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A SECOND PHASE FOR THE ELECTRICAL INTERCONNECTION  
STUDY IN THE CENTRAL AMERICAN ISTHMUS

This document is a preliminary request for assistance to the Canadian  
International Development Agency (CIDA).

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## FOREWORD

This document has been prepared for the purpose of submitting a preliminary request for technical cooperation to the Canadian International Development Agency (CIDA), to partially support the second phase of the study on interconnection of the electrical systems of the countries in the Central American Isthmus, which the Economic Commission for Latin America is presently undertaking. This study is being implemented at the request, and with the support, of the national power institutions of the area, and with the financial assistance of the Central American Bank for Economic Integration (CABEI) and the United Nations Development Programme (UNDP).

CHAPTER

The first part of the book is devoted to a general introduction to the subject of the history of the world. It is divided into two main parts, the first of which is devoted to the history of the world from the beginning of time to the present day. The second part is devoted to the history of the world from the present day to the future. The first part is divided into three main sections, the first of which is devoted to the history of the world from the beginning of time to the present day. The second part is divided into two main sections, the first of which is devoted to the history of the world from the present day to the future. The second part is devoted to the history of the world from the future to the present day.

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## I. BACKGROUND

The Central American Electrification and Water Resources Subcommittee, a subsidiary organization of the Economic Cooperation Committee (ECC) resolved, in its third meeting, the creation of a Regional Electrical Interconnection Group (REIG), of high-level representatives from the national electrical institutions, for the purpose of drawing up guidelines for, and coordinating the activities connected with, electrical interconnection in the Central American Isthmus.<sup>1/</sup>

In 1969, acting upon a specific request from the REIG, the Central American Electrification and Water Resources Mission of ECLA submitted a document which demonstrated the technical and economic feasibility of interconnecting the electrical systems of adjacent countries in the Central American Isthmus.<sup>2/</sup> Such work was complemented with more detailed studies on interconnection possibilities between Costa Rica and Nicaragua (1970-1972)<sup>3/</sup> and El Salvador and Guatemala (1973).<sup>4/</sup>

In 1971 a study on technical-economical feasibility of the electrical systems interconnection between Honduras and Nicaragua was completed.<sup>5/</sup> At present, additional studies financed by the Central American Bank are being carried out to determine the convenience of interconnecting the system of other neighbouring countries.

<sup>1/</sup> Resolution 17 (SC.5), approved on 9 September, 1966.

<sup>2/</sup> La interconexión eléctrica en el Istmo Centroamericano; evaluación de interconexiones para sistemas eléctricos combinados: Guatemala-El Salvador; El Salvador-Honduras; Nicaragua-Costa Rica; Costa Rica-Panamá (CEPAL/MEX/69/20), 1969.

<sup>3/</sup> See documents Alternativas de interconexión de los sistemas eléctricos nacionales de Nicaragua y Costa Rica, (CCE/SC.5/GT-N-CR/II/2;TAO/LAT/103) and Evaluación de las posibilidades de transferencia de energía hidroeléctrica de Costa Rica a Nicaragua (CCE/SC.5/GTN-CR/III/2;TAO/LAT/123).

<sup>4/</sup> La interconexión eléctrica Guatemala-El Salvador. I. Análisis de la factibilidad de la interconexión del Sistema Central de Guatemala y el Sistema CEL de El Salvador (CEPAL/MEX/73/21;TAO/LAT/131).

<sup>5/</sup> Interconexión eléctrica Nicaragua-Honduras; estudio de factibilidad técnico-económica. Electroconsult, 1971.

By the end of 1974, ECLA recommended the preparation of a new study on the regional electrical integration of the Central American Isthmus, to serve as basis for promoting maximum utilization of hydroenergetic and geothermal resources available in the region and thus contribute to lessen the energy crisis.<sup>6/</sup> The REIG approved this idea<sup>7/</sup> and the study was initiated by ECLA at the end of 1975, with technical assistance from the Mexican Federal Power Commission (CFE), the direct participation of the electrical institutions, and financial support from the CABEI and the UNDP. Since the study methodology involved the use of mathematical models for planning, the computer facilities of the Mexican Social Security Institute (IMSS) were requested and obtained.

The first phase of the ongoing study, which should be completed by January 1977, has included the utilization of the mathematical models of the SIPSE system --developed by Electricité de France and refined by the CFE-- to make order-of-magnitude analysis of the technical convenience and economic feasibility of interconnection in the region. Use has been made of preliminary hydrological and approximate cost data, and only a limited set of conditions has been analyzed in this stage. The results of this analysis, although entirely valid, will necessarily be of a preliminary nature.

In order to provide the countries with more definite and reliable results, a second phase of the study is envisaged. In this stage, use would be made of more complete and updated information, to be processed by means of several mathematical models. The new study would also require sensibility analysis to take into account a wide range of situations, and would allow the examination of a large number of interconnection alternatives.

The completion of this second stage would provide the interested countries and financial institutions with a reliable and optimum calendar of interconnection, a detailed economic analysis of its implementation,

6/ See Términos de referencia para la elaboración de un estudio de interconexión eléctrica en el Istmo Centroamericano. Note from the Secretariat (CCE/SC.5/GRIE/II/3), April 1975.

7/ Informe de la Segunda Reunión del Grupo Regional sobre Interconexión Eléctrica (GRIE) (E/CEPAL/CCE/SC.15/105); (CCE/SC.5/GRIE/II/4/Rev.1), May 1975.



and an account of investment requirements. Besides providing these results for the regional basis, the analysis would allow the definition of national generation and transmission construction programmes.

It should be noted that during the third meeting of the REIG, it was agreed that an ad-hoc ECLA/IDB/IBRD working group was to be established for the purpose of making a first comparative study --for the case of Central America-- of results obtained through the SIPSE model presently being utilized by ECLA, the WASP system which the banks have available, and those used by ENDESA of Chile and other institutions.<sup>8/</sup> Such work is already being implemented and can, in effect, be considered an integral part of the proposed second phase of the study.

8/ See Informe de la Tercera Reunión del Grupo Regional de Interconexión Eléctrica (E/CEPAL/CCE/SC.5/109;CCE/SC.5/GRIE/III/7/Rev.1), May 1976.

## II. THE PROPOSED PROJECT SECOND PHASE

### 1. Purpose and scope of the studies

The studies to be carried out under the second project phase are intended to formulate an optimized calendar for binational and/or regional electrical interconnection in the Central American Isthmus, through the year 2000.

To that effect, the following activities would be undertaken:

- i) Revision and updating of the foreseen electrical demands,
- ii) Preliminary investigation of the possibilities to displace sectorial energy demands presently met through oil-fired power generation, by the use of hydropower and geothermal power, and its possible modification to the electrical demands to the year 2000.
- iii) Analysis and processing of additional hydrological data for each hydroproject, standarizing the available records,
- iv) Review, complementation and updating of basic information for all hydroelectric projects, with special reference to technical characteristics and costs,
- v) Evaluation and comparison of the available mathematical planning models characteristics --the SIPSE system supplied by CFE, the WASP models, and the MGI model used by ENDESA of Chile-- and selection of the ones which more closely apply to the special conditions of the Central American area,
- vi) Revision and updating of all technical and economical parameters required for the utilization of the selected model (s), through detailed analysis of the data available within and outside the region,
- vii) Review of the proposed energy generation scheme, for the purpose of defining the optimum size of hydroprojects as well as geothermal and thermoelectrical units, both for the independent national systems and the regional interconnected system,
- viii) Application of the adopted methodology, for the purpose of defining the national generation and transmission programs, including sensibility analysis of the more significant parameters, assuming different degrees of generation autonomy for the countries of the region,
- ix) Preliminary

ix) Preliminary estimate of the precise period during which the Central American interconnected system could be advantageously tied to its neighbouring countries (Mexico and Colombia), and

x) Determine the appropriate tariffs system for the transfers of energy and power, and the economic benefits --to each country and to the region in general-- derived from interconnection.

## 2. Schedule of activities

The implementation of the proposed studies would require a total period of twelve calendar months. Since the systematic processing of available data is already underway, the final project report should be available by December of 1977. (See table 1.)

The mathematical model comparison, to select the system(s) which most adequately conform to the Central American conditions, would be carried out during the last quarter of 1976 and the first one of 1977.<sup>9/</sup>

During the first quarter of 1977, all hydrological records would be extended and standardized.<sup>10/</sup> The study on electricity demands would be reviewed and expanded; and the costs of hydroelectrical projects would be reviewed and updated. A revision would be made of the technical and economical parameters to be used in the study. An optimization of hydroelectric projects proposed operation would be made, and the most adequate size for thermoelectrical units would be determined. A report would be prepared describing the possibility of displacing oil-fired energy supplies through the use of locally available sources, and its possible short and long term modification on the magnitude and distribution of electrical demand.

During the second and third quarters of 1977, the model(s) considered most appropriate would be utilized for the determination of interconnection possibilities between the region's electrical systems. An analysis of

<sup>9/</sup> This part of the study is already underway, with the collaboration of IDB, IBRD and ENDESA of Chile.

<sup>10/</sup> The collaboration of the UNDP/WMO Central American Hydrometeorological Project has been obtained for this activity.

the different interconnection alternatives, under an ample range of assumptions and probable conditions would also be made.

Finally, the benefits and tariffs for interconnection would be studied during the fourth quarter; the convenience of a possible interconnection with Mexico and Colombia would be considered, and a report describing the results of the results of the study would be prepared.

The Regional Electrical Interconnection Group (REIG) would meet three times in the course of 1977, for the purpose of evaluating the progress made in the study and commenting on the partial results obtained. (See again table 1.)

### 3. Cost and financing of the study

The total cost of the proposed study would be 508 000 Central American pesos.<sup>11/</sup> This implies a total of 135 man-months for personnel at an estimated cost of 416 000 Central American pesos, which would include a Coordinator for the study (6 man-months), two experts on planning for the electrical sector (24 man-months) with experience in the application on mathematical models, 21 man-months for specialized consultancies, and 84 man-months for backstopping and counterpart personnel.

An additional allotment of 50 000 Central American pesos for computer time and installations would be required, together with 18 000 pesos for travel expenses and 24 000 more to finance unforeseen expenses. (See table 2.)

Of the total cost, ECLA would make an in-kind contribution of 30 000 man-months from its regular personnel, at an estimated cost of 106 000 pesos, in addition to the office facilities which might be required for the study. The electrical utilities of the Central American Isthmus will contribute 72 man-months of counterpart personnel (engineers and economists), at an estimated cost of 178 000 pesos, which includes wages, travel and per diem.

The Central American Bank has already pledged an additional sum of 65 000 pesos;<sup>12/</sup> the UNDP has agreed to a six-month extension to an

<sup>11/</sup> One Central American peso (C.A.\$) --an accounting unit of the various currencies in the region-- equals one United States dollar (U.S.\$).

<sup>12/</sup> Besides its C.A.\$35 000 contribution to the first study phase.

electrical interconnection expert already on board, a contribution which amounts to 24 000 dollars.<sup>13/</sup>

Of the total 508 000 pesos required for the timely completion of the proposed studies, an amount of 135 000 pesos remains unobtained. It refers to funds earmarked to finance 6 man-months of an electrical planning expert, 21 man-months of consultants in specialized fields, computer time and miscellaneous expenses. It is anticipated that 55 000 pesos would be required for the first half of 1977, and 80 000 for the second half.

The participation of the CIDA in the proposed studies is requested in order to finance the aforementioned expenditures.

<sup>13/</sup> In addition to a contribution of U.S.\$122 000, which was utilized during 1975 and 1976.



Table 2

ESTIMATED COST AND FINANCING FOR THE SECOND PHASE  
OF ELECTRICAL INTERCONNECTION STUDY

| Component                                | Man-<br>months    | Cost<br>(C.A.\$)      |
|--|-------------------|-----------------------|
| <b>A. <u>Project Costs</u></b>           |                   |                       |
| <b><u>Total</u></b>                      | <b><u>135</u></b> | <b><u>508 000</u></b> |
| <b>Personnel</b>                         |                   | <b><u>416 000</u></b> |
| General Coordinator                      | 6                 | 24 000                |
| Electrical planning expert <sup>a/</sup> | 12                | 48 000                |
| Hydroelectrical development expert       | 12                | 48 000                |
| Miscellaneous consultants                | 21                | 84 000                |
| Backstopping personnel                   | 12                | 34 000                |
| Engineers and economists                 | 72                | 178 000               |
| Computer time and facilities             |                   | <u>50 000</u>         |
| Travel expenditures                      |                   | <u>18 000</u>         |
| Miscellaneous expenses                   |                   | <u>24 000</u>         |
| <b>B. <u>Financing</u></b>               |                   |                       |
| <b><u>Total</u></b>                      | <b><u>135</u></b> | <b><u>508 000</u></b> |
| <b>Already committed</b>                 | <b><u>102</u></b> | <b><u>373 000</u></b> |
| ECLA                                     | 30                | 106 000               |
| CABEI                                    |                   | 65 000                |
| UNDP                                     | 6                 | 24 000                |
| Electrical institutions                  | 72                | 178 000               |
| <b>Still unobtained</b>                  | <b><u>27</u></b>  | <b><u>135 000</u></b> |

a/ The UNDP has already approved the funding of 6 months for this expert.

