagasy subcontractors for services (in addition to systematic participation in feas. study, JIRAMA is eligible to receive such payments as subcontractor for certain services provided in Madagascar).

Specific selection criteria: a) previous prof. experience and quality of prof. skills to conduct hydropower feas. study, b) specialized experience & technical competency of personnel to work in analysis, planning & design of small hydro (50MW or less) and for understanding/use of appropriate technology, c) French language capabilities [fluency required for chief engineer/team leader & economist/fin. analyst], d) experience of firm and personnel working in developing countries, e) capability to fulfill quality & timing of services per TORS, f) Past performance on gov't or comm'l contracts vis. cost control, work quality, and compliance w/TORS/SOW.

Bid selection by "triple sealed envelope" method (one containing professional qualifications of team and firm, one containing proposed feasibility study methodology, and one containing unit cost financial proposal). Selection of the prime contractor will be made by the government of the Democratic Republic of Madagascar, Ministry of Industries, Energy, and Mines (MIEM), which agency will be the contractor. The contractee (that consulting firm selected as prime contractor) will submit all expense vouchers for payment in U.S. dollars to the Ministry (MIEM) for approval and transfer to the Embassy for forwarding to TDP for processing of final payment. Estimated feas. study level of effort: 160m/d field, 40m/d U.S. Est. service delivery period: 6 months from offical date of contract. Only written requests for RFP/TORS to the above TDP address will be accepted dated up to 30 calendar days from CBD announcement; bids must be received by the Ministry (MIEM) in Antananarivo within 60 calendar days from the date of this CBD announcement by 12:00 hours, Malagasy time. Announcement of the selected firm will be made 30 days after the bid closing date. Unsuccessful bidders will be notified. Contractors' bids must be valid for at least 90 days and selected firm must be prepared to begin work no later than 15 days after contract 1) signed, and 2) approved by TDP. Additional info.: Ray Dinkin, Project Officer, TDP, Ph. (703)235-3657.

COMPLETED SCOPE OF WORK

1. Travel to Madagascar

The DSI team traveled to Madagascar between September 4 - 18, 1986. See attached Diary of Field Work for details of definitional study activities.

2. Review Past Studies

Intensive review was made of all existing studies for hydro-electric proposals for the Ambodiroka site. The DSI team analyzed these studies independently and in cooperation with JIRAMA staff.

3. On-site Analysis of Project

The DSI team visited the Ambodiroka site on September 10, 1986, accompanied by JIRAMA staff. Vehicles and logistical arrangements were kindly made by JIRAMA and travel expenses were partially financied by DSI.

4. Host Country Finances for Project

The budgetary planning information that currently is available in presented in the Executive Summary as well as, TDP Qualification Requirements for Feasibility Study Funding, No. 3.

5. Terms of Reference and Estimated Study Costs

These sections are presented in the Terms of Reference/Request for Proposal portion of this report.

6. Provide Draft RFP, including TORS and CBD Announcement, and Review Contracting Procedures with Host Country Agencies

These sections are presented in the Terms of Reference/Request for Proposal portion of this report. The TORS and contracting procedures were jointly reviewed with JIRAMA staff.

7. Competitiveness of U.S. Firms

Assessment of U.S. competitiveness is presented in the Technical Evaluation.

8. Brief Appropriate Host Country and U.S. Officials

Briefings were held throughout the definitional study with MIEM and JIRAMA officials. Briefings similarly were held with the U.S. Ambassador, DCM, Commercial Attache, AID Mission Director, and AID/REDSO Energy Officer.

9. Brief TDP Staff

Briefings were conducted with TDP (and World Bank) staff prior to and after the definitional study field effort.

10. Required Reports

a. The draft report material was reviewed in Washington with TDP and was submitted to TDP for review by JIRAMA.

b. The present constitutes the final report, reflecting the changes requested by JIRAMA, U.S. Embassy, and TDP officials.

AMBODIROKA DEFINITIONAL STUDY

Diary of Field Work

September	Activity
3	Team members arrive Washington
4	Meetings: Nancy Frame, TDP Juergen Franz, World Bank Depart Washington for JFK Depart JFK for Nairobi
5	En route
6	Arrive Nairobi & ensure Tanarive continuation
7	Depart Nairobi/Arrive Tanarive
8	Meetings: U.S. Embassy: Ambassador, DCM, Commercial Attache, AID Mission Director MIEM Director for Energy JIRAMA engineering & financial planning staffs
9	Meetings: DG, DINIKA - Malagasy engineering firm U.S. Commercial Attache JIRAMA working sessions
10	Travel to Ambodiroka site (approx. 400km. in 18.5 hrs.)
11	Documentation review Meetings: DG, Ste. Fraise et Fils U.S.-AID/REDSO Energy Officer JIRAMA staff contacts re. TORS U.S. Commercial Officer re. participation in RFP
12	Documentation review Albertson: toured metal fabricating plants in Tanarive Mello: briefed MIEM Director of Energy, AID/REDSO Energy Officer and working session w/JIRAMA economist Albertson & Mello: working session w/JIRAMA engineering & planning staffs re. RFP/TORS

	Began drafting technical & econ./financial evaluations
13	Albertson: field visit to Ampef mini-hydro facility Mello: continued drafting financial evaluation, RFP/TORS Documentation review
14	Continued documentation review Continued drafting reports
15	Continued documentation review Meetings: U.S.: Ambassador, Commercial Attache, AID Mission Director, and AID/REDSO Energy Officer Final briefing sessions with JIRAMA staffs
16	Depart Tanarive/Arrive Nairobi Continued drafting reports
17	Travel
18	Travel

AMBODIROKA REDUCED-SCALE
HYDRO-ELECTRIC DEFINITIONAL STUDY

PERSONS CONTACTED

JIRAMA

Majilo Ratsimiebo	Directeur d'Etudes et Plannification
Jacques Rajaofera	Directeur des Equipements Electriques
Benjamin Rakotondrafara	Ingenieur Chef des Projets
Aimee Andrianasolo	Ingenieur/Economiste
Dilferson Rabarilala	Chef du Projet/Mini-hydro (Ampef)

U.S. EMBASSY/U.S./AID

Patricia Gates-Lynch	Ambassador
Robert Tynes	Deputy Chief of Mission
Thomas Morrow	Economics/Commercial Officer
Henriette Ralaharisoa	Commercial Assistant
Samuel Rae	Director of Mission/AID
Anthony Pryor	REDSO/EA Energy Officer

OTHERS

Emmanuel Randrianarisoa	Directeur de l'Energie, Ministere des Industries, Energie, et Mines
Nancy Frame	Deputy Director of Planning, TDP/W
Juergen Franz	Financial Analyst, World Bank
Rakotobe Razanakoto	DG, DINIKA, S.A.
Markus Eisenring	AID Hydropower Consultant
John de Jager	DG, Ste. Fraise et Fils, S.A.
Marcel Ramanantsiarovana (foreman)	DG, Ste. Taobavy, S.A. Ste. Cimelta, S.A.