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INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT PERFORMANCE AUDIT REPORT ON
GUATEMALA FIRST AND SECOND POWER PROJECTS

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PREFACE

IBRD Loans 487-GU and 545-GU, of 1967 and 1968, to the Guatemalan Instituto Nacional de Electrificación (INDE) were closed in December 1972 and November 1974, respectively. This performance audit evaluates both of these loans, especially in light of their close relationship, which makes review of one nearly impossible without a discussion of the other.

The report is based primarily on (a) the Project Completion Report for Loan 487-GU issued by the Latin America and Caribbean Regional Office in February 1974; (b) a review of the relevant material in the Bank files, including the financial and engineering quarterly progress reports submitted by INDE during the projects' construction, as well as the various consultant's reports dealing with project feasibility and management reorganization; (c) discussions with several members of the Bank staff who have been involved with the projects; (d) a one-week mission undertaken in August 1974 to gather basic data unavailable in the Bank, to visit plant sites and to discuss the projects with the management and staff of INDE; and (e) INDE's comments on an earlier draft of the report.

The valuable assistance provided by the Instituto Nacional de Electrificación, its General Manager and Senior Staff, by the Empresa Electrica de Guatemala, and by the Infrastructure Department of the Consejo Nacional de Planificación Economica in Guatemala, is most gratefully acknowledged.

Note: Currency Equivalent (quetzales)

1963-1974: Q 1.00 = US\$ 1.00

Fiscal Year: January 1 - December 31



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SUMMARY

Loans 487-GU and 545-GU, both to the Instituto Nacional de Electrificación (INDE), are the only two loans that the Bank has made for power development in Guatemala. INDE, an autonomous Government agency which began operations virtually from scratch in 1961, is now the principal bulk power supply agency in the country, accounting for two-thirds of national generation, but it also serves 45,000 direct retail customers, mainly in small towns and some rural areas, and eight municipal distributors. It sells about 85% of its production to Empresa Electrica de Guatemala (EEG), a subsidiary of an American corporation until 1972 when it was purchased by the Government, and its concession -- for distribution of energy in the country's principal market, Guatemala City and neighboring towns, and generation from thermal plants built before 1965 -- was extended a further five years, to 1977. The Bank's loans were mainly for the foreign exchange cost of generation facilities required to meet the growing demand of this market area and have in fact partly financed 110 MW of INDE's current total installed capacity of 162 MW.

Due to difficulties Guatemala had had in settling a minor external debt dispute, Loan 487-GU of March 1967 was the first Bank loan to Guatemala since 1955 and was itself signed more than 18 months after the underlying project had first been appraised. The main element in the project was the 60 MW Jurun-Marinala hydroelectric station, supplemented by a 12.5 MW gas turbine to provide an early increment to system capacity. Both items, together with related transmission lines and conversion of a sub-station to a central dispatch center (decided after loan approval and largely financed with funds saved from consultant services), were completed close to schedule. The total project, as modified, cost only 12% more than the US\$ 23.5 million equivalent originally planned, and the Bank's US\$ 15 million loan was fully disbursed by December 31, 1972.

The second power loan, 545-GU, was signed in June 1968, only 15 months after the first. It was intended mainly for a 33 MW steam unit which INDE had first suggested in mid-1966, the Bank had then questioned as an unjustified emergency investment to reduce an expected period of shortage prior to completion of Jurun-Marinala and finally, after prolonged discussion, accepted for its long-term ability to provide base-load energy complementary to the rather low plant-factor Jurun-Marinala. A flood in September 1969, after civil works had already been started, revealed that its proposed site (the same as that for the gas turbine) lay in an ancient river bed. Recommendation of work at a new site, involving substantially greater civil works, was the main factor causing a 22-month delay in completion of the unit, to July 1972, and a 60% cost overrun. Operating problems have long prevented the unit being run at more than 30-31 MW load and caused extended outages, but the main supplier, AEG of Germany, recently agreed to rectify the plant in return for retention payments previously withheld by INDE, and the only remaining matter outstanding is how the interim increase in the dollar value of total DM sums should be shared between the two enterprises. The Bank's US\$ 7 million loan became fully disbursed in November 1974.

Due to delay in the Bank's first loan, the difficulties with the steam unit and extended outages on some other plants for lack of spare parts, INDE has had difficulty in meeting peak loads and the annual load factor on the main system interconnecting EEG and INDE plants rose to as much as 65% in 1973. The gas turbine has fulfilled a crucial role under these circumstances and has been heavily used. The additional investment in Jurun-Marinala compared with an equivalent thermal plant was expected, according to the appraisal report, to yield a return of about 10% but will in fact yield more, mainly due to the subsequent very large increase in fuel prices. Given the delays in hydro-electric planning that had occurred, the 33 MW steam unit was also probably the best system addition that could be made at the time, and the investment is likely to come to yield a satisfactory economic return to Guatemala, despite the expense of the site-change and the delay in effective operation, in part because further delays are occurring in construction of capacity to keep up with system load growth.

INDE's financial performance -- with return to overall average net fixed assets never exceeding 6% and dropping below 4% in 1973, compared with the covenanted 9% level -- has been very disappointing. Net internal self-financing of construction expenditures, which was not projected high because of the small base and rapid growth of its systems, has fallen short of expectations, actually reaching only 20% for instance for 1968-71, and Government, instead of terminating financial support for the sector as projected in the first appraisal, has had to continue to contribute between 33 and 40% of construction expenditures in the form of equity. The main reason for poor financial performance is the organizational structure of the sector, with the most lucrative market in the hands of EEG, under a favorable concession and with strong political power, and the large capital requirements, for expansion of bulk supply and system extension to new areas, the responsibility of INDE. The Bank may have missed an opportunity offered by the Government in 1965 to help create more satisfactory financial arrangements between the two companies; the problem has been significant enough that a six-month delay to try to solve it at that propitious moment would probably have been worthwhile, although the previous history of delay due to the external debt dispute helps to understand why the Bank did not choose this course.

INDE has accomplished a remarkable growth and its unit costs of production, although quite high -- and much higher than projected by the Bank's appraisal reports -- do not seem unreasonable compared with some other producers. The Bank's insistence on retention of an accounting advisor as a condition of the first loan and its emphasis on training -- especially of steam plant operators -- in connection with the second loan have probably contributed a little to the growth of the organization. The more major studies done at the suggestion of the Bank, and partly financed by it -- on organization and planning/forecasting procedures by International Middle West Services Co. (IMWSCO) in 1968 and on power industry regulation by a UN ECLA team in 1968-70 -- seem to have had little impact, mainly because of lack of decisive action by INDE management on them and their recommendations. INDE's External Auditor has continued to press for implementation of the IMWSCO recommendations and the Bank could probably

usefully have given him more regular and frequent support. The Bank has not given INDE the extent of loan supervision service that a borrower is normally deemed to warrant and that INDE's special difficulties might particularly have justified. The Bank staff states that an explicit decision to limit supervision was made around 1970-71 in light of a strong feeling that INDE was not very receptive to Bank advice; it is unclear how much this arose from a real lack of interest on INDE's part and how much from the fact that the Bank had really 'lost' a number of earlier technical arguments and from the very lack of deep contact itself at a crucial stage-- there was only one officially so-designated supervision mission in the three years following appraisal of the second loan in October 1967.

But the most serious problems, in retrospect, to solution of which the Bank could have contributed more -- though one might first have expected more of INDE and the Guatemalan Government -- are the persisting fault in the organization of the sector and the lack of follow-up to the hydroelectric recommendations of the major power study carried out by Acres International in 1960-62 under Bank auspices as Executing Agent for the UN Special Fund. Only 40% of capacity additions between 1962 and 1976 will in the event have been hydroelectric, compared with 95% recommended by Acres -- and this not because Acres was considered wrong, but because projects were not prepared, except for one (Atitlan) which the Government eventually decided, mainly for geological and ecological reasons, to shelve. One new hydroelectric project is now under preparation, but INDE initiated only late in 1974, with generous German technical and financial assistance, the Master Planning exercise which the Bank had belatedly suggested in 1971. Amidst the many, more minor problems the Bank appears to have given insufficient emphasis to the basic structural one and the insufficient hydroelectric planning, and it confined its efforts too frequently to INDE even when action had really to be taken by the Government.



PERFORMANCE AUDIT REPORT ON
GUATEMALA FIRST AND SECOND POWER PROJECTS
(Loans 487-GU and 545-GU)

The Instituto Nacional de Electrificación (INDE) has risen over the thirteen years since it began operations late in 1961 to be the principal bulk supplier of electricity in Guatemala, a country with a population of some 6 million growing at 3.3% per year. INDE was established as an autonomous Government agency with a very broad future mandate to develop the country's electric power resources but with direct control over only quite minor existing power systems, totalling about 12 MW installed capacity, transferred by the Government. By 1973 it had an installed capacity of about 162 MW, 70% of the country's total, and accounted for about two-thirds of national generation of electricity but only about 5% of electricity distribution. The latter function remains largely in the hands of the Empresa Electrica de Guatemala (EEG) which was purchased by the Government from the Boise Cascade Corporation (successor to American and Foreign Power) for US\$ 18 million in 1972 and had its original 50-year concession extended a further five years to 1977. EEG has been and remains responsible for virtually all electricity distribution in the Central Region (including Guatemala City with its 1 million inhabitants), which accounts for about 85% of the country's total consumption, and also generates about 30% of national electricity production from thermal plants built before 1965. In other major inhabited areas of the country -- the Western Region centering around the industrial town of Quezaltenango, the minor Eastern Region ^{1/} including the town of Zacapa, and the Atlantic Region based on Puerto Barrios (see map) -- responsibility for distribution is shared between INDE and eight municipal utilities which it has been helping to build up. Outside of these areas electricity, where available, is supplied mainly by small municipal and private companies. It is currently estimated that about 25% of the country's total population have access to electricity, but only about 5% of those who live in rural areas.

The Bank has made only two loans for electric power development in Guatemala, in quick succession in 1967 and 1968 and both to INDE, but these loans, mainly for generation, contributed to the costs of 110 of the 150 MW added by INDE since its establishment, and the Bank has in fact been continually concerned with the development of the sector since 1960. As Executing Agency for the U. N. Special Fund it was responsible for a comprehensive study of Power and Irrigation Development which was carried out by Acres International in 1960-62. Acres covered the electric power sector quite comprehensively and outlined a proposed national program of generation and transmission development through 1976.

^{1/} The Eastern Region system was interconnected with the Central system in 1969 and a transmission link between the Central system and the more significant Western Region system was due for completion in September 1974.

The Bank was unable to participate in financing the initial projects in the program due to a small but long-outstanding international debt dispute (between Guatemala and some Belgian bondholders) which prevented any Bank lending to the country between 1955 and 1966. However, late in 1964, in the expectation that this dispute would soon be settled, the Bank did agree to send a mission to discuss a possible power project. Concerned at finding Guatemala favoring a hydroelectric project (Jurun-Marinala) rejected by Acres, the Bank recommended an independent reassessment by a competent consultant. When this study, by Harza, confirmed the Guatemalans' choice the Bank appraised the project in May 1965.

Preparatory work continued, including complex negotiations between INDE and EEG on a sales contract and on compensation to the latter for land and water rights required to construct the proposed project, and bids were called and received, but it was not until the middle of 1966 that a new Government took office which was finally able to take the politically difficult step of paying off the foreign bondholders. Final negotiations for the Bank's loan took place in October 1966 and it was approved by the Executive Directors in January 1967, signed in March and became effective in November, the delays being principally due to time required by INDE to fulfill various conditions of loan signing and then by the Guatemalan Congress to approve the loan.

Before this loan (487-GU) had become effective, but nearly one year after the original request had been made, the Bank undertook two further missions to appraise a steam plant originally intended to first fill an expected gap in the country's generating capability before eventual commissioning of Jurun-Marinala, but finally supposed to complement the latter (with an expected plant factor of only about 35%) with base-load energy. Negotiated in May 1968, a loan for this project was signed in June (Loan 545-GU), and became effective in December.

Intermittent discussions followed over the ensuing years on Bank financing of a rural electrification project, eventually undertaken in 1971 with U. S. AID financial assistance, and of the next stage of generation development. When the Government finally determined that a hydroelectric scheme based on Lake Atitlan, which had been virtually the sole focus of planning since the Acres report, should not be initiated so that INDE was obliged to add a thermal plant instead, the Bank appraised and negotiated a loan for the project in 1972, but INDE eventually had to turn to a local bond issue for financing after disputes on bid awards with both the Bank and its own preferred supplier. The possibility of Bank participation in financing a hydroelectric scheme on the Chixoy River, now envisaged as the next major development, is presently under consideration.

Project Implementation

The 60 MW Jurun-Marinala hydroelectric scheme, which accounted for nearly two-thirds of the projected and actual costs of the project financed with Loan 487-GU, involves diversion of water by an earth dam across the Michatoya River at Jurun, about 10 miles downstream from Lake Amatitlan, and

its passage through a 12,000 ft. concrete-lined tunnel to a 9,000 ft. penstock terminating in a power station located on the Pajal River about one and one-fourth miles above its confluence with the Marinala River; main storage is provided naturally by Lake Amatitlan, while there is daily regulation capacity at Jurun; the head available between the intake at Jurun and the power station discharge into the Pajal River is about 2,000 ft. The scheme was implemented without major change from original design.

Apart from a decision, approved by the Bank in 1968, greatly to expand works and installations under the project at Guatemala Sur substation, so as to convert it to a dispatch center for the main (Central Region) system, the principal physical change in the project between appraisal expectations and actual achievements was a change in location of the thermal units. Electro-Watt, INDE's consultants for this work, had recommended installation of both the gas turbine envisaged under the first project, and the 33 MW steam plant which was the main item under the second project at the same site at Guacalate, near Escuintla, where INDE had installed its first 12.5 MW gas turbine, completed in September 1965; in none of its several appraisal missions does the Bank appear to have enquired into this question. The Bank-financed gas turbine (also 12.5 MW rather than the 15 MW mentioned in the appraisal report) was installed there by May 1968. But in September 1969 a flood engendered by Hurricane Francelia engulfed the area, which turned out to have been a former course of the Rio Guacalate, put the gas turbines out of operation and damaged the civil works which had been begun for the steam unit. An Electro-Watt study early in 1970 concluded that the site of the units should be changed a few miles to Finca Mauricio, to which the gas turbines were transferred and where work on the steam station was duly recommenced, most of the civil works being accomplished by INDE force account, by agreement with the Bank in face of the contractor's high price demands and the difficulties and delays of re-bidding under the circumstances.

In face of slower than expected demand growth in the Puerto Barrios area (especially at Puerto Matias de Galvez), and shortage of capacity on the Central System it was decided to procure three mobile diesel units of 1,350 kw each instead of the originally envisaged four 1,250 kw package units and to install them initially in the Central Region, for transfer elsewhere after completion of Jurun-Marinala; two are now in the Atlantic Region and one in the Western Region.

The principal physical items built under each project, their forecast and actual costs and completion dates are summarized in the following table.

First and Second Guatemala Power Projects: Costs and Schedules

	<u>Total Costs (\$ mns)</u>			<u>Date of Completion</u>	
	<u>Expected</u>	<u>Actual</u>	<u>Increase</u>	<u>Expected</u>	<u>Actual</u>
<u>Loan 487-GU Project</u>					
Jurun-Marinala ^{a/}	14.8	16.9	14%	Jan. '70	Feb. '70
Escuintla Gas Turbine ^{a/}	1.6	2.3	44%	Dec. '67	May '68
138 kv Transmission Line ^{a/}	1.1	1.3	20%	June '69	May '71
Sub-stations on 138 kv Line ^{a/}	0.3	3.0	900%	n.a.	n.a.
Diesel Units ^{a/}	1.4	0.8	-43%	n.a.	n.a.
Other Engineering Services	1.4	0.1	-93%	-	-
Contingencies	1.4	-	-	-	-
Interest during Construction	<u>1.5</u>	<u>2.0</u>	33%	-	-
Total	23.5	26.4	12%		
<u>Loan 545-GU Project</u>					
Escuintla Steam Plant ^{a/}	5.7 ^{b/}	9.2 ^{c/}	61%	Sept. '70	July '72
Feasibility Studies	2.7	4.6	70%	-	-
Interest during Construction	<u>0.5</u>	<u>0.8</u>	60%		
Total	8.9	14.6	64%		

^{a/} including engineering services

^{b/} including 10% contingencies

^{c/} excluding allowance for any additional payments (not more than \$200,000 at most) that may be made to AEG on account of increase in the dollar value of the DM-denominated retention payments.

Further details of project costs are given in Annex Tables I and II.

Because of the delays which preceded the making of both loans, bids for the major items were in before the final project cost estimates were put together. Nonetheless, the facts that final cost overrun on Jurun-Marinala's estimated cost (excluding contingencies) was only 14%, compared with low 7% contingencies allowed, and that most of the additional overrun was due to the prime contractor winning a US\$ 498,000 bonus for early completion, indicate good estimating. The very large increase in expenditure on sub-stations under the first project was virtually entirely due to the changes in composition of works described above. The large cost overrun on the 33 MW steam plant under the second project, as well as the smaller ones for the Escuintla Gas Turbine and the 138 kv Transmission Line, were mainly the result of the original mistake in plant-siting. The estimated actual costs include

substantial additional items for purchase of the site at Finca Mauricio, site preparation and civil works ^{1/} (costs originally expected to be low because only extension of the existing Guacalate station was involved) and construction of a 10-mile pipeline to bring make-up water from Monte Maria whereas on-site wells had been planned at Guacalate (although it is now thought that they would have proved inadequate there, and that the Monte Maria scheme would have been necessary anyway). Other items contributing significantly to the increase in dollar costs for the steam plant were changes in relative currency valuations (since the main supplier was AEG of Germany), changed specifications for the make-up water treatment plant (serious errors had been made - apparently by the foreign contractor involved and the general consultants - with regard to the silica content of the water), additional engineering services connected with the change in site and certain operational difficulties that have arisen with the plant.

These operating problems, which have been the subject of prolonged dispute between AEG and INDE as to whether they result from deficiencies in maintenance and operation or in design, have added significantly to the costs imposed by the long delay in completion of construction, which was particularly important from an operational point of view only for this item among the major works financed under the two projects. The three 20 MW Jurun-Marinala units were commissioned consecutively in December 1969, January and February 1970 compared with appraisal report estimates of July 1969, October 1969 and January 1970, respectively; after nine months of operation excessive wear was noticed on the Pelton turbines, a problem that the special consultants called in by INDE attributed to poor quality of materials, and the electrical-mechanical contractor (Brown Boveri of Germany) did agree in April 1971 to repair all three turbines free of charge and train INDE personnel to make any necessary future repairs. The delay in completion of the transmission line appears long but this relates only to the sections linking with the new Escuintla station, and supply of Jurun-Marinala power to Guatemala City was not delayed for lack of transmission. But the 22-month delay on the Escuintla steam plant mainly due again to the site change, was more serious, and it has been followed by persistent operational problems limiting output to 30-31 MW and causing frequent outages (on as many as 182 days in 1973 according to INDE). Through the end of 1973 it had generated only 227 million kwh compared to the 777 million kwh projected in the appraisal report (see Annex Table III-B). Recent settlement of the dispute and repair of the machines by AEG should enable the plant to produce the full 33 MW in future.

Project Justification and System Planning

Available data on the growth and operation of the Central Region's interconnected system, to which all the plant partially financed by the Bank loans except for the Puerto Barrios diesels was destined, show that the delay in fully effective operation of the Escuintla steam unit has had a clear cost in terms of extra use of expensive gas turbine generation and that it may

^{1/} But there is no evidence that construction by force account increased costs more than would anyway have been the case. The Bank's decision on this score seems to have been wise.

have somewhat constrained the growth of system load; but it is evident that the cost has been nothing near so great as it would have been had the load forecasts used in the appraisal reports not proved considerable overestimates. Peak demand actually met is lagging as much as three years behind forecasts, reaching only in 1973 the 136 MW projected for 1970, while throughout these years there has been ostensible reserve capacity on the system of some 45-60 MW (see Annex Table III-A). But it is unclear how much this spare capacity has actually been available; there have, for instance, been some lengthy outages due to delays in getting spare parts. System annual load factor has risen extremely sharply from about 54% in the mid-1960s to 60% in 1971 and 65% in 1973, which is probably partly indicative of significant load compression. But energy sales are also running nearly two years behind forecast, showing a growth of only some 10% p.a. 1966-73 compared with the 12-13% projected in the appraisal reports. One fear that the Bank had at the time -- that the privately owned EEG might slow its rate of distribution expansion and thereby inhibit sales of the power generated -- does not seem to have been realized, and real GNP growth, at 5.5-6.0 annually, seems to have been better than expected. It is possible that energy demand growth has also suffered somewhat from poor performance with regard to plant availability, but it seems more probable that the Bank gave insufficient weight in its forecast to factors which it did nevertheless mention -- namely, the importance of conversions from self-generation and of reductions of earlier supply restrictions in explaining the high 14% annual rate of growth in energy sales in the preceding period (1960-65). It is noteworthy that Acres, referring to the same factors, had projected a drop-off in growth to 10% annually over the period 1967-71, which has proved very accurate.

Just as the present prospect of shortage of generating capacity in coming years -- due to delays in current plant additions -- means that the steam unit will probably prove to have been an economically worthwhile investment despite its high cost and delay between investment and realization of full benefits, so the difficulties on this unit have added to the use and the economic benefit of the plants financed under the first Bank project. The gas turbine appears to have operated at a plant factor averaging as much as 30% since its completion in May 1968.

It is hard, if not impossible, now to make a sound comparison between Jurun-Marinala and the 40 MW El Canada, the proposed plant on the Samala River with which it was mainly compared at the time and which was rejected then mainly on grounds it would preempt a possibly more attractive version of the long-discussed Atitlan scheme involving diversion of the Samala into Lake Atitlan -- grounds which may no longer exist if Atitlan is never to be built. Jurun-Marinala had a final cost (excluding transmission and interest during construction) of \$282/kw, moderately high at the time for a scheme with a plant factor of only some 30-35% (and only 25-30% if account is taken of the sacrifice in energy production at EEG's then-existing downstream plants on the Michatoya River that was involved by diversion of water at Jurun), but this actual cost was well within the range of costs of plants (then only at the pre-feasibility-study stage) that Acres had positively recommended and it was substantially less than the \$450/kw which Acres itself had put on the Jurun-Marinala scheme in their studies concluding against it. While many of the projects which they were recommending were expected to

have plant factors of around 50%, all of them would have involved substantially more transmission than Jurun-Marinala. In practical terms, moreover, the only project sufficiently prepared at the time that it might have been built to nearly the same time schedule, was El Canada and, given the hopes of the period to develop an improved Atitlan scheme precluding it, this alone might be considered sufficient reason for postponing it. As regards comparison with thermal plants, the Bank's appraisal report cited a return to the extra investment required to build Jurun-Marinala (assuming \$200/kw for thermal capacity) of 10%, and a similar calculation today -- in light of actual construction costs very close to forecast, the high actual cost of Escuintla steam plant (\$279/kw) and, particularly, recent fuel price trends -- would yield a higher return.

While the Bank might be criticized, especially in light of actual construction delays, for tardiness and inconsistency in its handling of INDE's proposal for the steam plant in 1966-67, 1/ 2/ it is clear that the much more serious and costly deficiency in Guatemala's power planning has been the small amount of work undertaken to prepare hydroelectric projects. On the basis of their investigations in the early 1960s and using then-prevailing fuel prices, Acres found that hydro energy could be generated in Guatemala for a cost of US¢ 0.3-0.5 per kwh, compared with thermal at US¢ 1.00 per kwh, and one of their principal conclusions was that "For the 15-year period under review it was found that there would not be any economic justification for the installation of additional thermal capacity in the proposed Central

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- 1/ INDE appears to have first raised this possibility with the Bank in July 1966. In September the Bank officially wrote to point out the need for a separate system planning study of the proposal. INDE, concerned about prospective capacity shortage, quickly contracted such a study and sent it to the Bank on February 6, 1967. Not till May 5, after INDE had complained, did the Bank come back with its critical comments -- which it then appears to have withdrawn in the course of a technical mission the following month, more as a result of fuller consideration of the Guatemalans' point of view and of important features of the system (such as the low plant factor of Jurun-Marinala and of Atitlan as then planned) than because of changes in underlying facts. The project was finally appraised in September-October 1967, almost one year after INDE's first documented application to the Bank for financial assistance for the project.
- 2/ Criticism on this score would moreover have to be tempered by recognition that, because of the mistake in plant-siting revealed only by the hurricane in September 1969, an earlier commencement on the project would probably have resulted only in even higher costs (more would have been destroyed at Guacalate) and no earlier completion.

System." ^{1/} Their recommended program for 1962-76 envisaged addition of 224,000 kw of generating capacity, of which 95% hydroelectric, including 11 new hydroelectric stations. What will actually have been added over this period is about 195,000 kw (including the 50,000 kw unit now under construction), of which less than 40% is hydroelectric. The reason for this is not that Acres' broad conclusions were ever found to be wrong -- recent fuel price trends would, moreover, clearly strengthen them -- but that thermal plants have repeatedly had to be added because there was insufficient time left to do anything else to meet the load.

Between the Acres study in 1960-62 and the Bank's first loan in 1967, and despite Acres' recommendations to get ahead with further studies and in particular to establish in INDE a hydrological department to fill the serious data gap they had found, little hydroelectric planning work seems to have been done except on Jurun-Marinala and on Atitlan -- with the latter still remaining far from being ready for execution, partly because of its size and more because of the many disputed variations on the basic scheme that were possible. The Bank's own appraisal report was somewhat equivocal on the matter of planning, mentioning in the introductory part that INDE's "general manager and key personnel lack experience in the electricity supply industry, and INDE will require assistance from consultants qualified in system planning, engineering and design, rate studies and in negotiating major sales contracts", but including in the project description only items for "consultants' services for organization and management in addition to those directly related to the design and supervision of construction". Documents in the Bank's files indicate that the fairly large amount (US\$ 1.8 million) provided against this item in the List of Goods under the Bank's loan did include US\$ 100,000 for studies on Atitlan (added at a late stage in project preparation, in October 1966) and also a certain amount for management studies which were to avoid actually doing planning work but to include a review of planning and forecasting procedures and preparation of recommendations for their improvement. This management study was carried out, but it was in the end the only work relating to planning to be financed under the loan. INDE was fortunate enough to receive bilateral technical assistance for feasibility work on Atitlan in the form of free studies by the Austrian Verbund-Plan and the French Sofrelec.

The appraisal mission for the Bank's second loan urged that Atitlan be examined in wider system context, including consideration of the possibility of interconnection with El Salvador, and the second loan included \$2 million for studies -- but all for definitive work on Atitlan. These studies were expected to start by September 1968 but, apparently due to INDE's delays, the contract was finally not signed until December 1969 -- a few months before serious talk began of the need to postpone construction of the project pending full review of possible adverse ecological consequences. Serious attention

^{1/} Acres International Limited, "Republic of Guatemala: Instituto Nacional de Electrificación: Power and Irrigation Study, Vol. II, Power Section" (September 1962), p. 65.

does not appear to have been given at any time in this period to the need to consider alternatives to Atitlan until December 1970, when Government officials raised the point with the Bank. By June 1971 the Bank was strongly urging studies of an alternative hydroelectric project and, for the first time since the Acres study, the preparation of a Master Plan for Guatemalan power development. The studies on Atitlan were cut short and loan funds were reassigned in December 1971 for studies of the Chixoy hydroelectric project and preparation of a Master Plan, but they were insufficient for the latter. By this time it was anyway too late to make the next major project a hydroelectric one, and preparation of a thermal project now under construction had already begun.

INDE asserts that the delay in Master Planning in recent years has been entirely due to lack of funds and that it is solely thanks to the generosity of German technical and financial assistance provided that it has now become possible, in November 1974 to make a major start.

Financial Performance

While INDE has adhered to the Loan Agreement covenants relating to its debt and capital-structure, its financial performance has been very disappointing compared with expectations and it has not been able to meet the rate of return covenants agreed with the Bank. Under Loan 487-GU INDE was to earn a 10% rate of return on average net fixed assets in operation in the Central Region through 1970, and a 9% rate of return over the entire system thereafter. Under Loan 545-GU the covenanted 9% return overall was expected one year earlier (i.e. starting with 1970). Instead the overall rate of return has never exceeded 6% and fell below 4% in 1973 (see Annex Table V); the covenants were met only in 1969, when the rate of return in the Central Region was 10.3%. As a proportion of construction expenditures, net internal cash generation was 17% for the 1967-70 period compared with 17.4% projected under the first loan, and 20.5% for the 1968-71 period compared with 25.6% projected under the second loan -- despite actual total investment being much less than projected in both periods (Annex Table VIII). Government contributions to capital expenditure, instead of terminating with 1969 as projected in the Bank's appraisal of the first project, have risen to around 40% of the annual total, amounting to more than US\$ 4 million equivalent for instance in 1973.

Comparison between forecast and actual income statements (Annex Table V) suggests that the problem results mainly from higher costs of production and lower sales than forecast; unit prices have generally been above the forecast level, and inflation has not been a major problem in Guatemala (the official wholesale price index, for instance, was by 1972 only 15% above its level in 1965). If unit costs had been held at the forecast level annual rates of return would have nearly reached the covenanted minimum. The top portion of Table 2 compares actual and forecast unit costs of production for INDE's operations as a whole and shows that the main deviation has been on costs of Administration, Operation and Maintenance, which have always been substantially higher than forecast and have in recent years been more than double projected levels.

The Bank, in its internal memoranda during the execution of the project, tended to put main emphasis on these deviations of operating costs from appraisal projections. Yet, while there are surely economies and improvements in efficiency which could be made (for instance INDE's total employment, at about 3000, is considered high for an entity with its responsibilities), it is not clear that these unit costs are unreasonable compared with other countries.

Unit Costs of Electric Power Supply^{a/}
(US¢ per kwh sold)

	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
<u>INDE Total (mainly bulk supply)</u>								
Forecast: Admin, O & M	0.72	0.61	0.42	0.39	0.33	0.32		
Fuel	0.67	0.38	0.50	0.50	0.29	0.31		
Depreciation	<u>0.42</u>	<u>0.40</u>	<u>0.30</u>	<u>0.31</u>	<u>0.30</u>	<u>0.27</u>		
Total	1.81	1.39	1.22	1.20	0.92	0.90		
Memo: Total sales, Gwh	(78)	(115)	(231)	(285)	(451)	(551)		
Actual: Admin, O & M	0.90	0.83	0.54	0.69	0.64	0.67	0.74	0.74
Fuel	0.60	0.43	0.63	0.49	0.15	0.25	0.34	0.44
Depreciation	<u>0.21</u>	<u>0.34</u>	<u>0.31</u>	<u>0.35</u>	<u>0.39</u>	<u>0.43</u>	<u>0.40</u>	<u>0.38</u>
Total	1.71	1.60	1.48	1.53	1.18	1.35	1.48	1.56
Memo: Total sales, Gwh	(79)	(124)	(215)	(245)	(353)	(370)	(432)	(519)
Total customers, thousands	(16)	(16)	(17)	(23)	(26)	(31)	(37)	(45)
<u>Guatemala Total (INDE and EEGSA excl. Municipal Utilities)</u>								
Total				<u>2.15</u>	<u>2.02</u>	<u>2.07</u>	<u>2.11</u>	<u>2.22</u>
of which Admin, Operation and Mtce				1.00	1.15	1.15	1.10	1.10
Memo: Total sales, Gwh				(492)	(539)	(578)	(651)	(721)
Total customers, thousands				(135)	(145)	(157)	(171)	(187)
<u>Guatemala City and Environs (Central Region)</u>								
INDE				0.52	0.50	0.59	0.67	0.73
EEGSA				<u>1.48</u>	<u>1.33</u>	<u>1.31</u>	<u>1.23</u>	<u>1.20</u>
Total				<u>2.00</u>	<u>1.83</u>	<u>1.90</u>	<u>1.91</u>	<u>1.93</u>
of which Admin, Operation & Mtce.				1.05	1.00	1.00	0.92	0.84
of which INDE				0.16	0.21	0.22	0.25	0.22
Memo: Total sales, Gwh				(461)	(502)	(532)	(597)	(660)
Total customers, thousands				(112)	(119)	(126)	(134)	(142)

^{a/} excluding interest costs.

Source: Annex Table V and EEGSA Annual Report 1973

Inter-country comparisons of electricity production costs are always difficult but whatever data are available do not indicate that administration and operation costs are greatly higher in Guatemala than on roughly similar systems at a corresponding stage in their development. As shown in the bottom portion of Table 2, unit costs of administration and operation for supply to Guatemala City and environs (the Central Region) have come down fairly steadily over the last five years, as would be expected with growing scale of operations, and reached US¢ 0.84 in 1973, exactly the same (after adjustment for inflation) as they were for the more compact but entirely thermal system of the Singapore Public Utilities Board in 1962 when its kwh sales were about the same but it had 15% fewer customers. Systems comparable with the overall INDE/EEG operation are more difficult to find but it is noteworthy that the National Electricity Board of Malaysia appears to show consistently higher overall unit costs of production, while more detailed figures for the smaller but neighboring Honduras system of Empresa Nacional de Energia Electrica (ENEE), also with national responsibilities, show expenses for administration, operation and maintenance of US¢ 1.25 per kwh sold in 1973 (sales 328 million kwh to 73,000 customers) compared with the Guatemalans' US¢ 1.10 in the same year, indicating some scale economies to INDE/EEG if not as much as might be expected.

While the Bank's appraisals seem to have been somewhat unrealistic in their projections of costs of meeting Central Region demand (partly probably due to poor basic data provided, due to accounting deficiencies) a more serious error was their neglect, from this point of view, of INDE's responsibilities elsewhere in the country. It was formally agreed, in negotiations for both loans, that INDE would limit capital expenditures "outside the projects" (largely corresponding to expenditures on the other smaller systems, outside Central Region) to US\$ 500,000 equivalent p.a., but this seems to have been observed by INDE more in the breach than in the observance; after the second loan was made the Bank seems to have given up trying to insist on it; and the Government appears to have always been ready to support substantially higher non-project expenditures. After 1968 the Bank demonstrated considerable readiness to help prepare a new project involving works outside the Central Region but INDE never showed inclination to get the necessary studies done, although substantial investment in "rural electrification" has now been accomplished in the last two or three years with U.S. AID support. At appraisal time the Bank did usefully insist on better contracts being reached between INDE and the two municipal distributors it was then supplying (excluding, for example, the large quantities of free energy previously supplied), but the problem which actually materialized, and added to INDE's financial difficulties, was serious delays in payment of accounts, particularly by some of these municipalities and some Government bodies; accounts receivable doubled between 1966 and 1967 and again by 1973 (see Annex Table VI), to reach US\$ 2 million equivalent, and the large majority of them relate not to sales to EEG but to other bodies, totalling only US\$ 2.4 million equivalent in 1973.

The Bank adjusted its advice to these financial problems as they arose, urging efforts to recover arrears and to increase tariffs in a timely manner to cover higher than expected costs, but with only limited effect. Because they were still higher than retail prices in Guatemala City and environs

it was not felt politically possible to raise tariffs to the municipal companies and direct retail consumers outside the Central Region, even though they barely covered INDE's direct costs (excluding capital charges) after 1967. As for EEG, it was making a return on average net fixed assets in operation of about 14% throughout the period, paying dividends on its common stock rising from 12% in 1965 to nearly 25% by 1971-72, and still financing most of its investment out of retained earnings, but it refused, as it was apparently entitled to do under the rather easy terms of its concession, to absorb internally any INDE tariff increase. Noting that the problem was more one of poor distribution of revenues between supply agencies than of excessively low prices to the final consumer, and accepting the political constraint to reducing EEG's rate of return to more reasonable levels even after it had been taken over by Government (a very small share of ownership remained with private shareholders whose interests had apparently to be protected), the Bank agreed with the Guatemalan authorities in 1972 a system whereby Government dividends from its holding in EEG would be transferred, after servicing the debt incurred to buy the stockholding, to INDE in sufficient quantity to compensate the latter's net income shortfall from the agreed 9% level. Some transfers of this nature have indeed been made, but not sufficient, when added to the 4-5% direct return earned by INDE in 1972-73 to meet the 9% minimum target.

In retrospect it appears that the Bank, in its understandable haste finally to make the first loan after the long delays that had surrounded its preparation, may have missed an opportunity in 1966 to have avoided these problems in the financial relations between INDE and EEG, with their considerable costs to Guatemala. The question had been raised within the Bank whether a long-term contract between INDE and EEG for supply of the power to be produced with the Bank-assisted investments should be insisted on as a condition of the proposed first loan. Very conscious of the weak bargaining position in which such insistence would place INDE vis-a-vis EEG, the Bank decided to insist only on finalization of the contract for supply from INDE plants already completed. Prudent within a scenario confined to these two companies, this decision may well have been unfortunate in a wider framework taking account also of what the Government could do, for it is recorded in the official minutes of an internal Bank meeting on October 28, 1966 that "The Bank had learned from the Finance Minister that the Government was prepared to enact legislation regulating power rates, covering both generating and distributing margins, in the event that the proposed "interim" sales contract could not be settled by the end of October. The Government was already thinking in terms of 10% rate of return for both the generating and distributing companies, and was prepared to pass such legislation if necessary to facilitate obtaining the Bank loan." Used at the time as an argument for not worrying about the long-term INDE-EEG contract, these points suggest in retrospect that firm action at the time might have helped Guatemala substantially, although Bank staff now suggest that the quoted statement may have been unduly optimistic in light of the lack of Government action on the matter since that time, and that Bank Management would anyway have had difficulty pressing an issue which might have adversely affected the concession of a foreign-owned company. In view of the strength which the Government that took office in mid-1966 had already shown and the fact that project construction was subsequently able to go firmly ahead despite the long delay (until November 1967) in the actual

availability of Bank funds, it is hard to argue that it would not have been worth taking say up to another six months (or, even better of course, to have initiated action earlier) to see if a solution could not be found to a problem that was to be so preoccupying in later years. Clearly the action that was taken did not justify the breadth of the claim that was made verbally to the Bank's Executive Directors on the presentation of the second loan, that "related to our loans are also the agreements for the sale of INDE's power to Empresa Electrica de Guatemala under conditions which assure satisfactory rates of return to both institutions"; such agreements as there were proved quite inadequate to this purpose.

Institutional Development

INDE has been responsible for construction and subsequent operation of virtually all major additions to Guatemala's power generating capacity since 1965, it has taken over from EEG responsibility for day-to-day control and dispatch of the Central interconnected system and it has increased its outlying municipal customers from 2 to 8 and its direct retail consumers from 13,000 in 1965 to 45,000 by the end of 1973, a much faster rate of increase in service than EEG. These are substantial achievements for an entity that was dependent on Government operating subsidies through 1965 and that the Bank clearly characterized, in its first appraisal report, as "not capable of satisfactorily undertaking and managing the project" -- without the substantial consultant assistance which INDE had undertaken to obtain.

These consultants, arrangements for whose retention was to be a condition precedent even to signing of the loan, were described in the appraisal report as follows:

- "(1) suitable management consultants, acceptable to the Bank and under terms of reference agreed with the Bank, to assist in developing an effective organization structure; to advise on changes required in the accounting system and to advise on system planning, engineering and design and contract negotiations... , and
- (2) a suitably qualified expert for the purpose of assisting the Government and INDE in the establishment of a rate regulatory agency and in the training of the necessary staff."

INDE proceeded to make arrangements with an individual from Peat, Marwick, Mitchell and Co. for the accounting work and with Sofrelec for advice on organizational structure and on planning and forecasting procedures and it had the respective terms of reference cleared with the Bank. For the studies of power industry regulation it made an arrangement with UN ECLA. Sofrelec withdrew unexpectedly in October 1967, before it had actually signed the contract, and so arrangements along similar lines were made with International Middle West Services Co (IMWSCO) of the United States. About \$100,000 of Loan 487-GU seems to have been spent for the two-man IMWSCO team which carried out its study from January to December 1968 and on the accounting assistance.

It is unclear how much has actually been achieved by these studies. Most was probably accomplished on the accounting side: the new system, worked out on the model of the U.S. Federal Power Commission, was applied starting January 1, 1968 and, despite problems in its early application, INDE's accounts do seem to have improved, although many difficulties of inconsistency from year to year, problems of valuation of assets, liabilities and inventories, and others remain, which INDE's Guatemalan External Auditor is helping to overcome.

The IMWSCO team produced, as required, six basic reports, together with ten supplementary ones. Their most important recommendations were:

- (a) that INDE decentralize responsibility (especially for purchases, payments, and hiring) to allow top management to concentrate on improving its overall guidance as well as to reduce redundant decision-making time;
- (b) that INDE's "charter" (Decree 287) be changed to allow management representatives on the Board of Directors and relieve that body of any day-to-day burdens;
- (c) that functions and subfunctions be more clearly defined and reorganized along more efficient lines;
- (d) that the information system -- accounting and operating data -- be standardized to reduce confusion and unnecessary paperwork; and
- (e) that more emphasis be given to personnel development and safety.

IMWSCO's contract was not extended to implement the reorganization, and not much seems to have been done along the recommended lines, although INDE's External Auditor urged in 1970 that a high-level executive be placed in charged of implementing the recommendations and still persistently refers in his report each year to the need to act on the IMWSCO report. Some of the suggestions may have been too expensive for a small entity to implement immediately (e.g. the detailed and extensive reporting procedures, appointing three Assistant Managers instead of one). One additional Assistant Manager has eventually been appointed. INDE's statutes were never changed, and it is uncertain whether some of the more useful ideas concerning planning, forecasting and cost control will ever be implemented.

As regards power industry regulation, the ECLA team produced various reports, and the Bank pressed INDE for more and for decisions as to what should be done about them, but it is not clear that any such decisions were made or anything done. The Government decision in 1972 simply to extend EEG's concession unchanged for a further five years has been explained on the ground that this time was necessary to enable decisions to be reached about how the power sector could best be organized.

No additional "institution-building" components were included in the second Bank project; several of the studies mentioned above were in fact only just getting underway at the time this project was negotiated, and anyway the appraisal report declared that there were "no substantial shortcomings in INDE's present organization." The report did however give attention for the first time to training needs -- particularly for operators for the new steam station -- and, although no funds were included in the loan to cover the cost of such training, some minor reallocations of funds were approved at a later date for this purpose.

Conclusions

Bank Loans 487-GU and 545-GU have played a large part in the expansion of Guatemala's power supply over the last ten years and in enabling INDE to become the major institution in the power sector. All the major items envisaged in the projects have been successfully completed. The principal component, the hydroelectric project accounting for 40% of Bank funds lent and of combined projects' costs, was completed particularly close to original cost estimates and time schedule. INDE has been providing a power supply of moderate quality at costs that are fairly high compared with systems in other countries, but not unreasonable. Its financial performance has however been poor and the key financial covenant under the Bank's loans has been repeatedly broken, mainly due to difficulties in the organization of the sector.

Power planning has been very poor, despite the fact that the Bank's first involvement with the Guatemalan power sector was as Executing Agency for a UNSF-financed comprehensive planning study. The study seems to have had many merits, but little effect on what was done. Major planning mistakes have occurred at several levels. Gas-turbine and steam units financed under the Bank loans had to be expensively relocated because of a mistake in site-selection. Exploitation of the country's hydroelectric potential has been slow mainly because of the insufficiency of hydroelectric planning and too exclusive emphasis of whatever work was gradually done on a single project which Government eventually felt had to be dropped for various reasons, mainly geological (cracks in the lake, volcanic aspects, deep underground earthquakes) and ecological. The organization of the sector, particularly its financial structure, remains poor, with the most lucrative market in the hands of one company, without other responsibilities, and all the costly jobs of building supply capacity and extending the system to new areas in the hands of another entity; for lack of decisive planning in the interim, this situation had to be prolonged another five years even when EEG's concession fell in in 1972.

On all of these problems one can point to measures that the Bank took and to opportunities that it held out to INDE. It insisted on feasibility studies of the various thermal units and the use of consultant engineers for project design and construction supervision. It included funds in both loans for project planning, and there is no reason to think it would not have accepted that part of them be devoted to other hydro projects beyond Atitlan -- as it did in 1971. It financed technical assistance to INDE's own planning and forecasting work. And, although it did not place as great emphasis on organizational rationalization as in some other cases involving multiple companies (e.g. Bucaramanga, Colombia in the early 1950s and Buenos Aires in the early 1960s), it did urge the Government and INDE in 1966 to develop the regulatory function and it pressed INDE for action on the studies done. INDE, often very lax about progress reporting, preparing the action timetables promised to the Bank or trying to make best use of the consultant services provided, failed to take full advantage of the opportunities offered.

But the case does suggest ways in which the Bank could have helped more. First, the Bank's own perspective does not seem to have been very good in this case: the two problems which stand out in retrospect, the insufficiency of hydroelectric planning and the poor organizational structure at the sector level, both of which could have been identified from the Acres report, do not seem to have got enough attention relative to other problems such as INDE accounting, organization, non-project investment, other borrowing; and there is no evidence of the Bank clearly pointing out the need to get ahead with broader hydroelectric data collection and planning and to have eggs in more than one basket, nor of its drawing attention to the need to have a new organizational structure ready for the time when the foreign concession ended. Rather it seems to have allowed itself to be taken by surprise on these issues, for instance, the decisions to postpone Atitlan and to buy EEG. Second, project supervision by the Bank seems to have been more irregular, partial and short than might have been planned for the case of such a weak borrower as was described in the appraisal reports, so cheaply accessible from Washington. Over the three years starting with the appraisal of the second loan in October 1967 there was only one officially so-designated project supervision mission, in November 1968 (there were in addition a few fleeting one-man visits in connection with the project), and no supervision report on file from any period deals with actual system operation or, in a comprehensive way, with loan covenants; the lack of regular follow-up to supervision missions exacerbated the problem resulting from INDE's failure to provide timely reports or to keep to promises about making decisions. This shortage of any deep contact, as well as the fact that the Bank had not been proved correct in several of the technical arguments that it had earlier espoused (e.g. on Jurun-Marinala vs. El Canada and the need for the steam plant) may help to explain not only why the Bank seemed to show rather poor perspective in this case but also why it formed the opinion that INDE was not a very cooperative borrower and hence apparently decided around 1970-71 that supervision, for this particular borrower, should not attempt to include the provision of technical assistance - of course a wise decision if the circumstances were such that technical assistance could not be expected to be useful. Third, the Bank seems to have aimed its efforts too much at INDE and too little, especially given the sectoral organization prevailing, at the Government, not taking advantage of the latter's offer in 1966 to pass legislation regulating the division of revenues between the two companies, not pursuing the Government for its failure to fulfill either of the two commitments it made in connection with the first loan (enabling INDE to achieve a reasonable rate of return and establishing an independent Tariff Regulatory Agency) and seldom taking up issues with Government even when INDE pointed out that it was powerless to act alone.

LOAN 487-GU
INSTITUTO NACIONAL DE ELECTRIFICACION
GUATEMALA

FORECAST AND ACTUAL PROJECT COSTS
(in millions of US\$ equivalent)

	Appraisal Estimate			Actual			% Increase		
	FX	LC	Total	FX	LC	Total	FX %	LC %	Total %
Jurun Marinala*	8.6	6.2	14.8	8.9	8.0	16.9	3.5	29	14.2
Escuintla Gas Turbine*	1.4	0.2	1.6	1.7	0.6	2.3	21.4	200	43.8
Diesel Units*	1.0	0.4	1.4	0.5	0.3	0.8	-50	-25	-42.9
138kV Transmission Lines and Substations*									
Transmission Line	0.62	0.47	1.09	0.74	0.57	1.31	19.4	21.3	20.2
Guatemala Sur Substation	0.27	0.03	0.30	0.82	1.53	2.35	203.7	5000	683.3
Mauricio Substation	-	-	-	0.20	0.44	0.64	-	-	-
Subtotal	0.89	0.50	1.39	1.76	2.54	4.30	97.8	408	209.4
General Management and Engineering Services	0.8	0.6	1.4	0.1	-	0.1	-87.5	-	-92.9
Contingencies	0.8	0.6	1.4	-	-	-	-	-	-
Interest during Construction	1.5	-	1.5	2.0	-	2.0	33.3	-	33.3
Total	15.0	8.5	23.5	15.0	11.4	26.4	-	34.1	12.3

FX - Foreign Exchange Costs.

LC - Local Costs.

*Including engineering services.

LOAN 545-GU
INSTITUTO NACIONAL DE ELECTRIFICACION
GUATEMALA

FORECAST AND ACTUAL PROJECT COSTS
(in thousands of US\$ equivalent)

	<u>Appraisal Estimate</u>			<u>Estimated Actual^{a/}</u>			<u>% Increase</u>
	<u>Foreign</u>	<u>Local</u>	<u>Total</u>	<u>Foreign</u>	<u>Local</u>	<u>Total</u>	
1) <u>Steam Plant</u>							
Civil Works	820	730	1,550	711	2,074	2,785	80%
Equipment	3,050	330	3,380	4,319	1,352	5,671 ^{a/}	68%
Consultant Services	174	45	219	239	502	741	238%
Contingencies	<u>380</u>	<u>130</u>	<u>510</u>	-	-	-	
	4,424	1,235	5,659	5,269	3,928	9,197	63%
2) Atitlan Study	2,076	665	2,741	651	1,722	2,373	-13%
3) Study of Other Projects ^{b/}	-	-	-	666	1,515	2,181	
4) Interest during Construction	<u>500</u>	<u>-</u>	<u>500</u>	<u>500</u>	<u>378</u>	<u>878</u>	+76%
	7,000	1,900	8,900	7,086	7,543	14,629	+64%

^{a/} including allowance for retention payments yet to be paid to main equipment contractor.

^{b/} Chixoy and steam station.

INSTITUTO NACIONAL DE ELECTRIFICACION

EMPRESA ELECTRICA DE GUATEMALA

Forecast and Actual Operating Capacity

	Central System								Average Annual Growth Rate (%)	
	1966	1967	1968	1969	1970	1971	1972	1973		
<u>FORECAST LOAN 487-GU</u>										
<u>Installed Capacity</u>										
- Hydro ^{a/}	(Mw)	26	26	26	56	76	96			
- Steam	(Mw)	30	30	30	30	30	30			
- Gas turbine	(Mw)	25	25	40	40	40	40			
- Diesel	(Mw)	9	9	9	9	9	9			
Total	(Mw)	90	90	105	135	155	175			14.2
<u>Peak Demand</u>	(Mw)	85	95	107	120	135	150			12.0
<u>Gross Reserve Capacity</u>	(Mw)	5	-5	-2	15	20	25			
<u>FORECAST LOAN 545-GU</u>										
<u>Installed Capacity</u>										
- Hydro	(Mw)	26	26	26	46	86	86	86	178 ^{b/}	
- Steam	(Mw)	30	30	30	30	61	61	61	61	
- Gas turbine	(Mw)	25	25	37	37	37	37	37	37	
- Diesel	(Mw)	9	9	9	13 ^{c/}	9	9	9	9	
Total	(Mw)	90	90	102	122	193	193	193	285	17.9
<u>Peak Demand</u>	(Mw)	86	90	100	117	136	154	176	212	13.8
<u>Gross Reserve Capacity</u>	(Mw)	4	0	2	5	57	39	17	73	
<u>ACTUAL ^{d/}</u>										
<u>Installed Capacity</u>										
- Hydro	(Mw)	26	26	26	26	88	88	88	88	
- Steam	(Mw)	30	30	30	30	30	30	61	61	
- Gas turbine	(Mw)	25	25	37	37	37	37	37	37	
- Diesel	(Mw)	9	9	9	9	9	9	9	9	
Total	(Mw)	90	90	102	102	164	164	195	195	11.7
<u>Peak Demand</u>	(Mw)	86	88	95	105	116	119	128	136	7.9
<u>Gross Reserve Capacity</u>	(Mw)	4	2	7	-3	48	45	67	59	

a/ Includes planned commissioning of 2 x 20 Mw units at Jurun Marinala and consequent reduced effective capacity of the El Salto and San Luis Hydro units in 1969.

b/ Includes SOFRELEC estimate of Atitlan capacity (92 Mw).

c/ Temporary installation of Puerto Matias de Galvez diesel units.

d/ Actual figures include the capacity (about 2 Mw of hydro) and demand of the Eastern System, which was interconnected with the Central System in 1970.

INSTITUTO NACIONAL DE ELECTRIFICACION

EMPRESA ELECTRICA DE GUATEMALA

Forecast and Actual Generation and Sales (Gwh)

	Central System								Average Annual Growth Rate (%)	
	1966	1967	1968	1969	1970	1971	1972	1973		
<u>FORECAST LOAN 487-GU</u>										
<u>Generation by EEG</u>										
- Hydro	68	68	68	30 ^{a/}	30	30				
- Steam	240	240	240	230	230	220				
- Gas turbine	30	40	50	40	40	30				
- Diesel	10	15	15	15	10	10				
Total	348	363	373	315	310	290				-3.7
<u>Generation by INDE</u>										
- Hydro	14	55	55	185	245	345				
- Steam	-	-)	82	93	107	118				
- Gas turbine	43	34)	-	-	-	-				
- Diesel	-	-	-	-	-	-				
Total	47	89	137	278	352	463				60.4
<u>TOTAL GENERATION</u>	<u>395</u>	<u>452</u>	<u>510</u>	<u>593</u>	<u>662</u>	<u>753</u>				13.8
<u>Total Sales</u>	<u>345</u>	<u>390</u>	<u>440</u>	<u>500</u>	<u>560</u>	<u>630</u>				12.8
<u>Losses^{b/} (%)</u>	<u>13%</u>	<u>14%</u>	<u>14%</u>	<u>16%</u>	<u>15%</u>	<u>16%</u>				
<u>FORECAST LOAN 545-GU</u>										
<u>Generation by EEG</u>										
- Hydro	68	48	5	5	5	5	5	5		
- Steam	227	228	225	225	163	210	210	200		
- Gas turbine and Diesel	41	41	65	82	49	6	52	110		
Total	336	317	295	312	217	221	267	315		-0.9
<u>Generation by INDE</u>										
- Hydro	15	70	110	136	277	277	277	373		
- Steam	-	-	-	-	87	230	230	230		
- Gas turbine and Diesel	42	43	88	108	47	8	57	59		
Total	57	113	198	244	411	515	564	662		41.9
<u>TOTAL GENERATION</u>	<u>393</u>	<u>430</u>	<u>493</u>	<u>556</u>	<u>628</u>	<u>736</u>	<u>831</u>	<u>977</u>		12.3
<u>ACTUAL</u>										
<u>Generation by EEG</u>										
- Hydro	68	53	3	3	1	-	-	-		
- Steam	239	232	235	256	200	248	275	244		
- Gas turbine	28	35	32	39	38	17	14	19		
- Diesel	13	14	15	15	18	4	3	5		
Total	348	334	285	313	257	269	292	268		-3.8
<u>Generation by INDE</u>										
- Hydro	15	54	102	125	278	275	256	261		
- Steam	-	-	-	-	-	-	58	169		
- Gas turbine and Diesel	44	50	87	96	40	62	100	79		
Total	59	104	189	221	318	337	414	509		36.1
<u>TOTAL GENERATION</u>	<u>407</u>	<u>438</u>	<u>474</u>	<u>534</u>	<u>575</u>	<u>606</u>	<u>706</u>	<u>777</u>		9.7
<u>Total Sales</u>	<u>349</u>	<u>377</u>	<u>411</u>	<u>461</u>	<u>502</u>	<u>532</u>	<u>597</u>	<u>660</u>		9.6
<u>Losses^{b/} (%)</u>	<u>14%</u>	<u>14%</u>	<u>13%</u>	<u>14%</u>	<u>13%</u>	<u>12%</u>	<u>15%</u>	<u>15%</u>		

a/ Reduced generation from the El Salto and San Luis units after July, 1969.

b/ Gross Generation less sales as a percent of the Gross Generation.

GUATEMALA ENERGY CONSUMPTION: Combined Sales of INDE and EEG by Class of Consumer, 1966-73

	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>Average Annual Growth Rate (%)</u>
Residential	110.09	127.00	129.7	140.7	152.31	163.76	179.22	191.23	8.2
Commercial	51.71	n.a.	63.37	72.8	78.35	85.43	91.35	107.78	11.1
Industrial	149.48	159.24	174.7	193.11	213.75	223.22	248.32	293.3	10.1
Municipal ^{a/}	43.78	45.56	54.32	63.31	68.62	78.52	96.52	94.13	11.6
Government	13.34	n.a.	15.52	16.99	18.74	19.57	21.8	24.32	9.0
Public Lighting	1.19	n.a.	2.01	3.44	4.09	4.83	5.36	6.05	26.2
TOTAL	369.88	401.2	439.91	492.36	539.54	577.85	650.83	720.66	10.0

^{a/} Including block sales to municipalities.

INSTITUTO NACIONAL DE ELECTRIFICACION

Forecast and Actual Income Statements
(Thousands of Quetzales)

	1966			1967			1968			1969			1970			1971			1972			1973		
	Central System	Other	Total	Central System	Other	Total	Central System	Other	Total	Central System	Other	Total	Central System	Other	Total	Central System	Other	Total	Central System	Other	Total	Central System	Other	Total
FORECAST*																								
Kwh Sales (millions)	52	26	78	83	32	115	196	35	231	240	45	285	394	57	451	489	62	551						
Average price/Kwh (centavos)	2.12	3.65	2.63	1.98	3.66	2.44	1.60	3.48	1.88	1.60	3.25	1.86	1.60	3.09	1.79	1.50	3.13	1.68						
Gross Operating Revenue	1,100	750	2,050	1,640	1,171	2,811	3,136	1,217	4,353	3,840	1,461	5,301	6,304	1,763	8,067	7,335	1,941	9,276						
Operating Expenses																								
-Operation and Maintenance	76	190	266	140	250	390	358	441 ^{a/}	799 ^{a/}	430	472 ^{a/}	902 ^{a/}	733	504 ^{a/}	1,237 ^{a/}	877	537 ^{a/}	1,414 ^{a/}						
-Fuel	473	48	521	374	61	435	1,033	116 ^{a/}	1,149 ^{a/}	1,251	189 ^{a/}	1,420 ^{a/}	1,014	305 ^{a/}	1,319 ^{a/}	1,361	360 ^{a/}	1,721 ^{a/}						
-Administrative and General	30	47	77	60	47	107	180			200			250		315									
-Depreciation	167	164	331	233	230	463	473	248	721	631	274	905	1,052	231	1,343	1,187	308	1,495						
Total	746	449	1,195	807	588	1,395	2,014	805	2,819	2,492	935	3,427	3,049	1,100	4,149	3,740	1,205	4,945						
Net Operating Revenue	354	501	855	833	583	1,416	1,122	412	1,534	1,348	526	1,874	3,255	663	3,918	3,595	736	4,331						
Less Net Central Office Expenses and Other			220			200			- ^{c/}			- ^{c/}			- ^{c/}			- ^{c/}						
Operating Income			635			1,216			1,534			1,874			3,918			4,331						
Less Interest charged to Operations			135			216			168			234			810			1,467						
Net Revenue			500			1,000			1,366			1,640			3,108			2,864						
Average Net Fixed Assets in Operation			8,094			13,309			14,731			17,836			38,181			42,175						
Rate of Return on Average Net Fixed Assets in Operation(%)			7.8%			9.1%			10.4%			10.5%			10.1%			10.3%						
ACTUAL																								
Kwh Sales (millions)	58	21	79	100	24	124	185	30	215	212	32	245	333	40	353	324	46	370	379	53	432	458	61	519
Average Price/Kwh (centavos)	2.0	2.7	2.1	1.9	3.3	2.2	1.6	3.3	1.8	1.7	3.8	2.0	1.6	3.5	1.8	1.7	3.8	2.0	1.6	3.9	1.9	1.6	3.9	1.9
Gross Operating Revenue	1,169	568 ^{d/}	1,737	1,927	808 ^{d/}	2,735	3,054	994	4,048	3,656	1,188	4,844	4,995	1,392	6,387	5,579	1,729	7,308	6,407	2,073	8,480	7,588	2,397	9,985
Operating Expenses																								
-Operation and Maintenance	61	261	322	250	429	679	359	536	1,015 ^{e/}	446	645	1,091	736	727	1,463	840	784	1,624	695	585	1,280	479	674	1,153
-Fuel	462	15	477	498	32	530	1,277	84	1,361	1,135	56	1,191	459	88	547	825	84	909	1,361	115	1,476	2,107	148	2,255
-Administrative and General	84	64	148	160	58	218	n.a.	n.a.	n.a.	279	166	445	308	162	470	336	208	544	820	658	1,478	971	823	1,794
-Depreciation	101	62	163	274	149	423	432	244	676	539	307	846	1,007	387	1,394	1,160	429	1,589	1,140	598	1,738	1,300	662	1,970
Total	708	402	1,110	1,182	668	1,850	n.a.	n.a.	3,052	2,399	1,174	3,573	2,510	1,364	3,874	3,161	1,505	4,666	4,016	1,956	5,972	4,865	2,307	7,172
Net Operating Revenue	461	166	627	745	140	885	n.a.	n.a.	996	1,257	14	1,271	2,485	28	2,513	2,418	224	2,642	2,391	117	2,508	2,723	90	2,813
Less Net Central Office Expenses and Other			238			133			144			158			318			323			416			510
Operating Income			389			752			852			1,113			2,195			2,319			2,092			1,303
Add Other Income			13			27			13			36			97			243						490
Less Interest charged to Operations			30			146			170			238			700			990			1,036			1,120
Net Revenue			372			633			695			911			1,592			1,322			1,299			1,273
Average Net Fixed Assets in Operation			6,935			12,592			17,153			19,731			36,712			42,187			42,746			48,303
Rate of Return on Average Net Fixed Assets in Operation(%)			5.6%			5.9%			5.0%			5.6%			5.9%			5.5%			4.9%			3.9%

* For 1966 and 1967, Loan 487-GU appraisal forecasts have been used; thereafter, revised appraisal forecasts for Loan 545-GU have been adopted.

a/ Operation, Maintenance and Administrative Expenses are combined in the estimates for 1968-1971.

b/ Excluding Central Office Expenses.

c/ Central Office Expenses prorated to various systems in 1968-1971 estimates.

d/ Net of discounts to Government Offices.

e/ Includes Administrative and General Expenses.

INSTITUTO NACIONAL DE ELECTRIFICACION

GUATEMALA

BALANCE SHEET

(in thousands of Quetzales)

Year Ending Dec. 31	1966	1967 ^{a/}	1968	1969	1970	1971	1972	1973
ASSETS								
<u>Fixed Assets</u>								
Fixed Assets in Op.	12263	17099	22847	23959	47895	49331	52612	64392
Less: Depreciation	1751	2428	3213	4132	5555	7296	9155	11243
Net Fixed Assets in Op. ^{b/}	10512	14671	19634	19827	42340	42035	43457	53149
Work in Progress, etc. ^{b/}	4001	5618	11145	20194	6760	10785	15698	11910
<u>Total Fixed Assets</u>	14513	20289	30779	40021	49100	52820	59155	65059
<u>Current Assets</u>								
Cash, Bank & Investments	1143	661	506	250	523	741	1209	1293
Accounts Receivable	523	1023	1057	1168	1184	1537	1961	2129
Less: Doubtful Debt Reserve	-	-	-	(23)	(51)	(84)	(125)	(173)
Other Current Assets	803	837	307	518	585	696	548	1290
Inventories	1798	2159	1630	2220	2528	3388	4013	6217
<u>Total Current Assets</u>	4267	4680	3500	4133	4769	6278	7606	10756
Deferred Assets	-	-	-	-	-	724	602	480
<u>TOTAL ASSETS</u>	18780	24969	34279	44154	53869	59822	67363	76295
LIABILITIES								
<u>Equity</u>								
Govt. Grants & Contributions	16427	20127	24510	27319	32007	34130	36694	41045 ^{d/}
Surplus	183	829	1524	2316	3962	4738	6037	7309
<u>Total Equity</u>	16610	20956	26034	29635	35969	38868	42731	48354
<u>Long-Term Debt^{e/}</u>								
IBRD - 487-GU	-	1056	4748	9301	12152	13633	13869	13445
- 545-GU	-	-	-	464	1394	2708	5564	5758
IDB	1831	2540	2790	2430	2250	2070	1890	1710
USAID	-	-	-	-	-	-	537	3011
Other	-	-	10	-	-	-	64	79
<u>Total Long-Term Debt</u>	1831	3596	7548	12195	15796	18411	21924	24003
<u>Current Liabilities</u> incl. current portion of debt	339	417	697	2324	2104	2543	2708	3938
<u>TOTAL LIABILITIES</u>	18780	24969	34279	44154	53869	59822	67363	76295
<u>DEBT/EQUITY RATIO</u>	10/90	15/85	22/78	29/71	31/69	32/68	34/66	33/67

a/ Includes adjustments to allow for revaluation of assets.

b/ Includes exploration and planning.

c/ Accounts Receivable, Inventories, etc., less Doubtful Debt Reserve.

d/ Less amount (approx. Q 137,000) for revaluation of assets.

e/ Excluding current portion.

Annex Table VII

INSTITUTO NACIONAL DE ELECTRIFICACION

Actual Sources and Application of Funds

(Thousands of Quetzales)

	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	Total (1966-1973)
<u>SOURCES OF FUNDS</u>									
A) <u>Internal Cash Generation</u>									
-Net operating income	221	213	695	1,069	2,235	1,321	2,335	2,392	10,480
-Depreciation	96	494	785	847	1,102	2,096	2,059	2,286	9,765
Total cash generation	317	707	1,480	1,916	3,337	3,417	4,394	4,678	20,245
B) <u>Borrowing</u>									
-IBRD Loan 487-GU	-	1,056	3,692	4,553	3,026	2,035	637	-	14,999
-IBRD Loan 545-GU	-	-	-	464	930	1,594	3,056	410	6,454
-IDB	681	889	250	-	-	-	-	-	1,820
-Other ^{a/}	-	-	-	-	-	-	537	2,474	3,011
Total borrowings	681	1,945	3,942	5,017	3,956	3,629	4,230	2,884	26,284
C) <u>Government Contributions & Other</u>	3,863	2,044	3,103	3,574	2,657	2,131	2,627	4,504	24,503
<u>TOTAL SOURCES OF FUNDS</u>	4,861	4,696	8,525	10,507	9,950	9,177	11,251	12,066	71,033
<u>APPLICATION OF FUNDS</u>									
A) <u>Capital Expenditure</u>									
-IBRD Loan 487-GU	-	n.a.	6,475	7,364	4,104	n.a.	n.a.	-	n.a.
-IBRD Loan 545-GU	-	-	182	1,287	1,584	n.a.	n.a.	n.a.	n.a.
-Other	3,607	n.a.	1,679	1,468	2,619	n.a.	n.a.	n.a.	n.a.
Total Capital Expend.	3,607	6,270	8,340	10,120	8,307	6,949	8,896	10,334	62,823
B) <u>Debt Service</u>									
(1) <u>Interest</u> ^{b/}									
-IBRD Loan 487-GU	-	-	91	349	604	805	908	1,003	4,053
-IBRD Loan 545-GU	-	-	-	53	94	146	-	-	-
-IDB	-	-	169	158	148	137	128	117	857
-Other	-	-	-	-	-	-	-	-	-
Total Interest	-	-	260	560	846	1,088	1,036	1,120	4,910
(2) <u>Amortization</u>									
-IBRD Loan 487-GU	-	-	-	-	-	355	400	400	1,155
-IBRD Loan 545-GU	-	-	-	-	-	90	200	200	490
-IDB	-	120	180	180	180	180	180	180	1,260
-Other	-	-	-	-	-	-	-	-	-
Total Amortization	-	180	180	180	180	625	780	780	2,905
Total Debt Service	-	180	440	740	1,026	1,713	1,816	1,900	7,815
(3) <u>Increase (Decrease) in Working Capital</u>	1,254	(1,754)	(255)	(353)	617	515	539	(168)	395
<u>TOTAL APPLICATION OF FUNDS</u>	4,861	4,696	8,525	10,507	9,950	9,177	11,251	12,066	71,033
Debt Service Coverage Ratio	-	3.93	3.36	2.59	3.25	2.57	2.42	2.46	2.72

^{a/} Mainly A.I.D. loan for Rural Electrification.^{b/} Including capitalized interest.

INDE: FINANCING PLANS 1967-70 and 1968-71
(in millions of Quetzales)

	1967-70		1968-71	
	Appraisal Loan 487-GU	Actual	Appraisal Loan 545-GU	Actual
<u>Sources of Funds</u>				
Net Internal Cash	8.3	5.6	12.5	6.9
IDB Loan	-	1.1	0.3	0.3
IBRD Loan 487-GU	15.0	12.3	13.9	13.3
IBRD Loan 545-GU	-	1.4	7.0	3.0
New Foreign Borrowing	<u>14.2</u>	<u>-</u>	<u>12.2</u>	<u>-</u>
Sub-total	29.2	14.8	33.4	16.6
Government Contribution	<u>13.3</u>	<u>11.5</u>	<u>6.1</u>	<u>11.5</u>
	<u>50.8</u>	<u>31.9</u>	<u>52.0</u>	<u>35.0</u>
<u>Application of Funds</u>				
Loan 487-GU Project	22.0	20.0	19.3	21.0
Acquisition of Water Rights	6.0	3.1	-	-
Loan 545-GU Project	-	3.1	8.4	4.0
New Program Central System	17.2	-	18.7	-
Other Systems	<u>2.4</u>	<u>6.8</u>	<u>2.5</u>	<u>8.7</u>
	47.6	33.0	48.9	33.7
Interest during Construction	2.9	0.6	2.8	0.8
Working Capital Increase	<u>0.3</u>	<u>-1.7</u>	<u>0.3</u>	<u>0.5</u>
	<u>50.8</u>	<u>31.9</u>	<u>52.0</u>	<u>35.0</u>









