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REVIEW OF PROPOSED  
RURAL ELECTRIFICATION PLAN II  
FOR GUATEMALA  
  
AND RECOMMENDATIONS FOR  
TECHNICAL ASSISTANCE  
TO INDE  
(INSTITUTO NACIONAL DE ELECTRIFICACION)

An Analysis & Report  
Prepared for

THE US MISSION TO GUATEMALA  
GUATEMALA CITY, C.A.

By

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TO: Mr. Frederick W. Schieck, Acting Director  
FROM: Mr. Alf L. Carroll  
SUBJECT: Rural Electrification Program  
DATE: July 20, 1977

It has been a pleasure to have worked with the Mission Staff and with INDE in this assignment. If I listed everyone who has assisted me, the list would be long but may I summarize by saying that I appreciate your personal interest and the friendly cooperation of all concerned.

From your own experience you will agree that on a short assignment of this type (about 10 working days) in a country in which I have had no previous experience, one must resist the temptation to make broad and sweeping generalizations which may not be supportable; but at the same time one must endeavor to make useful and meaningful assessments and recommendations. I hope that I am offering the latter.

I also wish to acknowledge the fact that much work has been done on the technical aspects of this project by INDE and by AID principally through the efforts of Charlie Moseley. He has been diligent and professional and I generally endorse his judgements.

You have not requested that I comment on the basic rationale of the proposed project. Others have examined this question and your plan was developed after careful study and examination by others. You have, therefore, requested that I examine the project, and briefly, from a strictly pragmatic point of view; and this is what I have done.

I have also reviewed some of INDE's operations in order to make an overall assessment of its organization. While all of INDE's activities may not be directly related to the particular project, the general tenor of INDE's system is relevant and significant as to how they may perform on this project. Accordingly, I visited a

thermal generating station, a hydro station, several substations, a commercial office and the Office of the Chief Engineer of Operations. The latter is also INDE's Dispatch or Load Center. I also visited a construction warehouse. There are notes in this report covering these visits and the observations made.

I have observed some of the 69 KV sub-transmission lines and 13.8 KV distribution lines and I found that the construction of these facilities was quite good.

Because INDE is performing well in these areas, I have gained a generally favorable impression and therefore see no reason to doubt INDE's capability to construct the facilities included in this particular program. However, I do see a number of "opportunity areas" where INDE's organization can be strengthened and in these areas I believe that a well conceived technical assistance program will be helpful to INDE and to the program.

Experience in similar situations has clearly shown that in order to be successful technical assistance programs should be approached with care; and there should be complete agreement by the organization being assisted before the program is undertaken. There are some opportunities for short-term training which should have an immediate benefit to the program. There are other areas which should be considered from a more long term view point. In this report there is a summary of these "opportunity" areas. I have also discussed these and presented for your consideration the rationale for the recommendations made.

I also feel certain that AID/Engineering Office can assist you in developing a more detailed scope of work for this technical assistance program and finding a competent firm to perform the work. If you wish me to make some input to this I will be glad to do so.

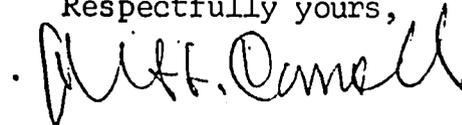
I also realize that you are not currently staffed to closely monitor this program, although Larry Donnelly can certainly give it general surveillance; and it is your good fortune that Larry, though a Civil Engineer, has had considerable exposure to the power sector. You may, however, wish to

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have someone make a periodic survey of progress. For the technical assistance program, you may wish to use a firm like Sanderson and Porter who have performed well to my personal knowledge in two other similar situations.

Again may I say that it has been a pleasure to have worked in your Mission on this assignment and I will be glad to assist in any appropriate manner in the future if you feel that I can be helpful.

Respectfully yours,

A handwritten signature in cursive script that reads "Alf L. Carroll". The signature is written in dark ink and is positioned to the right of the typed name below it.

Alf L. Carroll, P.E.

SUMMARY, GENERAL ASSESSMENT AND RECOMMENDATIONS

(The paragraph numbers of this summary refer to the report sections with the same numbers)

1. As expressed in the transmittal letter, this mission has been a most interesting one and both the Mission Staff and INDE have cooperated fully. Guatemala is indeed a beautiful country of great variety and the opportunities for INDE's development are great.
2. This summary contains the principal observations made, the conclusions reached and the recommendations offered. In each section these are more fully developed.
3. In preparation for this mission it was helpful to attend the joint meeting in Washington on June 10, 1977 and the subsequent briefing by Charlie Moseley and Wilson Hodgkin in Washington on June 21, 1977. Memos of these meetings are included in Section 3 of this report. These meetings were most helpful in providing me an understanding of AID's objectives in

Guatemala and the objectives and rationale of this particular program. Notes of these conferences are included in Section 3 of this report.

4. The guidelines for this mission are considered reasonable and were followed closely; and I believe that this report is responsive to them. Obviously, in a short assignment of ten working days in the Mission, it is not possible to delve into all details; however, I believe that the overall assessments and judgments are valid. To fully explore in depth all aspects of this situation would require more time and probably more than one individual.

5. It was of great assistance in executing this mission to have meetings in Guatemala after my arrival with: Larry Donnelly Chief Engineer, and Charlie Moseley; with the (then) Acting Mission Director Fred Schieck; with INDE staff; and with INDE's General Manager Ing. Luis F. Sáenz. Memos of all of these conferences are included in this report. They supplied very helpful background and information on the current status of the project and negotiations with INDE and with the GOG.

6. On Wednesday July 13, 1977, I traveled on the first of two extensive field trips accompanied by Mr. Gonzalo López, INDE's

General Commercial manager, to become familiar with INDE's system, with Guatemala and with some of the rural areas. I was most fortunate in having Mr. Lopez accompany me for several reasons:

- (a) Mr. Lopez is an engineer with long and broad experience in INDE in many different capacities. Previous responsibilities have included operation and engineering.
- (b) Mr. Lopez speaks English quite well, has a keen mind and a wide knowledge of INDE and its people. He had engineering training in the U.S. early in his career. (Tri-State University - Indiana)
- (c) Mr. Lopez could not have been more helpful.

On this trip we covered:

- (a) The Guate Sur Substation, Load Dispatch Center and Headquarters of INDE's Operating Department
- (b) The Escuintla Thermal Power Station
- (c) The Jurín Maninala Hydro Station
- (d) The Reservoir and Lake Amatitlán

The observations made on this trip and the conclusions drawn from it are fully covered in Section 6 of this report; however, they may be summarized briefly as follows:

- (a) The operation of these facilities is generally well handled. They are not overstaffed; the housekeeping is good; and the operators appear to be well trained.

(b) The supervisors with whom I talked were well informed and articulate; and they answered my many questions readily, frankly and clearly. Some of them spoke English and some spoke English quite well. There is a lesson here: in each one of these major facilities, the out-of-country engineering and/or construction firm which designed and built the facility also trained the local Guatemala staff. The second lesson: in every country this training may not be well absorbed and used; but in Guatemala the training was learned well and is being used. (c) In summary, therefore, it does not appear that INDE needs technical assistance for the operation of their generation facilities.

7. On Thursday, July 14, 1977, I traveled on the second extensive trip, again accompanied by Mr. Gonzalo López. On this trip we covered approximately 500 kilometers, leaving at about 8 AM and returning to Guatemala City at 8:30 PM. On this trip we covered the following areas and facilities:

- (a) The City of Chimaltenango, population of about 25,000, which was severely damaged by the earthquake of February 1976.
- (b) Novillero Village, a small but thriving village which has had electric service since 1966, is benefiting from it and utilizing it.

- (c) Nahualá, a small Indian town, which also has had electric service for a long period but on which this electric service has made no visible impact and where no economic growth potential is apparent.
- (d) Quezaltenango, population of about 80,000, where we visited the Commercial Regional Office and I was briefed on their work.
- (e) Quezaltenango substation (10 MW)
- (f) Construction Department Distribution Warehouse.
- (g) Santa Maria Hydro Station (approximately 5 MW).

The observations made and the conclusions drawn from this trip are fully covered in Section 7 of this report; however, they may be summarized as follows:

- (a) The operation of the small, necessarily and by nature isolated, hydro stations are well managed and to a remarkable degree well maintained. The engineers in charge are highly motivated and capable.
- (b) The new substations are of high quality but over designed and overly costly. These designs can be simplified and greater use made of local materials.
- (c) Some of the areas which are referred to as "rural" should more properly be referred to as "agricultural and suburban". In the Santiago area, for example, and

the area west of Guatemala City to Chimaltenango, the agriculture is in larger plots and very fine looking. The houses are not so far apart and the terrain not so steep and rugged. It looks relatively prosperous. Here the extension of electric service (which is presently available) was not too difficult or costly.

- (d) In other truly "rural" areas, such as were observed further west and north of the highway, the agricultural plots are quite small and very steep and the houses are scattered. Here the terrain is extremely rugged though beautiful. In this type of area the construction of electric service would be challenging and costly.
- (e) Although the rationale and the economic and social justification for this program have already been established, it seems relevant to comment on the sharp contrast in the two villages which were visited where in both cases electric service had been supplied for a period of about 10 years. The lesson which this suggests is that it may be wise to only extend service to a village that takes some initiative to obtain electric service and where there is an investment (a "stake") on the part of those who may use it. (Please refer to my notes on this point in section 7 of this report.)

(f) The Commercial Department of INDE is performing its essential function; however, it would benefit from stronger management support and more local autonomy with respect to service connections and disconnections. It would also be beneficial if unit costs were developed to cover line extensions for which the customer will bear a portion of the cost.

8. A meeting was held on Monday July 18, 1977 with the Projects Department to discuss in general INDE's plans and procedures for the implementation of this project and their part in it. This meeting is covered in detail in Section 8 of this report; however, the conclusions reached are briefly as follows:

- (a) INDE does not have an "Engineering Department" in the full sense of the word; but the Projects Department does have engineering responsibility and is staffed with engineers. Their responsibility is confined primarily, however, to transmission and distribution work; and generally they do not participate in the areas of generation and overall system development. This work, to the extent that it is done "in-house", is performed by the Planning Department.
- (b) The general concepts for the building of new facilities (such as this rural electrification program) are produced

the Planning Department. The Projects Department prepares the specifications and the tender (or bid) document but does not participate further in the project. They do not generally participate in the evaluation of bid proposals, inspect equipment or make inspections of actual construction.

Comment: It would seem clearly in INDE's best interest, and of benefit to this project, if the Projects Department's engineering capability were strengthened and more fully utilized.

9. An overall assessment of the project is covered in Section 9 of this report; however, it may be summarized briefly as follows:

- (a) The 69 KV subtransmission lines and substations should not in reality be considered "intra-structure" but are the most feasible, practical and permanent means for reaching the remote and scattered target areas which are AID's objectives.
- (b) The proposed substations are over-designed and too costly. They can be simplified, with a greater use of local materials and a resultant savings.
- (c) The project happily includes technical assistance, a concept which I heartily endorse. I recommend some increase in the amount allowed for this (from \$500,000 to \$550,000); however, the reduction in the costs of the

substations should more than cover this increase.

The rationale, the specific recommendations and a cost estimate are included in Section 12.

10. INDE is presently capable of physically engineering and building the sub-transmission lines, the sub-stations and the distribution facilities which are the components of this project; however, the rate of completion and the most effective use of the capital can be improved by the adoption of certain measures in the handling of the project. Furthermore the long term and lasting benefits of the project will be enhanced by a general improvement in INDE's management.

11. A number of specific recommendations are made in section 11 in regard to managing the project, principally in utilizing the engineering staff of the Projects Department more fully.

12. In general INDE is strong in operation and construction but needing more strength and development in other areas; but high motivation was sensed within INDE and many individuals with great potential were met even in the period of this very short assignment.

As INDE moves into the future with increasing responsibilities, an expanding system and a wider range of relationships with financial and other institutions, it is essential that they build greater strength, maturity and competency. Even in some areas where they appear to be strong, inputs from others within INDE which could be useful are not being utilized.

In my judgment, at this point in INDE's development, the right type of technical assistance is the best investment that AID could make. INDE does not need more studies, though some may be required to satisfy agencies like the World Bank; what they need is an in-house technical training program designed to meet their specific needs. Here we are proposing the use of seasoned and competent advisors working with their INDE counterparts on a day to day basis.

Because of its importance and because of the emphasis placed on technical assistance in the guidelines for my mission, this subject is discussed at some length in Section 12 of this report. Rather than approaching the subject from the standpoint of INDE's shortcomings and weaknesses, however, I have recommended certain specific "opportunity areas" for technical assistance. These are quite specific as to goals, people, time and cost. I have also recommended for your consideration some specific methods for implementation.

### 3.1

#### MEMO OF CONFERENCE IN WASHINGTON ON JUNE 10, 1977 REGARDING THE A.I.D. MISSION TO GUATEMALA

1. This conference was held in the A.I.D. offices in the New State Department Building in Washington in the offices of the Guatemala Desk. Present were the following:

Darean Day, LA/DR Finance Officer for Guatemala

Eric Zallman, LA/DR Finance Officer for Guatemala

Hank Bassford, LA/DR

Charles Moseley, Formerly Contract Consultant to Guatemala Mission and now direct hire A.I.D. in Panama

Charlie Stevens, A.I.D. Washington/ENGR

Wilson Hodgins, A.I.D. Washington/ENGR

Fred Schieck, Deputy Director A.I.D. Mission Guatemala

John O'Donnell, Program Manager A.I.D. Mission

Alf L. Carroll, Consultant

2. The project under consideration has to do with the further extension of electric service to the rural areas of Guatemala. There are two components of this project:

a) the building of three (3) 69KV subtransmission lines and two (2) distribution substations at an estimated cost of \$3,968,000

b) the connection of 92,800 new customers in the rural areas. This work will be performed by the National Electric System; namely, INDE. Associated with this program is a recommendation of technical assistance or training for INDE which is considered necessary in order that INDE complete the program in a timely and proper fashion. The total estimated

### 3.2

cost of the program is \$20,000,000 of which \$12,000,000 will be furnished by A.I.D. and \$8,000,000 will be furnished by INDE.

3. INDE presently serves approximately 70,000 customers directly and 14 towns which in turn distribute electricity locally under franchise arrangements. The proposed plan is based on serving 350 selected additional areas. The program envisions that each individual town will take the initiative and make the necessary arrangements to bring power to their communities.

This plan is not based on the idea of a rural coop. The whole program will be handled by the National Electric System known as INDE. There was considerable discussion of the so-called "front end" charge; that is, the amount of money required to cover the capital expenditure of connecting a rural customer and extending the lines to the area. One idea is that there should be a 50% split on this cost between INDE and the local citizens; but this is still a matter of discussion.

4. The World Bank is presently financing an electric rate study and has already invested heavily in the electric system development of Guatemala. The rate study presently being financed and managed by the World Bank must be considered in any final determination of the rates to be charged under the proposed program. This rate study will not be completed for a number of months; however, the World Bank is extremely interested in and supports the current program being undertaken by the A.I.D. Mission.

5. In answer to my question as to the rate of inflation, it was stated to be presently about 12%. It was estimated that the average cost per customer is \$150 including house wiring.

6. It was pointed out that 88% of INDE's power is sold to block customers and only 12% to direct consuming retail customers. 30% of INDE's customers pay the minimum amount only. In some areas this minimum is \$.60 a month for which the customer receives 7 kilowatt hours and in other areas the minimum is \$1.00 a month for which the customer receives 12

kilowat hours. The proposed rate is a \$2.00 minimum for 20 kilowat hours per month. The program envisions the connection of 92,800 new customers in 350 communities during a five-year period from 1978 to 1982. The criteria for determining whether or not a new customer should be connected is whether or not the investment or "front end" cost is not more than \$200 per customer. The range of population in the small villages to be connected is from 200 to 2500.

7. Program Objectives. The essential objectives to be accomplished in the program are the following:

(a) Eliminate the necessity of a cash outlay for the "front end" charge by the individual consumer to cover the cost of transformers and distribution extensions.

(b) The program is to be financed 60% by U.S. funding and 40% by local funding.

At the government level, the program would be handled through the Minister of Communication.

8. Scope of this Mission.

(a) To examine the plans for the subtransmission lines proposed to determine whether or not they are justified in consideration of INDE's capability to build the lines, make the distribution connections and pick up the local loads.

(b) To determine the scope of technical assistance and training which INDE may require and make specific suggestions as to how to implement the technical assistance including time, people and amount of input.

(c) To make an appraisal of the overall capability of INDE.

Later in the afternoon, since there seemed to be no opportunity for a scope of work to be prepared by the Mission or by AID/Washington, ALC drafted a scope of work which was subsequently reviewed with John O'Donnell and Wilson Hodgkin and finalized with their comments. (See attached.)

9. Further aspects of the forthcoming mission were discussed as follows:

(a) Scope of Work: Prepared by ALC in conference with O'Donnell and Hodgin.

(b) Passports, visas and shots: A.I.D. Travel Office will assist in these arrangements.

(c) Logistics: Quarters will be in a local hotel. The currency exchange is 1 to 1. Transportation will be provided. Adequate and competent bi-lingual stenographic assistance will be available in the mission.

(d) Guatemala City is at an elevation of 4,000 feet; it is cool at night and the temperature is generally pleasant.

(e) Tape recorder: U.S. equipment will work; the local supply is 60 cycles.

(f) Fees and budget: A budget was prepared by ALC and reviewed with O'Donnell. There was agreement on ALC's proposed fees and budget. John O'Donnell said that as soon as he returned to the mission he would request the mission's Contract Office to cable me a contract which would expedite making my mission official.

10. Further information:

(a) The present A.I.D. Engineering Staff consists of Larry Donnelly, Chief and one other civil engineer.

(b) There are no U.S. engineering firms operating in the country under A.I.D.'s programs at the present time. Recently Sanderson & Porter made a brief rate study, not in depth.

ALC  
7/7/77

MEMORANDUM OF A CONFERENCE IN WASHINGTON, JUNE 21, 1977  
with Mr. Wilson Hodgkin, AID/W Engineering Staff and  
Charles Moseley, AID Staff and formerly AID consultant in  
Guatemala.

1. Question to Mr. Moseley: Why did you choose the particular areas in INDE where you felt that technical assistance or training was needed?

Response: Mr. Moseley recommended particularly technical training in three areas namely, commercial, distribution, design and construction, and planning.

In regard to commercial, he felt that the commercial department generally was not given the management support that it could rightfully utilize and benefit from. He felt that the local offices needed to have more autonomy and that collections are inadequate. He stated that the meter readers work out of the central office, namely Guatemala City. (I subsequently found out that this is not essentially correct.) The processing of the bills is done in Guatemala City by machines but the actual meter reading and collection functions are handled in the district offices. Further comment by Mr. Moseley was that all the bill collectors are paid 15% commission for collecting the monthly bills. (However, I

ascertained subsequently that this is not entirely true. In the urban center the customers are expected to pay and do pay their bills at the commercial offices of INDE. It is only in the more scattered areas where they employ the principal of utilizing a collector paid on a commission basis. This collector is an employee of INDE in the full sense of the word.)

Regarding distribution practice Mr. Moseley felt that the construction capability was adequate; however, he felt that trouble calls and service connections should be handled locally on a district level whereas they are not so handled. He also explained that the distribution work is constructed by rather large teams or gangs which rotate on a circuit basis through the different areas; he felt that this work should be more district oriented.

Regarding planning, Mr. Moseley said that he felt there is a great need for improvement in this area. The only recent technical assistance which INDE had received in this area was by a German team about two years ago; however, the objective of this team was primarily to review the hydro potential in Guatemala and recommend those sites which had the best potential for development. This was not system wide overall planning in the usual sense of the word. He further stated that INDE has had some technical assistance but it has been fragmented and it has not been integrated in an overall sense.

In answer to my question as to INDE's attitude and assessment of the German technical assistance he said that he believed INDE felt that there was no real or genuine desire on the part of the Germans to transfer technology to the local INDE staff. There have been no other significant inputs of which he is aware, that is, no significant inputs to overall planning as such. Of course, there has been the necessary technical input for each one of the individual projects such as the hydro stations and thermal plants. In answer to my question, Mr. Moseley stated that the hydro plants were generally engineered by Europeans and the steam plants by the Germans.

2. Questioned as to his principal contacts within INDE.

Ing. Luis Saenz - General Manager, INDE  
 \*Ing. Rodolfo Morales - Assistant Manager - Technical  
 \*Ing. Luis Paz - Manager Planning Department  
 Ing. Eduardo Miron (Soto) - Manager Operations  
 \*Ing. Gonzalo Lopez - Manager Commercial Department  
 Ing. Francisco Montero - Exact status not clear but  
 apparently "Coordinator"

Further commenting on these contacts, Mr. Moseley mentioned four of these who spoke English quite well, namely, Messrs. Morales, Paz and Lopez. He spoke particularly of Mr. Gonzalo Lopez, one of the senior and long-term executives of INDE who had wide experience, good ideas and was a graduate of Indiana State University (I later ascertained that this was actually Tri-State University).

\* English Speaking  
 Note: Ing. is "Engineer"

3. Regarding the results of the last AID loan 520-L-019 my question was as to his candid appraisal of the success of this program. Mr. Moseley felt that this program had a limited success in the accomplishing of its target objective namely the connection of rural customers. The target was to connect 50,000 customers whereas only about 10,000 customers were actually connected; however, the program did help INDE in strengthening its system. In his judgement the program could have been more successful had there been more American supervision; however, at the time the AID Mission was not staffed with individuals who could give the program supervision. On the positive side however, he stated that the facilities that were built were well built by INDE.

Furthermore, the figures shown on the maps which I reviewed indicating how many customers had been connected, did not reveal the true facts insofar as what work was actually completed. Referring further to these maps he stated that the figures showing the projected customers to be connected under the new plan were only illustrative and not accurate. Further discussions changed substantially the target number of customers to be connected.

4. Regarding the source of power for the proposed rural electrification program, Mr. Moseley stated that the source

would be entirely from INDE's system or grid. No independent isolated hydro plants, for example, would be utilized in the program and there were no plans for installing diesels as has been done in some other countries.

5. Regarding Moseley's mission to Guatemala. His mission was essentially to supply bilingual engineering assistance to the Mission in developing this particular project. Information he required in general was supplied and he was on this assignment for a period of approximately 4 months. At the time Larry Donnelly, Chief Engineer, was in language school and although he gave Moseley moral support and what assistance he could he was not able to become deeply involved in the program because of being in language school.

6. Regarding INDE's strength. In general he felt that INDE's greatest strength was in physical construction and they were able to implement well specific projects. They used force account quite widely and contract for a lot of their work, particularly the substations.

7. In regard to INDE's weakest groups, he felt that engineers and planning were the areas where INDE needed the most help. There is no engineering group as such; however, the Projects Department performs generally the functions which an engineering

department would function. The construction group is rather strong and well staffed.

8. In regard to networks. What are they? Actually networks are small radial distribution systems and we probably should refer to them as "systems" rather than networks.

9. Regarding the Interim Report. My question was as to the purpose of this report and what its relationship was to the Project Review Paper. Wilson Hodgkin explained the situation as follows: After the Project Review Paper had been submitted (and by the way I found this a very informative and well prepared document), AID/W raised many questions regarding the project to the Mission. These questions had widely to do with the benefits of the program or the socialological aspects of it rather than the engineering aspects as such. The Interim Report, a very extensive document, was prepared in this particular case to respond to the many questions raised by AID. It was produced under great pressure at the Mission. In answer to my question as to whether there were significant changes in the project as a result of the Interim Report, Mr. Moseley said that there were some significant changes namely: a) 69 KV lines were added, b) the investment per customer was lowered, and c)

approximately twice the number of new customers were planned to be connected, and d) there was a proposal to eliminate the so-called "front-end charges".

By further explanation Wilson Hodgkin said that there is at present a very sensitive issue within AID and between AID and Congress on the matter of infrastructure financing in connection with projects of this type. Serious doubts have been raised therefore, regarding the wisdom of including the 69 KV subtransmission lines and the substations as a part of this project.

In further discussing the Mission's Project Review Paper, Mr. Moseley and Mr. Hodgkin said that it is essentially an accurate statement of the project although some of the figures have changed. The target for new connections is 93,000 but this may be cut back now because the project may be cut from a total of \$12 million to \$10 million. The figures shown in the tables are by individual years, they add up to approximately 95,000 for the entire four year program. By way of further explanation Mr. Hodgkin said that it should be borne in mind that this program is being financed out of the food and nutrition area of AID. This is another reason why the matter of infrastructure (69 KV lines and substations) is suspect. It is no longer AID's aim to transfer capital

resources into Guatemala. In this connection we discussed the matter of isolated diesel engine generation which has been used in some other countries. It was agreed that this approach has been found to be beset with many difficulties in other countries, consequently it could be argued with good reason that the building of some 69 KV subtransmission lines and substations is a more desirable alternate than installing isolated diesel engines, with all the problems which accompany that approach.

With reference to INDE's attitude toward this project, Mr. Hodgkin said that it seems apparent that INDE engineers want to build the lines where there is a genuine need for electricity and INDE has recently made a study to show how much money they are losing in the rural areas.

Mr. Moseley said there is a split in INDE on the attitude toward this program. The working engineers are generally against the program because they feel it is not helping INDE and would be unprofitable, whereas the upper management seems to favor it for broad humanitarian and possibly political considerations.

10. With further reference to the Interim Report, this exercise was somewhat frustrating both for AID/W and for the Mission because it channelled the time and attention

to both groups on these sociological issues and away from the preparation of a very complete and well conceived program as such. Consultants were used to determine the benefits of this program and it was apparent that these results and these surveys although well intentioned did not quantify the benefits in a very convincing manner.

11. Regarding the World Bank's assessment of INDE. The World Bank was generally critical of INDE's management, particularly their lack of planning. Was this opinion justified? Mr. Moseley felt that he was generally in accord with the assessment of the World Bank and that he believed INDE needed extensive technical assistance. Furthermore, in his contacts with INDE over the past four months he observed that many of INDE's people feel the same way.

## GUIDELINES

## GENERAL OBJECTIVE

The objective of this Mission was to assist the Office of Rural Development of USAID in the preparation of the Project Paper for the AID financed Rural Electrification Loan to the Government of Guatemala scheduled for Fiscal Year 1977 authorization.

## Specific Scope of Work

1. Determine, in collaboration with Instituto de Electrificación (INDE), the feasibility of, need for and location of the proposed sub-transmission lines and sub-stations to supply the expanded rural distribution system to be financed under the Rural Electrification Project. The subtransmission lines proposed by INDE are as follows:

	ESTIMATED COST
a) One 69 KV line (94 km) (Zaragoza-Quezaltenango)	\$1,711,000
b) One 69 KV line (56 km) (El Progreso-Quezaltepeque)	1,020,000
c) One 69 KV line (21 km) (El Porvenir-San Marcos)	396,000
d) Two distribution substations; one in Quezaltepeque, one in San Marcos	<u>841,000</u>
Total	<u>\$3,968,000</u> =====

2. Assess the capability of INDE to engineer and construct these substations, subtransmission lines and distribution lines and make the necessary connections to pick up the rural electric loads.

3. Prepare a description of the current organization, staffing and operating procedures of INDE and an appraisal of the overall capability of INDE to carry out this project. The appraisal should especially address the technical assistance and training which would be required to improve INDE's overall operation and, in particular, activities to be undertaken under this program.

4. Make specific recommendations as to the most effective method for providing the technical assistance recommended, including suggestions for staffing and other related questions.

The mission was expected to include up to two trips to Washington, D.C. and one trip to Guatemala, and probably will require travel in-country to outlying areas of Guatemala.

MEMORANDUM OF INITIAL DISCUSSIONS WITH AID MISSION  
IN GUATEMALA

I arrived in Guatemala City on Monday, July 11, at approximately 3:30 local time and was met by Larry Donnelly, Chief Engineer. After going through Customs, we had an opportunity to meet a member of the individuals in AID with whom I will be having conversations. We had an opportunity to meet - Fred Schieck, Acting Mission Director and others.

On Tuesday, July 12, I had a further conversation with Larry Donnelly, and the following interesting information was supplied:

1. The World Bank is considering several US firms to perform the rate study for INDE. They wish the same firm to assist INDE in a property evaluation or re-evaluation. This would of course, have a bearing on the rate result and the rate recommendations.

2. Larry mentioned the fact that has been considerable discussion in Guatemala recently regarding oil resources. The best current judgement on this question, however, is that it will have a limited impact on the power situation, for two reasons: a) The crude has a high sulphur content, b) The extent of the oil resources now appears to be less than was originally thought to be the case.

We had another brief conversation with Fred Schieck. He was most cordial and reviewed the tentative agenda or work schedule which I had prepared. He was in accord with the program and was quite willing to personally make the initial contact with INDE's General Manager. Charles Moseley will endeavor to make an appointment for this.

Fred also said that he had come to at least a tentative conclusion that the subtransmission lines requested by INDE were all necessary, unless it was found that they were entirely improper in concept and technically unsound.

We discussed briefly the general goals of AID in Guatemala in connection with the power sector. It was agreed that although

## 5.2

AID did not wish to support financially the infrastructure of INDE, it is reasonable to conclude that the subtransmission lines which are necessary to feed from INDE's basic grid to the point of distribution or load centers might not be considered infrastructure. They might therefore be necessary to accomplish the goals envisioned in the Rural Electrification Program.

INITIAL MEETING WITH INDE STAFF

Tuesday, July 12, 1977

The purpose of this meeting was to discuss my mission and to review for comment the tentative work schedule which I had prepared. Present were the following: Larry Donnelly-Chief Eng. AID; Charles Moseley-AID Staff (formerly Consultant); Alf L. Carroll-AID Consultant; Ing. Luis R. Toledo-Deputy Chief, Planning Department; Ing. Francisco Montero-INDE Coordinator; Ing. Francisco Ubieto-Engineering and Economics Division.

1. We discussed the general purpose of my mission to Guatemala, and the three principal objectives namely: a) To review the proposed program, particularly the subtransmission lines, the substations and the proposed distribution development; b) to review INDE's operations to determine how best they could implement this program; and c) to make recommendations for technical assistance or training which would benefit INDE.
2. INDE was concerned over possible delays in the program and/or the possibility of radical changes in the program as a result of this mission. They were also concerned regarding the problem of translation. However, I explained and reviewed a number of situations in other parts of the world where it had been possible to review a program of this kind and offer helpful suggestions.
3. After discussion there was general agreement on the program agenda and the INDE officials expressed their intention of cooperating fully.
4. During the discussion, several individuals in INDE were mentioned who were bilingual and could assist me on this mission. The most likely suggested source of help was Mr. Gonzalo López, Chief of the Commercial Department.
5. Subsequently we meet with Mr. López and he was most agreeable to assisting with my visits to some of INDE's Offices, plants and facilities. It was agreed that a specific program would be worked out, and Mr. López would endeavor to fit the trip into his schedule for the week.

## MEETING WITH MR. LUIS F. SAENZ-GENERAL MANAGER INDE

Wednesday, July 13, 1977

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Representing AID at this meeting were Mr. Larry Donnelly, Chief Engineer; Mr. Charles Moseley, AID staff (formerly AID Consultant); Alf L. Carroll, AID Consultant. Mr. Moseley outlined briefly the present situation with respect to the proposed Rural Electrification Program. He mentioned the future calendar of events and the necessary preparation to meet the schedule for final negotiations regarding the program.

Mr. Saenz outlined some of the difficulties which INDE faces in connection with this program. He also referred to the internal problems between INDE and the Ministries and pointed out that it was necessary for INDE to obtain formal approval by the Government before requesting funding from AID. He recommended an early meeting with the Economic Section of AID so that all matters could be resolved. He pointed out other problems which INDE faces, namely the following:

1. Their present rate structure is not meeting their financial needs and a rate increase is essential.
2. The World Bank is pressing INDE to increase their rates about 70% which is politically unfeasible.
3. The World Bank at the same time is pressing INDE to have a property re-evaluation which will affect INDE's rate base and its required rate of return. Mr. Saenz believed that according to the present rate base of INDE, their rate of return would be approximately 15%. However, if the properties were re-evaluated, he thought that the rate would be reduced to approximately 9%.
4. I explained briefly the purpose of my mission and requested Mr. Saenz's approval to have Mr. Gonzalo López accompany me on field trips to become familiar with INDE's operations, facilities and overall present situation. Mr. Saenz readily agreed to this proposal.

5. I also stated that it was my hope to have some helpful recommendations in connection with the program after reviewing the extensive work already completed by INDE and AID. Furthermore, that I intended to discuss these recommendations, if any, with INDE before making them formal.

6. I also expressed the hope that I would have an opportunity to hear Mr. Saenz outline his own plans and dreams for INDE's future and how he saw INDE developing. I also wished to hear the views of INDE's officials as to how they felt the proposed program could be most successful. Mr. Saenz expressed a desire to have such interchange of thoughts on a future date.

OBSERVATIONS, INFORMATION AND COMMENTSINDE FIELD TRIP

July 13, 1977, with Mr. Gonzalo López

1. GENERAL INFORMATION AND GENERAL COMMENTS:

a) The Municipals frequently do not pay their bills; that is, the Municipal distribution system which buy their power from INDE and distribute locally. For various reasons it is difficult for INDE to press for payment.

b) INDE executives are very capable but more departmental interchange would be helpful.

c) Some management training was given to INDE by the Middle West Utilities Company, a state-side engineering and management company, approximately six years ago. This program was conducted incountry for approximately one year's time and there were 4 or 5 individuals involved. However, the permanent benefits from this program appear to be doubtful.

INDE also utilized Acres of Canada for some consulting services. This was prior to the Middle West Program.

d) 70% or more of Guatemala is very mountainous.

e) The important export items are coffee, cane or sugar, cotton and cattle.

f) Concrete poles are used extensively; however, wooden poles are used, particularly in the highlands since they are much lighter.

2. VISIT TO INDE GUATE SUR SUBSTATION, LOAD DISPATCH CENTER AND OPERATING HEADQUARTERS:

This was a most informative visit and conference with Ing. Eduardo Mirón Soto, Chief Engineer, Department of Operation, who proved to be very well informed. Some of the information developed in this conference was as follows:

a) The total present thermal generating capability of INDE is 158 MW. (Including gas turbines and diesel), total

hydro capability is 85 MW. Therefore, total INDE generation capability is 243 MW. A new hydro development of 90 MW is to be financed by the World Bank. Mr. Mirón Soto spent 6 months in Japan in 1969 in a training program relating to hydro development and operation.

b) We discussed the matter of the 69 KV subtransmission lines that are being proposed as part of the AID Program. The capability of a 69 KV line in Guatemala is 12 MW. This is based on 477 MCM aluminum cable which is standard. The present 69 KV line from Guatemala City to Quezaltenango is approximately 200 Km in length. The additional distance to Huehuetenango is 100 Km.

The actual loading on this line in recent months has been as follows:

JANUARY	-	9,400 KW
FEBRUARY	-	10,300 KW
MAY	-	8,942 KW
JUNE	-	7,948 KW

The power factor is approximately 80%

It will be seen from the above that this line is already very near its peak carrying capacity. Actually, however, it is already overloaded, since there are two hydro plants in the area with a capability of 7 MW. The output from these two hydro plants must be carried on the 69 KV line; so, that it is acting as power interchange in addition to being a normal subtransmission line. It will be seen therefore from the above that, considering the present loading and the distance involved from Guatemala City, it is impractical to load this line any further.

c) Another factor which influences INDE's present planning is the high cost of substations transforming from 69 KV to 34 KV or 13 KV. Mr. Mirón Soto, expressed the view that these substations could be simplified and made less costly and he reflected the recommendations made by Charlie Moseley.

d) Looking toward the future development of the 69 KV system, in order to serve the rural areas North and West of Guatemala City, an important fact is that INDE plans to build with their own funds a 69 KV line from Antigua to Chimaltenango,

a distance of approximately 15 Km. This line is being built for several reasons. The Chimaltenango area was damaged severely by the earthquake which occurred on February 4, 1976. This area formerly served 13 KV. The area is now being redeveloped and an industrial area is planned. Two hydro plants which were in the area were also damaged and one will not be restored, since some of the water will be taken to Guatemala City for use there.

With further respect to either of these 69 KV subtransmission lines, there appears to be no economic justification for INDE to extend them any further, except to supply the rural loads which INDE considers unprofitable.

e) The rural customers in the highlands are considered unprofitable by INDE for several reasons. INDE had to pay 75% of the cost to extend the lines to serve these customers (they formerly had to pay 90% of the cost). The use of electricity is so small by these customers, in any case, the minimum, that INDE receives very little revenue. INDE finds it necessary to pay a 15% commission for the collection of the monthly bills in the rural area. (In the urban areas, the meters are read by INDE people and the customers pay their bills at INDE's Commercial Offices).

f) A general comment regarding this visit with Mr. Eduardo Mirón Soto. Mr. Mirón Soto was very well informed and was able to answer readily and clearly all of the questions which I raised in our conversation. He seems to have a good command of the situation. Through our conversations, I gained a considerable knowledge of INDE's system and its method of operation. I also visited the Control or Dispatch Center and was favorably impressed by the layout, the housekeeping and the general tenor of the place.

### 3. VISIT TO ESCUINTLA THERMAL STATION

a) The present equipment at the station is as follows:

<u>SOURCE</u>	<u>TYPE UNIT</u>	<u>CAPABILITY</u>	<u>YEAR INSTALLED</u>
GE (US)	GAS TURBINE	12.5 MW	1965
GE (US)	GAS TURBINE	12.5 MW	1967
(Station was relocated due to high water in the river)			1969
AEG (GERMAN)	STEAM	33 MW	1972
BRIDA (ITALIAN)	STEAM	53 MW	1977
TFM (US)	GAS TURBINE	25 MW	1976
TFM (US (Pratt & Witney)	GAS TURBINE	25 MW	1976
TOTAL . . . . .		161 MW	

b) Oil is received from the Texas Refining Company located approximately one mile or less from the thermal station. Oil is piped in from the refinery directly to the station.

c) INDE performs their own maintenance work; however, occasionally a US technician is called in. GE has supplied a technician from time to time. Each operating shift includes one engineer and 9 operators, or a total of 10. Approximately 25 employees comprise the maintenance crew and INDE performs its own maintenance.

d) The operators at the station have had no out of country training but were on the site when the units were being built and they therefore have had extensive in country training on the job by Spanish speaking Germans, Italians or Americans.

e) Cooling towers are used entirely for condenser circulating water. Generally all units are performing well. My visit indicated good housekeeping in the station which generally means good operation. The station reflects good

layout. Both boilers are completely outdoors; but except for the boilers, the station is totally inside. The general impression received from this visit was very favorable. It appeared to be a "tight ship". The design of the station was ample and the substation outside showed good spacing and good concept. It incorporates provisions for 230 KV transmission lines at some time in the future.

#### 4. VISIT TO JURUM MARINALA HYDRO STATION

a) This hydro station is located in a very remote and very beautiful area of the country. There are 3-20 MW units, installed in 1970. It is a well designed station, complete with all of the auxiliaries that are considered good practice in a hydro station.

b) The units and all the equipment in the station was furnished and installed by Brown Boveri of Switzerland, a company that has been in the hydro business for many years.

c) This is a high head plant, operating on a head of 600 meters. The units are impulse type.

d) There are 4 operators on each shift. We examined the station, all of the auxiliaries and the support facilities.

This station was clean and well maintained. The plant is fed from Lake Amatitlán and the flow from the lake is controlled by the hydro plant.

The operators and those in charge keep all of the equipment in the station in good repair and were well informed. Good house keeping was observed.

e. The direct feed to the plant is from a reservoir which is actually a surge tank or stabilizing tank. Remote indicators at the hydro plant show the level of both the reservoir and the lake. The reservoir has a very small volume.

On the day we visited the plant it was generating 34 MW. When the water is low, the plant is used for peaking only.

#### 5. GENERAL COMMENTS:

a) The rainy season in Guatemala is considered to be from July to November with the heaviest rain usually in August and September. The dry season is from December through June with the most pleasant weather in February and March when the weather is clear.

b) In the small villages we passed, the residents eat much corn, beans, rice and meat. Chickens are plentiful.

5. VISIT TO RESERVOIR AND LAKE AMATITLAN:

a) At the reservoir, there are three cleaning measures taken to insure good operation and the supply of good water to the hydro plant:

1. Trash racks at the inlet which have mechanical cleaning devices
2. Two settling basins which are drained periodically
3. The river bottom is dredged with a clamshell bucket

b) Amatitlan Lake is at an elevation of 4,000 Ft. It is a recreational area and its level is regulated not only by rainfall but also by INDE's draw down; so that this lake is actually the reservoir for the hydro plant.

The general impression of this hydro facility was favorable. It appears to be well designed, well constructed and was very dry inside, even those sections which are at a low level.

## OBSERVATIONS, INFORMATION AND COMMENTS

INDE Field Trip of July 14, 1977 with Mr. Gonzalo López

1. The first target on this trip was to visit the city of Chimaltenango, a city having a population of approximately 25,000. This city was damaged to an extreme degree by the earthquake of February 4, 1976 and is presently being rebuilt. There are two small hydro plants in the area each having a capability of 500 Kw.

A comment on the government of Guatemala was explained by Mr. López. The country is divided into 22 Departments (we might consider them states). A Governor for each Department is appointed by the President. Next year a new President will be elected and there will be a complete change in the government both administrative, elected and judicial.

We observed the great destruction the city suffered and observed a great deal of rebuilding in process. The area North and West from Guatemala City to Chimaltenango is a very beautiful area with much agriculture. It could not

really be called "rural" in the sense that the word is currently being used. I would call it "agricultural and suburban". It appears prosperous; there are attractive homes; and some residents commute to Guatemala City to work. This area is not supplied by INDE; it is supplied by EEG. There are no Indians living in this area. A distinction is being made here because some of the areas being considered for electrification in the highlands are peopled principally by Indians.

In Chimaltenango much damage was seen from the earthquake; and there is now much rebuilding. More wood is being used in construction than formerly. A comment on local resources: According to Mr. López, limestone is plentiful but there ~~is~~ not sufficient cement producing facilities to meet the demand; consequently cement must be imported. There is also plenty of sand and stone aggregate. Steel rebar is imported.

Electricity in the area is used primarily for lighting and some cooking. The primary distribution line in this area is presently 2400 volts but is being rebuilt to operate at 13.8 KV.

2. We discussed the matter of metering. INDE is presently analyzing their current policy in regard to metering and there is an opportunity to improve the present practice. For primary service (13 KV or 2400 volts), the present practice is to require high tension metering. This is expensive and requires potential transformers and other devices in order to perform the metering. It would be desirable for INDE to change this practice and do all of the metering on the low tension side. This matter of high tension metering is another "opportunity area" where technical assistance may be helpful to INDE.

3. Another matter which we discussed informally was the matter of cost analysis to determine the true cost for making line extensions to serve customers when it was necessary for INDE to extend the primary line beyond the point where they would normally go. Apparently, at the present time each situation of this kind requires an individual cost analysis. Regardless of how accurate this cost analysis might be, it would be of great benefit to INDE to develop standards so that if an extension of say 500 meters was necessary for a three phase primary line, this could be computed easily by using a previously established unit cost per meter or per kilometer. This is another possible area for technical assistance.

4. The highway from Chimaltenango to Quezaltenango is paved and in good condition but very winding. The country is high and very beautiful - almost breath taking in beauty. The cultivation is primarily by hand because the land is very steep. Beans and corn abound and some fruit. In the north central area the houses are very scattered and very small; and it would appear to be extremely expensive to extend electric service to these homes. Also they would probably be minimum use customers.

This situation is quite different from the area extending from Guatemala City to Chimaltenango. That area is more prosperous and the houses are much closer together. The cluster of homes is surrounded by the agricultural area.

Here, it seems, we must make a clear distinction between these two contrasting situations, viewing them from the standpoint of extending electric service.

To summarize:

(a) In an area such as that from Guatemala City to Chimaltenango we have relatively compact villages within repeat within an agriculture area where the service would be shortened, the houses larger and a possibility of some commercial or small industry use.

(b) An area such as that north of the highway between Chimaltenango and Quezaltenango. That country is much more rugged; the houses are very widely scattered; and the agriculture use is in smaller patches of very steep land. There would be minimum use and there appeared to be no opportunity for any commercial or small industrial use due to the pattern of living and due to the topography.

5. Another significant factor: it is common practice for the people who live in these truly rural areas north of the Chimaltenango - Quezaltenango axis to spend several days a week south of their homes to work and market. These local residents are transported by trucks owned by the farm owners in the southern part. While they are working in these farms, they live in what I would call field houses. On our trip we passed many truck loads of these workers being brought back to their homes in the upper area. The significance of this fact is that the homes of these residents would not be occupied for the entire week and they would have little use for electricity even for lighting.

6. Comment on the agriculture: We saw peach orchards with very good stand of young but healthy trees. The planting is the steepest I have ever seen anyway, as steep if not steeper

than some of the rice planting in Asia. Most of the land repeat most of the land is not terraced although some terracing was observed.

7. At Santa Lucía Utatlán we encountered the first rural electric line. It was supplying a normal regional school and fed from the hydro plant in Santa María. This distribution system was formerly fed at 22 KV but it has recently converted to 34 KV. Note: This is not fed from the 69 KV line coming around from the south since there are no transformers and since this 69 KV line is, as previously mentioned, presently overloaded.

8. We stopped at Novillero. This is a non-Indian repeat non-Indian town with a population of approximately 300. Electric service was brought to this town in 1966. There is a very active cooperative operating in the town. This town is a good example of how electricity has repeat has helped after being brought in about ten years ago. At the present time there is a visibly active growth pattern and economic life. Electricity is used in perhaps 50 homes; and it is used in these homes for lighting, cooking, ironing and some hot water heating. In the town there is a modern

and well maintained grain handling facility including silos and associated equipment. Electricity is used for blowers and other machinery in connection with the silos. There is also a very active rabbit producing facility here where both the skins and the meat are sold. The electricity for refrigeration is an important factor. Approximately 3000 rabbits are being grown at all times.

The coop has an attractive, well stocked and well maintained store where all manner of merchandise is sold. Tractors are also sold in the town and there is a shop for repairing tractors.

The local manager of the coop said the value of stock in his warehouse was approximately 8500 Quetzales.

There are 16 sub coops around the area which are related to this key headquarters at this village.

Mr. López told me that when electricity was brought to this town in 1966 there was very little if any economic life.

Repeating again, this is a good example of how electricity in a town can have a significant benefit. Besides

the economic activity it should be noted that the houses are relatively compact in the village. Consequently the secondary lines, service connections and other facilities would represent a modest investment per unit.

9. Another side comment here on the general construction aspects: the country in this area is extremely mountainous with extremely steep slopes and deep cuts for the roads. However, the approach to the 69 KV or 34 KV subtransmission is to utilize very long sections or loops with the towers or poles installed on the higher peaks. This is quite practical but it should not delude one into thinking that the construction of 13 KV primary lines closer to the surface of the ground to supply small houses in scattered areas would be inexpensive, On the contrary, it would be extremely expensive

In this village which was described above, the 34 KV line coming into the village traces a relatively easy path and it supplies other villages on the way; but between these villages there is no electric service even though the line may cross close to individual scattered rural houses.

10. We then visited a strictly Indian town by the name of Nahuala. This town was in sharp contrast to the non-Indian

town of Novillero. Electricity has been available to this town for a long time, partly due to a primary line near the area. Electricity is used for lighting but only in very few homes even though it is available. On the day we were there it was market day and there were many hundreds of people there, perhaps more than a thousand, buying and selling; but there was no significant use of electricity. The market area was not lighted and I could see no electric lights even in the market itself.

This is an extremely worn and tired town. There is an old church which had been there for many years but no growth was discernable except for two relatively modern buildings. In most cases the buildings were extremely run down. In general one might say that the electricity supply to this village had made no discernable impact. There is perhaps a lesson to be learned here and it seems rather obvious.

11. We continued to travel westerly to the town of Quezaltenango. We crossed the very high country on the highway which is called Guatemala's Alaska. Here I saw the highest wheat I have ever seen before. In this high area wheat appears to be the primary crop. It is grown in very

narrow terraces, presenting a really spectacular and beautiful sight. The trees are fewer at this high elevation; however, the wheat seemed to be growing very well.

12. Another comment prompted by the contrast between the Indian town and non-Indian town. If a village has to raise some money to bring in electricity there is a much better chance it will be utilized. Otherwise it may be very little used.

13. We spent some time in Quezaltenango. This is a city of approximately 80,000 population. It is presently served by one small hydro of approximately 1 KW capability, by diesels and by INDE power over a 50 KV line.

We visited INDE's Commercial Office where they have approximately 50,000 direct customers. The Commercial Headquarters controls 12 sub-offices. All meter readings are sent to Guatemala City where they are processed by machine. The bills are then sent back to the District Offices for collection. Bills are monthly and customers are normally cut off after two months of non-payment. New customers pay one month's estimated bill as a deposit. New service connections and disconnects are made by the Operations Department.

Regarding rates, INDE is free to establish its own electric rates. New rates were made effective on January 1, 1977 and represented a substantial increase.

14. We next visited the new substation near Quezaltenango. This substation contains 69/34 KV transformers with a capability of 5000 KVA (7000 KVA with fans) and from 69 KV to 13 KV with a capacity of 5000 KVA, 7000 KVA with fans).

This substation cost \$500,000.00 and is manned 24 hours a day. It is on a high area with very extensive land and an attractive building. It is almost a monument in appearance.

My impression of this station, however, is that it is over-designed and too costly. Looking toward the future, and considering the 69 KV substations which are contemplated under the proposed program, I would have the following recommendations: (a) The basic concept and circuitry could be simplified. (b) It is not necessary to use the heavy steel work. Some of the structure could be achieved by utilizing locally available concrete poles with a little imagination and improvisation. (c) In general I would think that the same objective could be accomplished at a cost of

approximately 65% to 75% of the cost of this station.

In this comment I am reflecting the views of Charlie Moseley, with whose judgement I concur, having seen this station. However, it is another opportunity for some helpful technical assistance. I think it would be unwise, with a broad brush, to simply sweep aside this design concept and attempt to redesign a substation in a brief discussion with INDE. I believe that a well qualified distribution engineer should spend time working in a careful, thoughtful and deliberate way with INDE Engineers to create a more practical, simplified and less expensive design. In principle, I feel certain this would be the way to go. Station had altogether 3-69 KV circuit breakers, four 34 KV circuit breakers and four 13 KV reclosers.

15. We next visited a warehouse in the area here. There was a good stock of line materials. This warehouse is handled by the Construction Department.

16. We also discussed INDE's present procedures for handling a project where new facilities are being requested. The sequence apparently, and this needs to be verified, by the way, is as follows:

(1) Planning Department would prepare economic engineering study to determine the need for a new facility and its size and other particulars.

(2) A request for new facilities would be prepared by the Planning Department and sent to the Projects Department.

(3) The Project Department would write specifications and prepare the necessary bid documents and send them to the Administration Department.

(4) The Administration Department would advertise for formal proposals to potential suppliers or contractors.

(5) The Suppliers or Contractors who are interested in bidding would prepare their bids and bring them to the Administration Department on a pre-determined date and time.

(6) The Administration Department would receive and open all of the proposals on the specified date publicly. They would make appropriate notations to identify the different proposals then reseal them and send them to the "Commission".

(7) The General Manager would appoint a "Commission" (actually a review panel). This would be an internal group appointed entirely by the General Manager.

(8) The Administration Department would send the sealed bids to the Commission for their review.

(9) The Commission would review all of the proposals, analyze them and make recommendations to the General Manager as to which should be accepted.

(10) The General Manager would review and in all likelihood accept and authorize the selection recommended by the Commission.

#### 17. Santa Maria Hydro

We then visited the Santa Maria Hydro Plant. This plant was originally built in 1930 and has been operating ever since. The units are as follows: Unit number one was installed in 1930, the turbine has a capability of 2400 KVA and the generator which replaced the original generator has a capability of 3100 KVA. Unit number two has a capability of 2400 KVA and unit number 3 2200 KVA. Unit number 3 was installed in 1952.

The operating head of this plant is 110 meters. Although it has a name plate rating of approximately 6800 KW the present capability is approximately 5000 KW due to reduced water flow in the stream because of diversion for irrigation purposes and because of the reduced efficiency of the units due to wear.

This station; however, is located in an extremely beautiful deep ravine and is unique in many respects. It is wholly self sufficient. The chief operator and staff do all of the maintenance work to keep the station going; they are extremely resourceful in this regard. This station is also operated essentially as a base load station.

DRAFT: July 20, 1977

MEETING WITH PROJECTS DEPARTMENT ON MONDAY JULY 18, 1977

The purpose of the meeting was to discuss in general the work of the Projects Department and their responsibility with respect to the implementation of projects such as the proposed rural electrification program. From this discussion the situation may be summarized briefly as follows:

1. For major projects such as thermal plants and hydro plants the Projects Department does not play any significant role. These are handled primarily by either the Planning Department and/or the Construction Department, utilizing outside engineering and/or construction contractors.
2. The responsibility of the Projects Department is confined primarily to transmission and distribution work. In these areas the general requirements are prepared by the Planning Department and conveyed to the Projects Department. The documents prepared by the Planning Department are quite definitive in that they include single line diagrams of substations and the number and carrying capacity of transmission lines, transformers and distribution lines.
3. The Projects Department prepares the specifications and drawings or diagrams and the bid (or tender) documents.

4. For procurement the tender (or bid) documents are then sent to the Administrative Department which handles the purchasing functions. (This may be an over simplification but is essentially the case.)

5. Requests for proposals or bids are then advertised through appropriate channels and are returnable on a specified date under the surveillance of the Administrative Department. The proposals are received and noted and then turned over to a "Commission" (or in US terms "Review Panel") which is appointed by the general manager. This commission analyzes the proposals and recommends which should be accepted. The Projects Department who performed the engineering input to the tender documents does not normally participate in this Commission. They do not, therefore, prepare an engineering analysis of the proposals to determine whether or not the proposals are technically responsive. Apparently the Construction Department has the primary responsibility for this evaluation.

6. Responsibility for further implementation of the project is in the Construction Department. No field inspection or technical supervision is performed by the Project Department.

7. Within the Projects Department, the draftsmen are generally part time but the engineers are essentially full time employees.

Comments: It is apparent that the operations of INDE generally and the implementation of this project would benefit from

strengthening the Projects Department and giving it more responsibility with respect to:

- (a) Input to evaluation of proposals
- (b) Inspection of equipment
- (c) Field inspection or technical supervision of field construction.

This would utilize their technical competence to a greater degree and also improve their technical performance by the experience gained in observing actual field construction.

Better coordination between the work of the Planning Department, the Projects Department, and the Construction Department should be achieved. One method of achieving this, as mentioned under technical assistance and management development, would be exchange of the supervisory staff members. This has proved to be most effective in U.S. utilities.

Although there is no doubt as to the ability of INDE to physically implement this project, its rate of completion and to some extent its economy will depend on the degree of cooperation between these three departments; and for this reason steps should be taken to improve this coordination and bring more engineering input to the project which can at present be best supplied by the Projects Department.

OVERALL ASSESSMENT OF PROJECT

The preparation of the proposed Rural Electrification Plan has involved a veritable mass of data by INDE in which they have considered in detail the particular rural areas to which electricity is to be brought. Mr. Moseley has spent four months in working with INDE in bringing together a broad summary and a cost estimate for this program. Obviously it would be impossible in a short time and a duplication of effort, for me to attempt to review and evaluate all of this material. However, based on what I have observed here in Guatemala and experience in other somewhat similar situations, I do have some general assessments. They are the following:

1. Sub-transmission lines.

I use the term sub-transmission lines since INDE now has and will be building in the future more 220 KV transmission lines for its principal power transfer systems. Also in the future larger generating units will be installed. For this reason it is valid to consider 69 KV sub-transmissions.

For several reasons I believe that these sub-transmission lines should properly be included in this program if it is to become a reality.

- (a) I am well aware of AID's sensitive posture on this issue but we must first consider the matter of

semantics. Here we have a somewhat grey zone; but generally speaking. "subtransmission" is to bring power to the load areas whereas "transmission" is for the bulk transmission of power from generator to transfer points in the system.

(b) Because of the topography of the land and the distance involved, 69 KV subtransmission is adapted to reach those remote areas. On the field trips I observed very long spans which were strung from peak to peak.

(c) INDE considers the supply to these remote and rugged rural areas to be unprofitable. To settle whether this is true or not it would be necessary to have an in-depth cost analysis made by competent engineers experienced in this work. Until and unless that is done, there will be no doubt much argument over this question. However, considering the physical aspects, the topography, the cost, the low use and other factors involved, I am inclined to agree with INDE. We might argue that some of the lines are more justified than others, and there may be some merit in this; however, the same rationale applies to all.

(d) The alternative to building the 69 KV lines and substations to supply those remote areas is to install

isolated diesel generators, as has been done in some other countries. I can speak from personal experience that the logistic problems, training required, fuel supply, associated equipment and other headaches are such that I would strongly advise against taking this course. The cost would also probably be greater and the probable useful life of the equipment might be in the range of 10-20 years (depending on the quality of maintenance) whereas the useful life of a 69 KV line and substation could be 40-50 years or more.

## 2. The substations.

The substations are an integral part of the system and are necessary if we accept the validity of the 69 KV subtransmission lines. However, I have the following assessments and recommendations with respect to these substations.

(a) They can be simplified in concept. They are over-designed and therefore too costly.

(b) A greater effort should be made to utilize local materials such as concrete pole construction. Even in the U.S. now, substations converting from subtransmission voltage to primary distribution voltage frequently utilize wooden pole construction to keep the cost down.

(c) Simpler design should make a more compact station requiring less land and land improvement.

In summary, it should be possible to reduce the cost of the proposed substations, somewhere in the range of 20-25%.

3. With further reference to substation design, the following suggestions should be considered:

1. Utilize fewer circuit breakers.
2. Utilize local materials to a greater extent.
3. Make cost comparisons of alternative designs.

This approach would not only be beneficial to INDE in reducing costs but it would also strengthen INDE's position in dealing with AID, the World Bank and other financial institutions. Furthermore, any steps taken to reduce costs would make capital resources used to better advantage. It would also help to lower rates and reduce the base on which INDE's earnings would be based.

Other ideas which should be beneficial to INDE are the following:

1. Executive interchange within INDE, particularly between the Projects Department (Engineering), The Planning Department and the Construction Department.

Since the proposed program involves heavy capital expenditures in sub-transmission and distribution, technical assistance to INDE should be helpful in examining all of the alternative ideas of substation design and distribution design.

#### 4. House Wiring

(a) If INDE installs the house wiring, in addition to building the distribution lines, this will place on them not only a present burden, but an undue burden on them for future maintenance. Furthermore, this plan will relieve the householder of any responsibility for taking care of the wiring in his own house which is doubtful wisdom.

A more desirable plan would be to have the householder own his wiring and have it installed by local electricians even though it may be necessary to train the electricians, and even though the cost of this wiring is paid for out of the program funds.

(b) It should be recognized also that the interior house wiring should be out of the control of INDE and therefore they should not have the responsibility of going into the householder's home to repair wiring and possibly appliances. This approach might take a little longer, but it would be more sound and result in a better situation ultimately. It would establish in the beginning that INDE's responsibility stopped at the meter.

(c) This presents an opportunity to develop another local skill which is one of the AID objectives in connection with the rural towns of Guatemala.

(d) In summary, it would be better to place on INDE the responsibility of building and maintaining their own facilities and not burdening them with the additional problem of every householder's wiring. There is some concern as to INDE's ability to bring electricity to the rural villages; and since their organization is probably already expanding at as rapid a rate as it can, it would be wise to let the development of local electricity utilization proceed concurrently with INDE's development without burdening INDE with this double responsibility. On the other hand, it would be quite proper to have INDE inspect the wiring and assist in organizing the training program for local electricians.

(e) In a discussion at the INDE Operating Department Headquarters with Mr. Gonzalo Lopez and Mr. Eduardo Miron Soto on 7/13/77, they stated that INDE does not normally install the wiring in the customer's home. They were both somewhat surprised that the AID program included the provision that INDE would install the wiring in the homes of the proposed rural customers. I mentioned the fact that it was to be my recommendation that INDE be relieved of this responsibility and that it be performed by local electricians. Furthermore, if there was a lack of local electricians that they be trained under INDE's guidance if necessary.

## 5. Technical Assistance

(a) I am thoroughly in accord with the inclusion of technical assistance as a part of this project and have developed rather detailed recommendations in Section 12 of this report in response to the emphasis given to this aspect in the guidelines for my mission. In fact, INDE is a veritable "gold mine" of opportunity for technical assistance to meet their special needs. I recommend that this be obtained through the services of a single competent firm which has experience in other developing countries. By using a single firm to supply assistance in the various special fields of INDE's work, fragmentation and possible conflict will be avoided.

(b) INDE does not need more studies as such; the recommendation is for in-house technical assistance to build INDE's own staff competence and skill.

(c) The recommended program includes allowances for U.S. state-side visits and training.

ASSESSMENT OF INDE'S  
CAPABILITY TO IMPLEMENT THE PROGRAM

1. INDE is capable of physically implementing this proposed program with its present organization structure and present stage of development; however, the rate at which the program is implemented and the effective use of capital made available can both be improved by adopting certain measures made reference to in other sections of this report.
2. The subtransmission lines, the substations and distribution lines which are in evidence are of good quality and therefore there is no reason to doubt that the same proficiency will be exercised in the proposed program.
3. However, these facilities, once in place, will remain in service for a long period so that in the long run any overall improvement in INDE's management and operation will have a beneficial effect on this part of their service area as well as other service areas. Consequently, we might say that INDE's overall proficiency in all phases of its operations are a valid concern with respect to the long term benefits of this U.S. investment in Guatemala. In other words, getting the lines in is only the beginning - not the end.
4. In section 11 of this report there are specific recommendations for managing this project most effectively. In section 12 is given

an overall assessment of INDE and detailed recommendations with respect to Technical Assistance are outlined in section **12.**

Even though the "target area" in this project is the rural area, the above considerations are valid concerns if we take a long term view of the U.S. investment in Guatemala.

DRAFT: July 20, 1977

RECOMMENDATIONS FOR PROJECT MANAGEMENT

1. The rate of successful project completion will depend in a large measure on the degree of cooperation and coordination between the following departments of INDE:

The Planning Department

The Projects Department

The Construction Department

A concerted effort by INDE management to improve the working relations between these three (3) key groups will expedite the work, reduce cost and result in a better project. For example:

(a) Management might consider some exchange of key personnel between these three Departments.

(b) The project should be reviewed in informal round-table conferences with free interchange of ideas and suggestions for improvement.

2. The experience and the abilities of the engineers in the Projects Department should be used to a greater degree. For example:

(a) The Project Department should participate on a regular basis in the tender (or bid) evaluation to make certain that the tenders are responsive to the specifications.

(b) The Projects Department should inspect the materials and equipment on arrival in country.

(c) The Projects Department should perform field inspections of construction and supply technical supervision of the work in the field (this does not mean managing the work which is properly the work of the Construction Department.)

3. Experience has shown that in order to have a successful project, either in the U.S. or in a developing country, it is very important to appoint a Project Manager who has the overall responsibility for the success of the project. This position would be established to last for the duration of the project and the Project Manager would be the contact point with A.I.D., with U.S. engineers or suppliers, or anyone else involved in the project. He should be free to cross over organization lines within INDE in order to expedite the project.

This plan may be a new concept, but it has been successful in developing countries and is recognized as good practice in the United States. It is therefore recommended that INDE appoint a Project Manager to have the sole responsibility of this particular project.

OVERALL APPRAISAL OF INDE AND  
RECOMMENDATIONS FOR TECHNICAL ASSISTANCE

1. In general INDE is strong in operation and construction and needing more strength in other areas. This is an over simplification, however, since there is good work being performed in all departments and I found individuals with high motivation and dedication to their work.

Rather than target on INDE's weaknesses or shortcomings; however, this phase of the mission has been approached from the standpoint of endeavoring to identify "Opportunity Areas" where well conceived technical assistance would bring a large return. This technical assistance would all be in-house with qualified and experienced advisors working closely on a day to day basis with their INDE counterparts.

2. This section of the report includes a tabulation of specific areas when technical assistance is recommended with specific target objectives and specific types of advisors. There is also included a cost estimate for the in-country training and for recommended state-side visits and special training.

3. COMMENTS REGARDING TECHNICAL ASSISTANCE

In every case I found INDE engineers and administrators

well informed, articulate and able and willing to answer my questions clearly. However, as a condition of the \$55 million loan by the World Bank, INDE agreed to reorganize and strengthen its Planning Department and its Financial Management Function. For this reason, discussions between the World Bank and AID relative to INDE's technical training may be useful.

In order to continue to have the support of the World Bank and other financial institutions and for INDE's own internal development, it would be wise to strengthen INDE's management in the following areas:

(a) Overall planning in all phases of INDE's development, not only in generation.

(b) Engineering, not only to implement specific projects, but to study primary and secondary distribution systems, and to analyze alternative methods of system development (that is, more creative and inovative ideas).

(c) Financial management, in particular financial planning.

4. Since the above goals require time to achieve, they must be addressed on a continuing basis. Therefore, it would be well now to identify individuals in the middle management group who have the potential for growth and expose these individuals to training in their special areas. English language training may properly be a part of this training.

5. Another factor is that the National Economic Commission recommended in September 1976 that INDE absorb EEG and become the single entity for power development in Guatemala.

In my informal discussions the idea of technical training seemed to be agreeable to INDE's engineers and executives. Some further examples of management development which would be beneficial are the following:

TRAINING AREAS	SHORT TERM	LONG TERM
1. Metering simplification (eliminate HT)	x	
2. Cost analysis (Develop Standards)	x	x
3. Substation Design (Simplify)	x	
4. Management Development (Seminars, State-side visits, Michigan State Course etc.)		x
5. Departmental Interchange		x
6. Distribution System (34Vs 13 KV)	x	
7. Middle Management Development (job exchange and language training)		x
8. System Development		x

6. COMMENTS ON TRAINING AND TECHNICAL ASSISTANCE METHODS

(a) Short term training programs or consulting programs can be handled very well by individual U.S. consultants being brought into Guatemala; however, when we consider long term training programs, this is another matter.

(b) For long time training programs it seems wise to build around those INDE engineers and/or officials who can now speak English. Although they themselves may not be in as much need of training as perhaps others, their bilingual ability will be of great help in developing a successful technical

assistance and training program. Another factor is that it would be important to build up a future program around some of the younger, promising engineers, and/or executives who can take time to learn English before going into an extensive training program.

(c) Language training in English will make possible a much wider range of training activities for several reasons. In the first place, English is becoming an increasingly international language. Furthermore, having the language training will make possible U.S. state-side training in public utilities in the United States and other institutions where the individual could spend several months to good advantage and gain thereby. After this training, this same individual could return to Guatemala and pass along knowledge to many of his associates.

(d) Another factor is that most of the World Bank documents are in English and international negotiations are commonly conducted in English; and if it were necessary or desirable for INDE to send representatives to the United States to deal with the World Bank, a knowledge of English would be a great asset.

## 7. USE OF CONSULTING ENGINEERING FIRMS

(a) Generally speaking, the employment of individual consultants for technical assistance to a local power agency overseas is not desirable except in a limited number of cases and equally true for this particular situation. Consultants

with long experience are not usually available except for short-term assignments since they are busy; and sometimes much of the consultant's time is consumed in logistic problems such as contract negotiations, passports, transportation, housing, etc., etc. It is also hard to achieve continuity on the overall project and the individual consultants may not know each other or have a clear understanding of each other's responsibility.

(b) Generally speaking, it is more desirable to contract with an engineering firm with wide overseas experience in similar situations who can supply and coordinate the efforts of the individuals working in-country in their respective specialties. There are several advantages in this arrangement.

You can cover a wide ranging field of disciplines under an "umbrella type" contract; and once you have selected the firm, they can find the people you need, check qualifications, develop the scope of work and make all the necessary arrangements. Stateside training for local people could be handled very easily by the engineering firm who usually has established contacts with manufacturers and utility companies. There are also other stateside services which an engineering firm can supply to the client. In theory, you may pay more for service through an engineering company because of their overhead and fees, but in actual practice, it will probably be cheaper.

(c) I have a strong conviction based on considerable personal experience that this is the best plan to utilize. AID/W engineering staff can assist in recommending and finding competent firms, and in negotiating a contract with appropriate scope of work and other features even though it be a Mission contract.

(d) There is one area, however, where an individual consultant might be employed to occasionally review the work being performed under the engineering contract and give an independent judgment as to how effectively the work is being done.

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TECHNICAL ASSISTANCE (  
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<u>Functional Area</u>	<u>Specific Objectives</u>
Substation Design	Simplify to reduce cost Use fewer circuit breakers Utilize local materials Analyze comparative designs.
Distribution System Design	Cost comparisons of alternative designs to determine most economical (34 KV vs 13 KV)
Distribution Cost Analysis	Develop unit costs for line extensions
Metering	Eliminate cost of high voltage metering
Departmental Executive Exchange	Executive Interdepartment Exchange Particularly in Planning Project Dept. and Construction Dept.
Senior Management Development	Seminars in Universities Visits to US Utility Companies Michigan State Utility Executive
Middle Management Development	Supplemental language assistance Stateside training in their respective specialties. Identify and develop individuals with potential
INDE System Development	Analyze and develop alternative plans for INDE's total system development considering generation, transmission, distribution, stores, etc.
Commercial and Rates	Rate analysis in relation to cost to serve
Financial Management	Strengthen in-house capability. Expand beyond accounting function
Planning	Strengthen in-house staff capability Rely less on consultants
Other Specialists	(Short term - as needed)

Notes: 1. Actually all phases of the recommended project will benefit this project in the long run. Once established, the Rural Electrification Authority will be in operation for an indefinite time in the future.

2. Whatever is AID's future relationship to this Technical Assistance will make this relationship more productive.

COST ESTIMATE FOR  
TECHNICAL ASSISTANCE AND  
MANAGEMENT DEVELOPMENT FOR INDE

PART I

1.	Experts, Specialists and Advisors 44 man months at \$3,500/MM	=	\$ 154,000
2.	Overhead 100%		154,000
3.	Fee 8% x \$308,000		25,000
4.	Home Office Studies & Assistance		20,000
5.	Travel 10 x \$600		6,000
6.	Living Expense 44 MM x 30 = 1320 MD at \$41		<u>55,000</u>
	Subtotal		\$ 414,000
	Contingencies		<u>56,000</u>
			\$ 470,000

PART II

Travel & Per Diem for travel to the  
U.S. for 20 INDE Executives and/or  
Engineers

1.	Travel 15 x 600		\$ 9,000
2.	Living Expense 15 x 3 months = 45 MMx30 = 1350MD at \$35.		47,500
3.	Travel in the U.S. 15 x \$300		4,500
4.	Other Expenses in U.S. 15 x \$200		<u>3,000</u>
	Subtotal		\$ 64,000
	+ Contingencies		<u>16,000</u>
			<u>\$ 550,000</u>