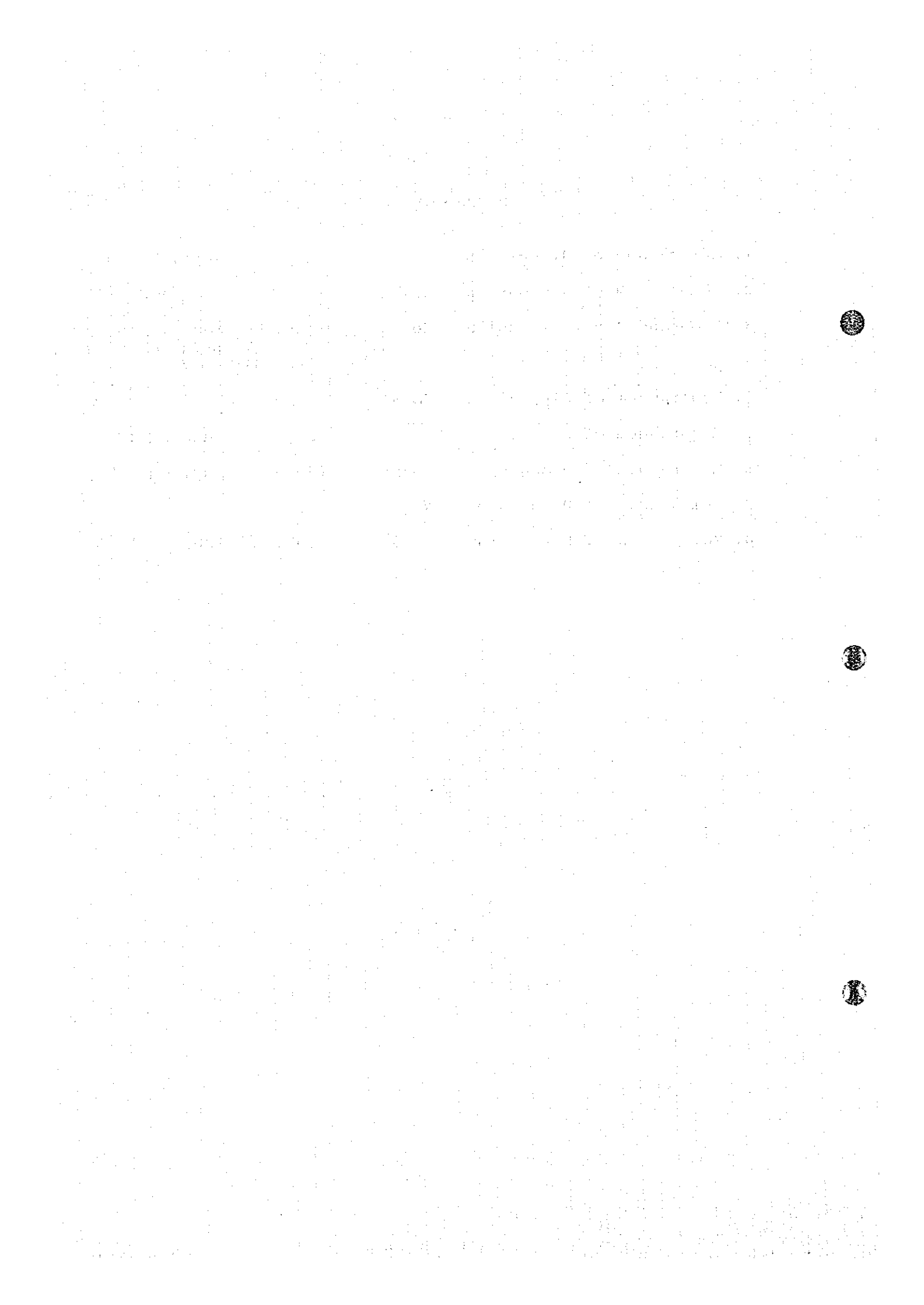


PART - III

MEMORANDUM OF DISCUSSION

MEMORANDUM OF DISCUSSION

1. Memorandum of Discussion (Sept. 1 - Sept. 5, 1994)
2. Memorandum of Discussion No.2 (Sept. 6 - Sept.24, 1994)
3. Memorandum of Discussion No.3 I (Nov. 15 - Nov. 29, 1994)
II (Nov. 30 - Dec. 9, 1994)
III (Dec. 19, 1994)
4. Memorandum of Discussion No.4
5. Memorandum of Discussion No.5 (May 19 - June 2, 1995)
6. Memorandum of Discussion No.6 (July 3 - Aug. 8, 1995)
7. Memorandum of Discussion No.7
8. Memorandum of Discussion No.8 (Feb. 1 - Feb. 9, 1996)



MEMORANDUM ON DISCUSSION

between ICE and JICA
from 1st September to 5th September 1994
on Feasibility Study for
Los Llanos Hydroelectric Power Development Project

PARTICIPANTS

J I C A

Y. Ebi
S. Hakoshima

M. Shibata
N. Demboya

I. Ikeshima

K. Kikuchi

T. Yabe

I C E

Mario López S
Roberto Jiménez V
Alexis Rodríguez R
Miguel Bolaños S
Leonel Rojas Castro
Héctor Vargás
Sergio Mora
Ricardo Granados V
Jorge Arturo Monge
Samuel Argueta D
Eduardo Peralta
Eduardo Peralta
Manuel Sanabria S
Jorge Salazar Alvarez
Alejandro Luna B
Fernando Montalto
Luis Fdo. Sáenz Sánchez
Carlos Rodríguez N
Alexis Cerdas S
Rody Rodríguez
JICA Headquarters

The Proceedings are as follows:

1. The Feasibility Study on Los Llanos Hydroelectric Power Project INCEPTION REPORT has been submitted to ICE on 1st September 1994 (Ref. LL6901/002/YE).
2. Meeting for the Preceding of a definite line was held between ICE (Ing. Agustín Rodríguez M., Ing. Guillermo Rivera S., and Ing. Mario López Soto) and JICA (Mr. T. Yabe, Mr. Y. Ebi, and Mr. S. Hakoshima)
3. Discussion for the method of implementation of the study, the services to be provided for the Study Team , equipment to be provided for ICE and the program for the transfer of technology / training were held between ICE and JICA study team. The major points raised during the discussions are as per APPENDIX 1 enclosed.
4. The ICE presented information and the result studied for the Project regarding the following items.

- 1) Planning by Ing. Roberto Jiménez
- 2) Hydrology by Ing. Manuel Sanabria
- 3) Topographical Map by Ing. Jorge Arturo Monge
- 4)-1 Geophysical Investigations by Ing. Luis F. Sáenz Sánchez
- 4)-2 Geological Investigations by Ing. Ricardo Granados V.
- 4)-3 Geotechnical Investigations by Ing. Jorge Salazar Alvarez
- 5) Environment by Ing. Eduardo Peralta

5. The site reconnaissance was executed to give the study team a perspective on the site conditions with ICE's counterpart.

- 1) On 3rd Sep. (Sat) Paquita river basin, Powerhouse site, Topographic stations

No.1 Car: Ing. Mario López S.
T. Yabe, M. Shibata, N. Demboya
No.2 Car: Ing. Roberto Jiménez V.
Y. Ebi, S. Hakoshima, K. Kikuchi
No.3 Car: Ing. Rody Rodríguez, Ing. Marcos Navarro
I. Ikeshima

- 2) On 4th Sep. (Sun) Naranjo river basin, Llanos Dam site, Topographic stations

No.1 Car: Ing. Mario López S.
T. Yabe, Y. Ebi, K. Kikuchi
No.2 Car: Ing. Roberto Jiménez V.
S. Hakoshima, M. Shibata, N. Demboya
No.3 Car: Ing. Rody Rodríguez, Ing. Marcos Navarro
I. Ikeshima

6. The subcontracted Costa Rican Consultants works for the study were set up the Topographic Mapping and the IEE Study (Initial Environmental Evaluation) under the ICE's admission by the JICA study team.

- 1) Aerial Photography and Field Survey
Rafael Soto y Asociados S.A.
- 2) Initial Environmental Examination Study
Fundación de la Universidad de Costa Rica para la Investigación (FUNDEVI)

7. The study team submitted the documents to ICE as follows:

- 1) Tentative Itinerary
- 2) Questionnaire
- 3) Equipment to be provided by JICA
- 4) Manual for the meteorological measuring equipment

8. The study team obtained the data from ICE as follows:

1) Planning

Annexo A CATASTRO PROYECTOS HYDROELECTRICOS
Annexo B GEOLOGIA Y GEOTECNIA
Annexo D ESTIMACIONES DE COSTOS
Annexo E HIDROLOGIA
Annexo F SIMULACRONES ENERGETICAS
Annexo G EVALUACION AMBIENTAL

2) Hydrology

INFORME HIDROLOGICO DEL PROYECTO HIDROELECTRICO LOS LLANOS (Octubre 1993)

CAUDALES SOLIDOS (Abril 1991)
CAUDALES CASA DE MAQUINAS

3) Environment

Informe Preliminar, Aspectos Ambientales P.H. Los Llanos, Direccion de Planificacion Electrica, Mayo 1994

Desarrollo Socioeconómico y el Ambiente Natural de Costa Rica, Fundación Neotropica 1988

Country Environmental Profile, A Field Study, TSC 1982

La Depreciación de los Recursos Naturales en Costa Rica y su Relación el Sistema de Cuentas Nacionales, CCT 1991

News, Aventura Con remos, Description de Los Viajes, LA NACION 1993

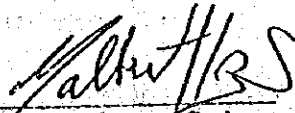
Zonas de vida de Costa Rica, CCT 1988

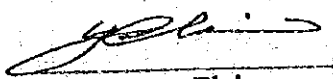
Cuestionario para Determinar los Requerimientos de Presentacion de estudios de Impacto Ambiental

Guia para la Elaboracion de Estudios de Impacto Ambiental para Proyectos de Acuicultura en Refugios de vida Silvestre y Humedales

Guia para la Elaboracion de Estudios de Impacto Ambiental para Proyectos de Salinas en Refugios de vida Silvestre y Humedales

Guia Basica para la Elaboracion de Estudios de Impacto Ambiental para Proyectos de Aprovechamiento de Recursos Naturales Renovables


Mario López Soto
Coodinador de ICE


Yasumasa Ebi
Team Leader of JICA

APPENDIX

- AA Topographic Mapping (ICE: Rody Rodriguez)
- 1) Aerial photography courses are changed as shown in CONTRACT.
 - 2) Monumental station, GPS station, Air photo signal station, Levelling route are changed as shown in CONTRACT.
 - 3) In flat road, difference of double runs shall be less than 10mm \sqrt{S} in approximate 15km.
 - 4) In mountain road, difference of double runs shall be less than 60mm \sqrt{S} in approximate 30km.
 - 5) A part of the mountain road shall be carried on Trigonometric levelling method in approximate 5Km.
 - 6) In supplemental survey, 2 cross section field survey shall be carried out near the dam site.
- BB Hydrology (ICE: Manuel Sanabria S., Rafael,)
- 1) Check the gauging station of Londres concerning location, measuring method and request the data of latest cross section and H-Q curve.
 - 2) Collect the data of Los Llanos gauging station. ('93.5 - '94.4)
 - 3) Advice the location and setting of the gauging station planned at the Paquita river.
 - 4) Request to gauge the flow at the Brujo river and the intake at the irrigation canal on every 15 days from December to May in dry season.
- CC Environment (ICE: Eduardo Peralta)
- 1) Explanation on the flame of environmental study to ICE was performed at the presentation of the Inception Report.
 - 2) According to the site inspection, outline on the current environmental situations including facility locations shall be constructed was grasped.
 - 3) Detailed items to be studied at IEE stage, especially on the data collection, were mutually confirmed by ICE and JICA study team, and the items to be studied were divided to 4 parts.
 - i) Items to be supplied to JICA team
 - ii) Items to be studied by ICE
 - iii) Items to be studied by ICE and JICA team
 - iv) Items to be entrusted to the local company

4) Two local companies introduced by ICE staff, including educational organization were sounded by JICA study team and ICE staff about the capability to achieve the data collection works at the IEE stage.

After receiving the proposal from 2 organizations, their capabilities and the costs were examined by JICA study team. The result was that FUNDEVI was selected by JICA study team as a cooperative local company.

DD Geology, Geophysical and Geotechnical Investigations
(ICE: Ricardo Granados V, Luis F. Sáenz Sánchez, Jorge Salazar)

- 1) Collect the geological datum of drillholes, pits and geophysical prospecting at damsite, waterway and powerhouse.
- 2) Collect the geotechnical datum and the specification of measuring method.
- 3) Confirm the quantity of geophysical prospecting being carried out at waterway by ICE.
- 4) Collect the datum of seismology in Costa Rica.
- 5) Advise the rock mass classification of drillhole core, pits and adits.

MEMORANDUM ON DISCUSSION NO.2

between ICE and JICA
from 6th to 24th September 1994
on Feasibility Study for
Los Llanos Hydroelectric Power Development Project

PARTICIPANTS

JICA

Y. Ebi
S. Hakoshima
H. Sudo

M. Shibata
N. Demboya

K. Kikuchi
N. Hamano
M. Yukawa

I. Ikeshima (leaved on 10th Sep.)

ICE

Mario López S
Roberto Jiménez V
Hector Vargas F
Rodolfo Brenes G

Sergio Mora
Ricardo Granados V

Eduardo Peralta

Mario Alfaro Zúñiga
Carlos Llobet Rodríguez
Alejandro Luna B
Carlos Rodríguez N
Luis Fdo. Sáenz Sánchez
Jorge Salazar Alvarez
Alexis Cerdás S

The proceedings are as follows:

- [I] The study team submitted the documents to ICE as follows:
1. MEMORANDUM ON DISCUSSION (from 1st Sep. to 5th Sep.)
 2. CONTRACT FOR AERIAL PHOTOGRAPHY AND SURVEY
SPECIFICATIONS FOR FIELD SURVEY
Rafael Soto y Asociados S.A.
 3. CONTRACT FOR INITIAL ENVIRONMENTAL EXAMINATION
SPECIFICATION FOR ENVIRONMENTAL STUDY AT IEE STAGE
Fundación de la Universidad de Costa Rica para la
Investigación (FUNDEVI)
 4. Proposals for an estimate of environmental study
FUNDEVI, CCT

[II] The site reconnaissance was executed with ICE's counterpart.

1. To investigate the geological conditions
On 5th Sep. (Mon) to 9th Sep. (Fri),
and On 12th Sep. (Mon) to 16th Sep. (Fri)

M. Shibata
N. Demboya

S. Hakoshima
(from 13th to 16th)

Ing.s

Ricardo Granados V
Carlos Rodríguez N
Alexis Cerdas S
Jorge Salazar A
Luis Fernando Sáenz S

2. To select the water gauging station at Brujo river
On 13th Sep.(Tue)

Y. Ebi
S. Hakoshima

Ing. Mario López S

3. To investigate on gauging station, existing power station & transportation routes and IEE
On 19th Sep.(Mon) to 21st Sep.(Wed)

No.1 Car; Y. Ebi
S. Hakoshima

Ing. Mario López S

No.2 Car; H. Sudo

Ing. Roberto Jiménez V

No.3 Car; K. Kikuchi
N. Hamano
M. Yukawa

Ing. Eduardo Peralta

[III] The major points raised during the discussions in this term are as follows:

AA:PLANNING

Basic development plan will be studied based on check and review of the obtained data and the existing study and concluded in Progress Report.

BB:TOPOGRAPHY

Reconnaissances concerning the general topography of the project area are to be made carefully on all areas of the various structures such as reservoir area, dams waterway, penstock, powerhouse and switch-yard based on the 1/50000 maps in which the layouts of the development schemes in this project are plotted in detail.

Utilization of aerial photographs of related area is also to be considered.

BB:HYDROLOGY

1. Setting of the gauging station at the Brujo river and gauging the river-flow at the same time of gauging at Londres and Los Llanos.
2. Site selection for the runoff gauging station to be newly installed in the Paquita river is to be made through site reconnaissance. Since a SUIKEN Model 62 water gauge furnished by JICA is to be installed at the gauging station, the selection is to be made considering the conditions for construction of the gauging tower for installation of the water gauge.

3. Checks are to be made to confirm all water-utilization facilities such as for irrigation water and other uses over the entire stretch of the African palm, from the inlet of Naranjo river to the outlet sites in the ocean. With regard to this investigation, in order for works to be done effectively, it would be desirable to be carried out at the time of the EIA.

CC: ELECTRICAL/MECHANICAL

1. The questionnaire for the power plant and power systems submitted by JICA study team is to be answered by ICE at least on the end of November 1994.
2. Vertical Pelton and vertical Francis turbines are to be studied by JICA team taking construction cost including civil works, annual production of electric energy (kWh), annual cost of operation and maintenance etc. into consideration.
3. Single phase and three phase main transformers are to be studied taking transportation conditions, stand-by facilities etc. into consideration.

DD: Geological/Geophysical/Geotechnical INVESTIGATION

1. Geological site reconnaissances to the damsite, up-stream reservoir area, waterway route, powerhouse site and construction material sites of Los Llanos project including with geological observations of adits, test-pits and drillhole cores.
2. Discussion on the geological, geophysical and geotechnical investigation results between ICE engineers and JICA members was made on the date from 19th September to 22nd September.

EE: Environmental

1. Meeting concern to entrusting IEE study was held between FUNDEVI and JICA study team, including ICE environmental engineer and the both parties made a contract under mutual agreement on September 14th.
2. Field inspection on the IEE stage was carried out with ICE from September 19 to 23.
On this inspection, regarding to actual conditions, natural and socio-economical information were investigated mainly by a hearing study. Main items studied in this term,

as follows.

- 1) Situation of local industries including fisheries.
 - 2) Public health
 - 3) River water utilizations
 - 4) Damage on flood near Cerritos village
3. Data relating to actual environmental situations of project area were collected by the cooperation of ICE.
 4. Water flowing channels in palm plantation was sampled for the identification of its sources. These sample shall be studied by chemical analysis.
 5. 3 locations at the Naranjo river to be observed air temperature and humidity were decided in this inspection.

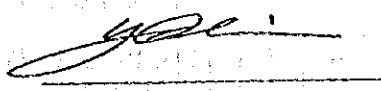
FF: FORMULATION of FURTHER INVESTIGATION PROGRAM

The further investigations include compilation of planning, geological and environmental studies to be made by the JICA study team, the construction material tests and hydrological survey by ICE with the cooperation and guidance of the JICA study team.

And further aerial surveying, photogrammetric mapping and IEE surveys will be performed under contract on selection of contractors paid for by JICA.

- 1) Concrete Aggregate Tests
Gradation, specific gravity and absorption, organics content, soundness, ablation loss, alkali-aggregate reaction at No.1 site and No.2 site of the upstream near the LL dam.
- 2) Gauging the flow at the Brujo river, the inlet and the outlet canals in the palm plantation.


Mario López Soto
Coordinador de ICE


Yasumasa Ebi
Team Leader of JICA

Data list

AA: CONSTRUCTION COST

1. PRECIOS UNITARIOS DE OBRAS PARA CONSTATISTAS Y POR ADMINISTRACION (ICE) DICIEMBRE 1993
2. PRECIOS UNITARIOS PARA LAMINOS (Válidos para Septiembre '94)
3. Minimum Wage (DIARIO OFICIAL 20 de julio de 1994)
4. BOLSA DE PRECIOS DE MATERIALES PARA LA CONSTRUCCION
5. Costs de electricidad para la industria de la construccion
6. Costos por ingenieria
7. Costos por administracion
8. Interest rate
9. Contingencias
10. Import Duties
11. Re-export Duties of Construction Equipment
12. Wholesale Price Index in Costa Rica
13. Material Cost
14. PRESUPUESTO DEL PROYECTO HIDROELECTRICO GUAYABO. (a)

BB: TOPOGRAPHIC MAP

1. Topographic Map (Scale 1:50000)
DOTA, QUEPOS, SAVEGRE, VUELTAS
2. PERFILES EN SITIO DE PRESA (1/4, 2/4, 3/4, 4/4)
3. PERFILES EN SITIO DE PRESA NO.3
4. LINEA DE TUNNEL (1/3, 2/3, 3/3)
5. TUBERIA DE PRESION
6. SITIO PRESA RIO NARANJO
7. SITIO PRESA, SITIO CASA MAQUINAS SECCIONES
8. SECCIONES TRANSVERSALES EN RIO PAQUITA
9. CASA DE MAQUINAS PERFIL PARA GEOFISICA (1/2, 2/2)

CC: ELECTRICAL/MECHANICAL

1. Power System and Power Plant
2. Route of 500kv and 230kv Transmission Lines under Planning
3. Sistema De Transmission Pacifico Central
4. Diagram Unifilar S.E.N. Año 2015
5. Sistema Electrico National Año 2010
6. Torre Tipo Cellosia Propuesta Para L.T. Pirris-Lindora
7. Informe De Diseño Preliminar Adendum P.H. A.

DD: GEOLOGY

1. Geological maps of damsite, waterway route and powerhouse site
2. Geological data of adits, test-pits and drillholes including of water pressure tests in drillholes.
3. Geological data of damsite including of adit and powerhouse site including of drillhole.
4. Geotechnical data of adits, test-pits, trenches, drillholes and some laboratory tests.
(Detailed list of geo-data offered from ICE is attached as Appendix)

EE: ENVIRONMENTAL

1. ANIMALS EN PELIGRO DE EXTINCION DE COSTA RICA (1990) PUBLICACION FINANCIADA POR: Embajada de Holanda, Embajada de Canadá, Sociedad Zoológica de Nueva York.
2. HISTORIA NATURAL DE LOS MONOS DE COSTA RICA
3. REGULACIONES PARA EL EJERCICIO DELA CAZA Y LA PESCA CONTINENTAL DURANTE EL AÑO 1990
4. HISTORIA NATURAL DE COSTA RICA EN PELIGRO DE EXTINCION
5. HISTORIA NATURAL DE LOS FELINOS DE COSTA RICA
6. HISTORIA NATURAL DE LAS AVES EN PELIGRO DE EXTINCION DE COSTA RICA
7. Lista de especies en vías de extinción y temporadas de casa
8. List of living things near national park, ICE

9. Algunas especies en peligro de extinción protegidas en los Parques Nacionales de Costa Rica
10. PROYECTO DE REGLAMENTACION DEL MANEJO DEL RECURSO AIRE, ANEXO 2
11. REGLAMENTO PARA EL CONTROL DE RUIDOS Y VIBRACIONES (1979)
12. PROGRAMA DE CONTROL DE CONTAMINACION DEL AIRE EN COSTA RICA
13. Regulations; Potrones OPS Para Agua Potable, Contaminaci por Liquidos, Residuos Solidos

APPENDIX 1

The Study Team Obtained Data from ICE as Follows:

1. Geology**1.1 Damsite**

- (1) Location Map of Geological Investigation
 - 1:2,000
- (2) Geological Map at Dam Site
 - 1:2,000
- (3) Geological Outcrops Map at Reservoir Area
 - 1:2,000
- (4) Geological Cross Sections
 - 1:1,000 (E-1 and E-2)
 - 1:500 (E-3) (draft)
- (5) Geological Log of Drillholes
 - PHLLL1SP, PHLLL2SP, PHLLL3SP and PHLLL4SP
 - Geological Description, Core Recovery Rae, RQD and Water Table
 - 1:100 (PHLLL1SP and PHLLL2SP)
 - draft (PHLLL3SP and PHLLL4SP)
- (6) Water Pressure Test Data of Drillholes
 - PHLLL1SP, PHLLL2SP, PHLLL3SP and PHLLL4SP
 - List of Depth and Interval of Tests
 - Data sheets of Pressure, Flow Rate and Time
 - Pressure VS Quantity Curve
- (7) Specification of Equipment and Analysis Theory of Water Pressure Test
- (8) Geological Log of Test Pits at Damsite
 - Test Pit No.1 and Test Pit No.2

- 1:50

(9) Geological Log of Adits at Damsite

- Adit No.1 and Adit No.2

- 1:25 (draft)

(10) Fracture Distribution Analysis Results of Adit

- Adit No.1

- Distribution Graph, Contour Graph and Rose Diagram

1.2 Waterway

(1) Geological Map of the Waterway Route

- 1:10,000

(2) Geological Section of Waterway Route

- 1:10,000

1.3 Power House, Penstock and Surge Tank

(1) Distribution Map of Geological Outcrops

- 1:2,000

(2) Geological Map at Power House

- 1:2,000

(3) Geological Sections of Penstock Route

- Route No.1 and No.2

- Cross Sections (6 sections)

- 1:2,000

(4) Geological Logs of Trenches at Penstock Route

- C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11 and C12

- 1:100

(5) Results of X-ray Analysis of Bedrock

- CM1, CM2, CM3 and CM4

(6) Photograph of Outcrop and Trenches

- Outcrop of Terrace Deposits and Bedrock

- Trench No.8 and No.13

(7) Geological Log of Drillholes at Power House and Penstock

- PHLLL5CM, PHLLL6CM, PHLLL7CM, PHLLL8CM, PHLLL9CM, PHLLL10CM, PHLLL11CM,
- PHLLL12CM, PHLLL13CM, PHLLL14CM, PHLLL15CM, PHLLL16CM, PHLLL17CM
- Geological Description, Core Recovery Rae, RQD and Water Table
- 1:100 (PHLLL5CM, PHLLL6CM, PHLLL7CM, PHLLL8CM, PHLLL9CM and PHLLL10CM)
- draft (PHLLL11CM, PHLLL12CM, PHLLL13CM, PHLLL14CM, PHLLL15CM, PHLLL16CM and PHLLL17)

(8) Water Pressure Test Data of Drillholes

- PHLLL9CM and PHLLL14CM
- Pressure VS Quantity Curve (no Digital Data)

(9) Core Photograph

- PHLLL6CM, PHLLL7CM, PHLLL8CM and PHLLL9C

(10) Geological Sections at Surge Tank

- 1:1.000
- 6sections

(11) Photograph of Outcrop at Surge Tank

1.4 General

(1) List of Drillholes, Adits and Lines of Geophysical Prospecting

- Latitude, Longitude and Elevation at Damsite and Powerhouse
- except PHLLL-11CM and PHLLL-16CM

(2) The Map of Interpretation from Aerophotograph

- 1:30.000

(3) A Published Literature about General Geology of Costa Rica

- Cuencas Sedimentarias de Costa Rica: Evolucion Geodinamica y Potencial de Hidrocarburos (in Spanish)

Astorga et. al. 1991. Rev. Geol. Amer. Central. vol. 13. p. 13-25

(4) The Figure of A Genral Idea of Drowing of Adits

(5) Information about Advance of Geological Investigation

- No. 1 and No. 3

2. Geotechnical Data

2.1 Plate Jack Test in Adit at Damsite

- Adit No.1
- Data Sheet of Tests
- Pressure VS Deformation Graph
- Results of Analysis and Conclusion of Tests

2.2 Plate Jack Test in Test Pit at Damsite

- Test Pit No.2
- Data Sheet of Tests
- Pressure VS Deformation Graph
- Results of Analysis and Conclusion of Tests

2.3 Goodman Jack Test in Drillholes at Damsite

- PHLLL1SP, PHLLL2SP, PHLLL3SP and PHLLL4SP
- Data Sheet of Tests
- Pressure VS Deformation Graph (PHLLL2SP and PHLLL4SP)
- Results of Analysis and Conclusion of Tests

2.4 Goodman Jack Test in Drillholes at Power House

- PHLLL10CM, PHLLL11CM, PHLLL12CM, PHLLL13CM, PHLLL14CM and PHLLL16CM
- Data Sheet of Tests (PHLLL10CM, PHLLL11CM, PHLLL12CM, PHLLL13CM and PHLLL14CM)
- Pressure VS Deformation Graph (PHLLL16SP)
- Results of Analysis and Conclusion of Tests

2.5 Laboratory Tests of Rock Samples for Concrete

- Power House, Quebrada Azul and Los Alacranes
- Average Data of Test Results (not Detail Data)
- Location Map of Rock Sampling Area 1:50,000

2.6 Location Map of Rock Quarry

- 1:11,111

2.7 Exploration of Aluvial Deposits for Concrete Aggregation

- Trenches at Rio Naranjo, Rio Paquita and Rio Canas

- List of Trenches (Locations and Elevations)
- Location Map of Sampling Area 1:50,000
- Location Map of Trenches at Rio Naranjo and Rio Paquita(1:4,444)
- Average Data of Test Results (not Detail Data)

2.8 A Published Literature about Goodman Jack Test

- The NX-Borehole Jack:A Lesson in Trials and Errors
Heuze and Amadei .1985. Int.J.Rock Mech.Sci.and Geomech.Abstr.
vol.22,no.2,p.105-112

2.9 Manual of Goodman Jack Test

- Julio Delgado and Jorge Salazar (ICE)

3. Geophysical Investigation Data

3.1 List of Drillholes,Adits and Lines of Geophysical Prospecting

- Latitude,Longitude and Elevation at Damsite and Powerhouse

3.2 Seismic Prospecting on the Surface at Damsite

(1)Location Map of Profile

- 1:5,000

(2)Time VS Distance Curves and Cross Sections

- PS-1,PS-2,PS-3,PS-4,PS-5,PS-6,PS-7,PS-8
- PS-8(continued)
- 1:1,000

(3)Table of Layer Correlation between Velocity and Lithology

(4)Conclusion of Prospecting

3.3 Seismic Prospecting in Adit No.1 at Damsite

- (1)Time VS Distance Curve (draft)
- (2)Conclusion of Prospecting

3.4 Seismic Prospecting on the Surface on the Waterway Route

- (1)Time VS Distance Curve (draft)
- (2)Section of Velocity Layer
- 1:1,000 (draft)

3.5 Resistivity Surevey on the Surface on the Waterway Route

(1) Section of Resistivity Destribution

- 1:1,000 (draft)

3.6 Seismic Prospecting on the Surface at Power House

(1) Location Map of Profile

- 1:5,000

(2) Time VS Distance Curve

- PS-1, PS-2, PS-3, PS-4, PS-5 and PS-6 (draft)

(3) Section of Velocity Layer

- PS-3, PS-4, PS-5, PS-6

- 1:500 (draft)

(4) Section of Result of Seismic and Resistivity Prospecting

- PS-1 (draft)

(5) Table of Layer Correlation between Velocity, Resistivity and Lithology

(6) Table of Layer Correlation between Velocity, Rock Properties and Rock Strength

(7) Conclusion of Prospecting

3.7 Resistivity Survey on the Surface at Power House

(1) Location Map of Profile

- 1:5,000

(2) Conclusion of Prospecting

3.8 Downhole Seismic Prospecting in Drillhole PHLLL16CM at Power House

(1) Time VS Distance Curve (draft)

3.9 Seismic Prospecting on the Surface on Penstock Route

(1) Time VS Distance Curve

- Route No.1 (draft)

(2) Section of Velocity Layer

- Route No.1 and No.2

- 1:1,000 (draft)

3.10 Resistivity Survey on the Surface on Penstock Route

(1) Section of Resistivity Distribution

- Route No.1 (not covered full Route)

- 1:1,000 (draft)

3.11 Format Sheets of Recording of Resistivity Survey

3.12 List of Equipment used for Geophysical Prospecting

The Study Team Requested ICE Data as Follows:

1. Geology

1.1 Damsite

(4) Geological Cross Sections

- 1:500 (E-3) (final)

(5) Geological Log of Drillholes

- PHLLL3SP and PHLLL4SP

- 1:100

(9) Geological Log of Adits at Damsite

- Adit No.1 and Adit No.2

- 1:25 (final)

1.3 Power House, Penstock and Surge Tank

(6) Photograph Trenches

- Except Trench No.8 and No.13

(7) Geological Log of Drillholes at Power House and Penstock

- PHLLL11CM, PHLLL12CM, PHLLL13CM, PHLLL14CM, PHLLL15CM, PHLLL16CM and PHLLL17CM

- Geological Description, Core Recovery Rae, RQD and Water Table

- 1:100 final

(8) Water Pressure Test Data of Drillholes

- PHLLL9CM and PHLLL14CM

- Digital Data

1.4 General

(1) List of Drillholes, Adits and Lines of Geophysical Prospecting

- Latitude, Longitude and Elevation at Damsite and Powerhouse

- PHLLL-11CM and PHLLL-16CM

2. Geotechnical Data

2.3 Goodman Jack Test in Drillholes at Damsite

- Pressure VS Deformation Graph (PHLLL1SP and PHLLL3SP)

2.4 Goodman Jack Test in Drillholes at Power House

- Data Sheet of Tests (PHLLL16SP)
- Pressure VS Deformation Graph (PHLLL10CM, PHLLL11CM, PHLLL12CM, PHLLL13CM and PHLLL14CM)

2.5 Laboratory Tests of Rock Samples for Concrete

- Power House, Quebrada Azul and Los Alacranes
- Detail Data (of each sample)
- Location Map of Rock Sampling Point

2.6 Location Map of Rock Quarry

- Distribution Map or Information of Rock Quarry

2.7 Exploration of Aluvial Deposits for Concrete Aggregation

- List of Trenches (final) (Locations and Elevations)
- Location Map of Trenches at Rio Canas (1:4,444)
- Detail Data (of each sample)

3. Geophysical Investigation Data

3.2 Seismic Prospecting on the Surface at Damsite

(2) Time VS Distance Curves and Cross Sections

- PS-8 (final)
- 1:1,000

3.3 Seismic Prospecting in Adit No.1 at Damsite

(1) Time VS Distance Curve (final)

3.4 Seismic Prospecting on the Surface on the Waterway Route

(1) Time VS Distance Curve (final)

(2) Section of Velocity Layer

- 1:1,000 (final)

3.5 Resistivity Surevey on the Surface on the Waterway Route

(1) Section of Resistivity Distribution

- 1:1,000 (final)

3.6 Seismic Prospecting on the Surface at Power House

(2) Time VS Distance Curve

- PS-1, PS-2, PS-3, PS-4, PS-5 and PS-6 (final)

(3) Section of Velocity Layer

- PS-1, PS-2, PS-3, PS-4, PS-5, PS-6

- 1:500 (final)

3.7 Resistivity Survey on the Surface at Power House

(1) Section of Resistivity Distribution (final)

3.8 Downhole Seismic Prospecting in Drillhole PHLLL16CM at Power House

(1) Time VS Distance Curve (final)

3.9 Seismic Prospecting on the Surface on Penstock Route

(1) Time VS Distance Curve

- Route No.1 and No.2 (final)

(2) Section of Velocity Layer

- Route No.1 and No.2

- 1:1,000 (final)

3.10 Resistivity Survey on the Surface on Penstock Route

(1) Section of Resistivity Distribution

- Route No.1 (not covered full Route)

- 1:1,000 (final)

3.13 Crosshole Vp Measurement

(1) Velocity Distribution Section

- Between Drillhole PHLLL8CM and PHLLL9CM, PHLLL12CM and PHLLL14CM, PHLL
L15CM and PHLLL16CM (draft)

LOS LLANOS PROJECT

Sep. 22, 1994
JICA MISSION, San Jose

GEO-INVESTIGATION WORKS Finished in The Project Area

1. Core Drilling

Drillhole No.	Location	Length (m)	Dir.	Elevation (m. asl)	Coordination		Remarks
					Lat.	Lon.	
PHLLL1SP	Damsite, up-str. right bank	70.70	V.	501.939	388.235	461.161	Water pressure tests and water level
PHLLL2SP	Damsite, mid-str. right bank	83.30	V.	509.51	388.230	461.068	measurements were done
PHLLL3SP	Damsite, down-str. right bank	80.0	V.	493.28	388.194	460.692	in every drillholes
PHLLL4SP	Damsite, down-str. left bank	60.0	70° 300°	453.03	388.068	461.070	
(Sub-Total : 294.00m)							
PHLLL5CM	P/S site, Penstock 'A'	30.00	V.	97.431	385.332	454.988	
PHLLL6CM	ditto	24.30	V.	96.436	385.295	454.993	
PHLLL7CM	ditto	28.00	V.	95.037	385.391	454.986	
PHLLL8CM	Down-str. of P/S site and 'A'	20.10	V.	86.094	385.352	454.891	
PHLLL9CM	P/S site, Penstock 'A'	31.50	V.	88.195	385.394	454.949	
PHLLL10CM	Penstock 'A' (Downstream line)	36.40	V.	148.005	385.363	455.120	
PHLLL11CM	Penstock 'B'	30.80	V.	?	?	?	
PHLLL12CM	P/S site, Penstock 'B' (up-str. line)	30.85	V.	100.415	385.542	455.157	
PHLLL13CM	Between 'A' and 'B' near river bank	50.0	V.	101.273	385.422	455.031	
PHLLL14CM	P/S site, Penstock 'B'	34.15	V.	102.947	385.552	455.191	
PHLLL15CM	ditto	26.40	V.	102.202	385.547	455.176	
PHLLL16CM	ditto	26.0	V.	102	385.546	455.177	Downhole seismic wave velocity measured
PHLLL17CM	Between 'A' and 'B' on high elevation	21.60	V.	275.156	385.415	455.555	
(Sub-Total : 390.10m)							
(Grand-Total : 684.1 m / 17 holes)							

2. Adit

Adit No.	Location	Length (m)	Dir.	Elevation (m. asl)	Coordination		Remarks
					Lat.	Lon.	
1	Damsite, down-str. right bank	31.15	90°	444.05	388.112	461.048	Vp/Vs measurements, Plate Jack Tests
2	Damsite, down-str. left bank	6 (5.5) 37.15m + 5.5 m open cut	120°	453.03	388.068	461.070	

3. Test Pit

Pit No.	Location	Length (m)	Dir.	Elevation (m. asl)	Coordination Lat. Lon.	Remarks
1	Damsite, up-str. right bank	9.55	V.	503.67	388.220 461.140	
2	Damsite, mid-str. right bank	9.50	V.	506.07	388.211 461.063	Plate Jack Test above the bottom

4. Geophysical Prospecting

(1) Refraction Prospecting/Resistivity Prospecting

Line No.	Location	Length (m)	Dir.	Refraction Prospecting	Resistivity Prospecting	Remarks
PS-1		170		0	X Resistivity	
PS-2		220		0	X Prospecting	
PS-3		220		0	X was done	
PS-4	Damsite	220		0	X in part	
PS-5	right bank	330		0	X	
PS-6		220		0	X	
PS-7		330		0	X	
PS-8		220		0	X	
(Sub-total)		1,930 m				Extending + 280m along headrace tunnel route
PS-1		125		0	X Resistivity	
PS-2		125		0	X Prospecting	
PS-3	P/S site	115		0	X was done	
PS-4		95		0	X in part	
PS-5		85		0	X	
PS-6		115		0	X	
(Sub-total)		660 m				
(Grand-total)		2,590 m / 14 holes				

(2) Vp/Vs Measurement in Adit

Measurement length: 22m in Adit No. 1

(3) Vp Measurement in Drillhole

Measurement length: 22m in Drillhole PHLLL16CM

(4) Cross-Hole Vp Measurement

Measurement between Drillholes PHLLL8CM and PHLLL9CM, PHLLL12CM and PHLLL14CM, PHLLL15CM and PHLLL16CM

5. Geotechnical Tests

(1) Plate Jack Test in Adit/Test Pit

Test No.	Location	Direction	Remarks
1	TD. 15m Adit No. 1	Horizontal	
2	TD. 28m Adit No. 1	Horizontal	
3	Dep. 9.00m Test Pit No. 2	Horizontal	

Two directions

(2) Goodman Jack Test in Drillholes

Drillhole No.	Nos. of Test	Remarks	Drillhole No.	Nos. of Test	Remarks
PHLLL1SP	7 (pts)	Damsite: 9.75-64.75m	PHLLL10CM	7 (pts)	11.88-33.50m
PHLLL2SP	6 (pts)	Damsite: 2.50-30.70m	PHLLL11CM	6 (pts)	9.55-26.25m
PHLLL3SP	17 (pts)	Damsite: 4.70-80.00m	PHLLL12CM	4 (pts)	6.40-24.87m
PHLLL4SP	9 (pts)	Damsite: 12.75-59.50m	PHLLL13CM	7 (pts)	9.25-40.66m
			PHLLL14CM	9 (pts)	1.20-28.60m
			PHLLL16CM	2 (pts)	3.40, 3.60m
(39 (pts))			(35 (pts))		

(3) Laboratory Test

- Core Test -
- Uniaxial compressive strength
- Density
- Porosity
- Concrete Aggregate test -

No detailed data
only outlines of test results

ditto

MEMORANDUM ON DISCUSSION NO.3

between ICE and JICA
on Feasibility Study for
Los Llanos Hydroelectric Power Development Project

Part I; from 15th November to 29th November, 1994

PARTICIPANTS

J I C A

Y. Ebi
S. Hakoshima
M. Kato

T. Fujiuchi
(leaved on 25th Nov.)

I C E

Mario López S.
Roberto Jiménez V.
Antonio Arogón
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Alejandro Luna B.
Alejandro Hidargo
Laureano Montero
Hector Vargas F.

The proceedings are as follows:

[I] The daily meeting of the JICA study team was called to discuss in the conference room (7F) by Ing. Mario López.

* Basic Development Plan

- 1 From review of the existing Master Plan, Los Llanos project is the best among the five projects.
- 2 For Los Llanos project, some alternative plans will be studied by the end of February, 1995.
- 3 Basic development plan of Los Llanos project will be output capacity of about 100MW including daily regulating reservoir considering the electricity demand in Costa Rica.
- 4 Los Llanos project will program to develop after the existing thermal plants (Barranca, Colima, San Antonio Gas, San Antonio Vapor) discontinued services.
- 5 Import and wind-power electricity will be took out of consideration.
- 6 The plant factor of the newly-established thermal power plant will be applied 70% for Diesel power plant and 35% for Gas turbine plant respectively.

- * Design criteria for Seismic Coefficient in Costa Rica
- * Sedimentation in Costa Rica
- * Design of Surge Tank and Settling Basin
- * Design of Waterway and Electric Equipment in TORO I and II project
- * Development Plan for Transmission-line

1 The commencement time of Los Llanos will be committed after SIPAC (500 kV) when will be connected in 2000 to 2003 year.

2 The transmission-line of Los Llanos will connect at the San Rafael Sur transformer substation.

[II] The JICA team made an inspection for the provision of vehicles & equipments which JICA donated to ICE for the Los Llanos project at Caldera port with ICE counterpart, and inspected to existing power station sites and under-constructing sites.

Caldera port ----- on 21st November
Toro 1, 2 (Under construction)

Arenal P/S ----- on 22nd November

Corobici P/S & Sandillal P/S ---- on 23rd November

Part II; from 30th November to 9th December 1994

PARTICIPANTS

J I C A

Y. Ebi
S. Hakoshima (leaved on 10th Dec.)
M. Kato (leaved on 10th Dec.)
K. Mishima
M. Shibata
N. Demboya

I. Ikeshima
K. Kikuchi (leaved on 10th Dec.)
T. Hirahara (leaved on 10th Dec.)

I C E (chiefly)

Mario López Soto.
Robert Jiménez V.
Manuel Sanabria S.
PT Luis E Acuña R.
Jorge Salazar A.
Carlos Rodríguez
Alexis Cerdas S.
Rody Rodríguez
Eduard Peralta
Hector Vargas

[I] 20 copies of PROGRESS REPORT has been submitted to ICE on 30th November, 1994. (Ref. LL/6N30/022/YE & Agenda)

[II] Second field inspection was performed with ICE from 5th to 8th December. (Ref. Itinerary)
The major points raised during the presentation and discussions at field in this term are as follows:

* PLANNING & DESIGN

- 1 Alternative studies would be included the all of analysis and results of investigations, and based on the newest topographic map of 1/5,000 for the whole area and 1/1,000 for the Dam and the Powerhouse area.
- 2 Comparison designs for the dam-type of Los Llanos are a concrete gravity dam, arch-gravity dam and arch dam on the selected axis.
- 3 Other structures (Power intake, desalting basin, surge tank) would be taken into consideration how the most effective and economical operation will be made in a plan.
- 4 Power-house also will be selected the suitable place and type depend on the geological and topographical conditions.
- 5 Concrete aggregate for the dam will be collected from quarry site of Quebrada Azul which has been investigated by ICE.

* HYDROLOGY & ENVIRONMENT

- 1 IEE report entrusted by JICA was received on 29th Nov. from FUNDEVI (Costa Rica University).
Explanation of IEE report was performed on 30th Nov. to the Presentation, and fundamentally accepted by ICE.
- 2 Following Items were inspected by JICA's hydrologist with ICE.
Locations of measuring points to be studied at EIA stage were confirmed and the current situation of water quantity flowing in the channels and water quantity of intake were grasped in the Palm Plantation.
Based on the results of inspection, continuous measurements concerning with river flow-rate, flow rate of channels and the water quality were accepted between JICA and ICE.
And also, topographical measurement at the intake was proposed by JICA to ICE, in addition to quality in several channels. (see attached sheet)

3. Current condition of river mouth area near Cerritos village along Paquita river were inspected and by this inspection, existence of erosion and flooding problems were become more clear.
- a. Erosion problem at the mouth shall be taken into the condition after obtaining the basic information from "Port and Harbor Research Institute, Japan" who evaluated the movement of sand bank and the river mouth of Paquita river.
 - b. Flooding problem near Cerritos shall be studied by introducing the topographical measurement and water level calculations by cooperation with hydrologists of JICA and ICE.
- 4.
- a. Three (3) locations for equipment of observatories to be used in the measurements of local air temperature and humidity were established at the down stream near dam site.
 - b. Location of the Meteorological station to be donated by JICA was selected at near Napoles village consented to establish.
- 5.
- a. Meeting between JICA and FUNDEVI was held on 9th Dec. After the examination of the report, JICA requested to make a deficiency for FUNDEVI, especially on the part of hydrological study. FUNDEVI made a promise to filling the efficiency in the report within 1 week.
 - b. Outline and lists of EIA program to be studied from next March was explained on 9th Dec. JICA and ICE agreed to the enforcement of EIA study by carrying the proposed basic program into effect. Detailed study contents and procedures shall be proposed on March by taking the results of second inspection and the proposal for next detailed stage from FUNDEVI into consideration.

* TOPOGRAPHIC MAPPING

1. Mapping area and neat line for 1:1,000 and 1:5,000 were confirmed as shown in attached sheet. Marginal was also confirmed as attached sheet.

2 In supplemental survey, a cross section was decided at the dam site presented by JICA and ICE.

3 Three (3) air photo signals were added to the boring points (near the dam site, near the power house and near the penstock).

*** ECONOMIC AND FINANCIAL EVALUATION**

1 Basic data for economic/financial evaluation as of December 1994 were received.

2 Actualized data for use in evaluation will be supplied to the JICA mission in July/August 1995.

3 Evaluation time, as well as exchange rate used for evaluation will be identical to the ones to be used for cost estimate.

4 Remaining data including "Informe anual de labores" and "Informe de Operacion de los Principales Empresas Electricas" will be passed to Mr. Ebi later.

*** DATA COLLECTED (1)**

(2)

*** ATTACHED SHEETS**

Submission of Progress Report

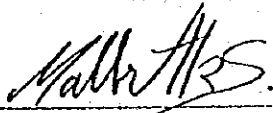
Agenda of Presentation

Itinerary for the Second Reconnaissance

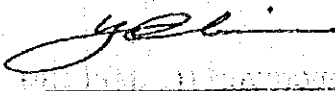
Environmental Survey Points at EIA Stage (hand over)

Mapping Area, Neat Line

Marginal



Mario López Soto
Coodinador de ICE



Yasumasa Ebi
Team Leader of JICA

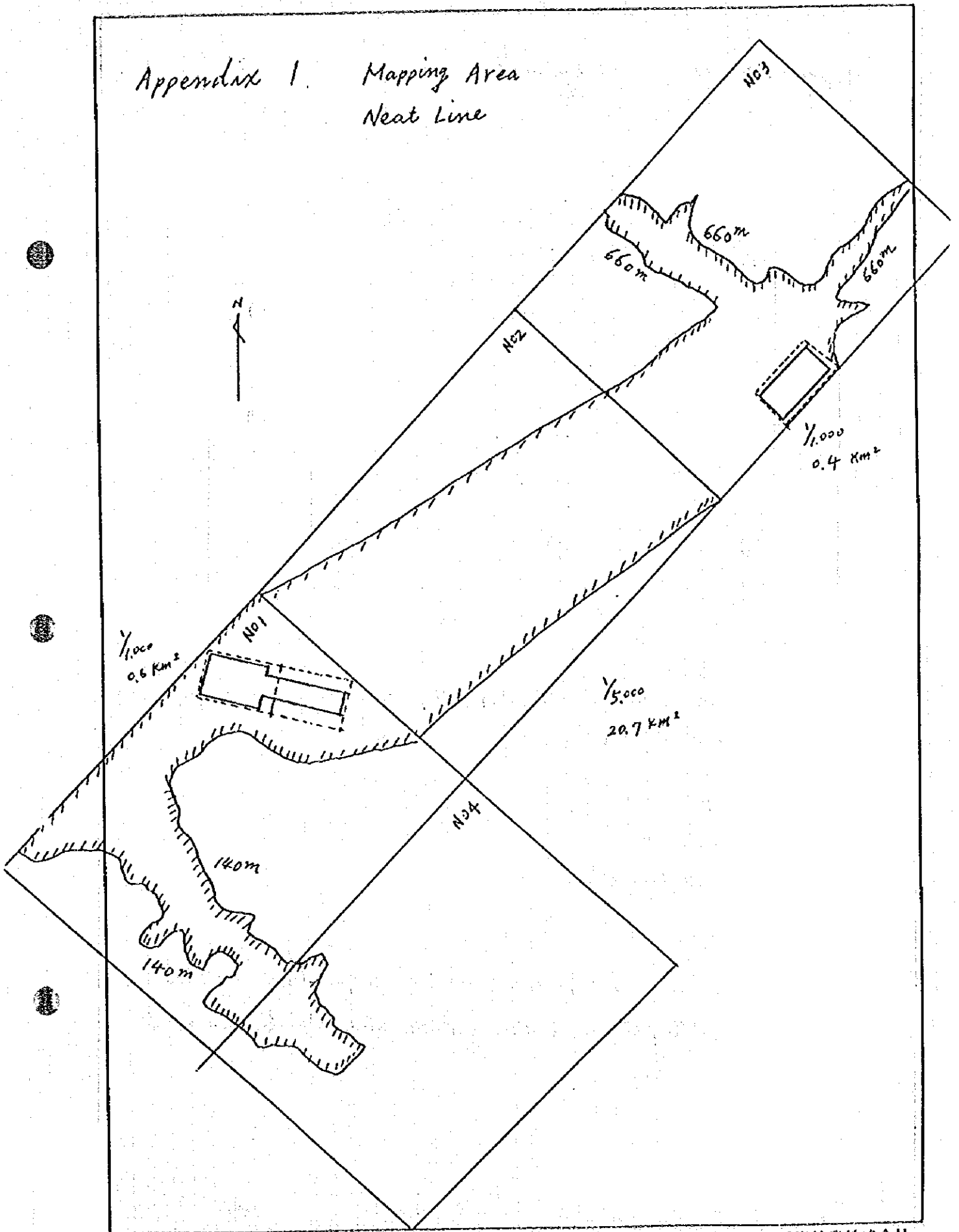
DATA COLLECTED (1)

- * CODIGO SISMICO DE COSTA RICA 1986
- * Sedimentological Studies in the CACHI Reservoir, Costa Rica
- * SEDIMENTO EN SUSPENSION
- * Sedimentation Study for P.H. BORUCA, P.H. PACUARE, P.H. SAVEGRE, P.H. VENTANAS GARITA and P.H. SIQUIRRES
- * Calculation of water and sediment flow in the ANGOSTURA reservoir in Costa Rica
- * P.H. VENTANAS GARITA PRESA, TOMA, DESARENADOR Y CAMARA DE PRESION
 - 1/4 LOCALIZACION GENERAL
 - 2/4 PLANTA Y CORTES PRINCIPALES
 - 3/4 CORTES Y DETALLES
 - 4/4 DETALLES
- * COSTOS USADOS PARA PLANEAMIENTO DE PROYECTOS HIDROELECTRICOS
- * ESTUDIO DE GOLPE DE ARIETE Y SELECCION DEL TIPO DE TURBINAS (PROYECTO HIDROELECTICO TORO I)
- * Information about thermal alternative
- * PROYECCION DE PRECIOS DE COMBUSTIBLES
- * GENERACION Y VENTAS SNI (1989-1993)
- * Condition of credit from domestic and foreign resources
- * Financial Condition of ICE
- * Wetland Conservation in central America; North American Wetland Conservation Council (Canada)
- * ITC Textbook; International institute for Areal Survey and Earth Sciences
- * Some Comments on Beaches; Japan International Cooperation Agency, Kazumasa Kato
- * Outline of fishery operating in the sea near Quepos
- * Convention on Wetland of International Importance Especially as Waterfall Habitat
- * MANUAL DESCRIPTIVO DEL MAPA GEOMORFOLOGICO DE COSTA RICA
- * REVISTA DE BIOLOGIA TROPICAL
- * Aerial Photograph
 - 1:10,000 R.274 L-B 50008-50011
 - R.274 L-D 50026-50031
 - R.274 L-D 50036-50041
 - R.274 L-C 50020-50023
- *
 - 1:20,000 R.274 L-B 49978-49983
- * Aerial Map
 - 1: 2,000 No.3, No.4, No.5, No.6
 - 1:10,000 No.1, No.2

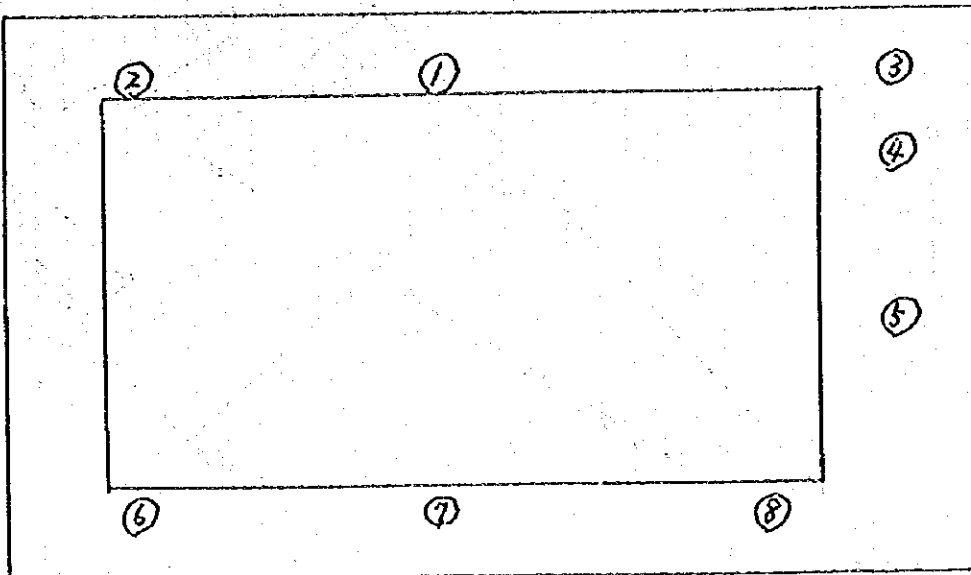
DATA COLLECTED (2)

- * Proyecciones de demanda energía eléctrica: 1994-2015
- * Informe de factibilidad (Ampliación planta térmica Moín instalación 4 unidad de gas)
- * Demanda de energía (1987-1993)
- * Escenario de demanda base (abril 1994)
Escenario se combustibles (caso base)
- * Demanda máxima mensual (Sistema nacional interconectado)
- * Intercambio -GWh
- * Potencia instalada y potencia efectiva
- * Evolución del consumo de energía eléctrica por sectores de consumo
- * Parámetros básicos de los escenarios de demanda
- * Población y PIB (1980-2015)
- * Características de los proyectos de generación (1995-2015)
- * Resumen de características de proyectos de generación (Septiembre de 1994)
- * Proyecto eólico Tejona (20MW)
- * Resumen: Recomendación de interconexión de proyectos
- * Indicadores económicos 1980-1992
- * Resumen general de índices: Período 1979-1990
- * Línea 230kV a doble circuito
- * Sistema eléctrico nacional: año 2015
- * Diagrama unifilar S.N.E.: año 2015
- * P.H. Angostura: Limitación de transporte de referencia
- * Memoria 1993: Estados financieros auditados
- * Memoria 1993
- * Plantas térmicas
- * El ICE
- * Complejo Hidroeléctrico Río Arenal
- * Proyecto Hidroeléctrico Sandillal
- * Complejo Hidroeléctrico del Arenal
- * Plantas Hidroeléctricas del ICE
- * Desarrollo Hidroeléctrico del Río Toro

Appendix 1 Mapping Area
Near Line



Appendix 2 Marginal



- ① LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT NO. —
- ② Scale
- ③ Index
- ④ North Direction
- ⑤ Legend
- ⑥ This map was produced under cooperation between the Republic of Costa Rica and the Government of Japan
- ⑦ Scale
- ⑧ Work schedule

Part III: 19th December 1994

PARTICIPANTS

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Miguel Barano (PM)
Fernando Montalto (PM)
Jorge Salazar Alvarez (PM)
Luis Fernando Saenz Sanches (PM)
Carlos Rodriguez N. (PM)
Alexis Cerdas S. (PM)

[1] In the meeting, briefing of the field inspections by the JICA Study Team in cooperation with the ICE's geologists and geotechnical engineers from 1st to 16th of December, 1994, was made in the ICE head office.

The main points brought out through the said field studies are as follows:

- (1) Most of necessary knowledge including with topographic, geologic and geotechnic conditions for the feasibility study of this project have been obtained by this field inspection and discussion with the ICE people.
- (2) However, it has been pointed out that some additional investigations, as shown in the attached sheet, are necessary for this project in order to raise its technical study level. The said investigation are to be tried to realize at the end of the coming February.
- (3) As for the additional investigation for the concrete aggregate source around the confluence of Rio Naranjo and Rio Naranjillo

which has been requested by the JICA Team previously, it was agreed by both sides, JICA and ICE, that the investigation works were suspended due to the difficulties of its accessibility within the limited period.

[2] The JICA Study Team received the additional geological /geotechnical data this time as shown in the attached sheet.

**ADDITIONAL GEOLOGICAL INVESTIGATION
IN FEASIBILITY STAGE OF LOS LLANOS PROJECT**

Dec. 21, 1994
JICA Study Team

The additional Geological Investigations for the Feasibility Stage of Los Llanos Project are recommended by the JICA Study Team as follows :

1. Supplementary Geological Mapping using New Topographic Maps
Geological mapping using the new topographic maps under measuring by JICA Team in Project Area.

Scale 1:1,000 (in part) , 1:5,000 (all area)

2. Subsurface Exploration

Additional 2 Drillholes specification shown as below.

	Drillhole "A"	Drillhole "B"
Location	Pensotck Route "No.1" (Elevation aout 296m)	Powerhouse "No.1" (point so called "2W")
Depth	30m	20m
Direction	vertical	vertical
Diameter	>66mm	>66mm
Coring	all core drilling	all core drilling
Geologic Log	0-30m in depth	0-30m in depth
Standard Penetration Test	10 points	6 points
Deformation Test	5 points	5 points
Vp/Vs Measurement	0-30m in depth	0-30m in depth
Water Level Measurement during Drilling	0-30m in depth	0-30m in depth

DATA COLLECTED

Dec. 21, 1994
JICA Study Team

1. Geological Investigation

1.1 Geology

1.1.1 Geological Map

1.1.1.1 Geologic Section at Dam Site 1:500 (revised)

- Section No.3 at Dam Site -

1.1.1.2 Geologic Map along Waterway Allignment Route 1:10,000

(revised)

- 2 sheets -

1.1.1.3 Geologic Section along Waterway Allignment Route 1:10,000

(revised)

- 1 sheet -

1.1.1.4 Geologic Map at Powerhouse 1:2,000 (revised)

- 2 sheets -

1.1.1.5 Geologic Section along Penstock 1:2,000 (revised)

- "Route No.1", "Route No.2" -

1.1.2 Drillhole

Geologic Log (revised)

- PHLL1SP, PHLL2SP, PHLL3SP, PHLL4SP, PHLL5CM, PHLL6CM, PHLL7CM, PHLL8CM,
PHLL9CM, PHLL10TO, PHLL11TP, PHLL12CM, PHLL13CM, PHLL14CM, PHLL15CM,
PHLL16CM, PHLL17TP -

1.1.3 Adit

Geologic Log (revised)

- Adit No.1, Adit No.2 -

1.1.4 Trench

Geologic Log

- Trench No.T6, Trench No.T7, Trench No.T8, Trench No.T9,

Trench No.T10, Trench No.T11, Trench No.T12 .

Trench No.C1, Trench No.C2, Trench No.C3, Trench No.C4,

Trench No.C5, Trench No.C6, Trench No.C7, Trench No.C8,

Trench No.C9, Trench No.C10, Trench No.C11, Trench No.C12 -

1.2 Geophysical Prospecting

1.2.1 Damsite

Location Map of Traverse Line

1.2.2 Waterway Allignment Route

Cross Sections and Travel Time Diagram

- 2 lines -

1.2.3 Penstock Route

Cross Sections and Travel Time Diagram
- Penstock "Route No.1", "Route No.2" -

1.3 Geotechnical Tests

Laboratory Test of Drillcore

- 5 samples from Drillcore PHL11TP -

2. Investigation for Construction Material

2.1 Geology

2.1.1 Geologic Section 1:500

2.1.2 Drillhole Geological Log

- QA-1, QA-2, QA-3, QA-4, QA-5, QA-6 -

2.2 Geophysical Prospecting

2.2.1 Seismic Profiling (Refraction Method)

Cross Sections and Travel Time Diagram

- PS-1, PS-4 -

2.3 Geotechnical Tests

2.3.1 Laboratory Tests for Concrete Aggregate

Abrasion Test and Soundness Test

- QA-6 -

MEMORANDUM ON DISCUSSION NO.4

between ICE and JICA
on Feasibility Study for
Los Llanos Hydroelectric Power Development Project

PARTICIPANTS

<u>JICA</u>		<u>ICE</u>
Y. Ebi	Agustin Rodriguez M.	Edgar Robles F.
	Mario López S.	Roberto Jiménez V.
M. Shibata	Leonel Rojas C.	Jorge Salazar A.
N. Demboya	Luis Fdo. Saénz S.	Alexis Cerdas S.
	Carlos Rodriguez N.	Miguel Bolaño S.
	Allan López	
K. Kikuchi	Eduard Peralta	
N. Hamano		

[I] Third field inspection was performed with ICE from 20th February to 9th March.

The major points raised during the inspection and discussions at field in this term are as follows;

- * Conditions of the Naranjo River (mouth) in dry season
 - 1 The water intake for the palm plantation is taking full capacity. Data of river flow at the Londres station in relation to the taking water are corrected.
 - 2 The prawn-farming is not taking pure water from the river and using salty water at the intake canal connected to the ocean.
 - 3 The pure water in the outer canal of the mangrove area is reserved (not mixed) with moving tide between inside-water and sea-water.
 - 4 ICE will be informed the confirmation results of water utilization rights.
- * The water quality study from dry season to rainy season.
 - 1 Bottles to be used in the survey shall be sent to ICE immediately.
 - 2 If possible, survey on March shall be executed.
 - 3 In addition to the execution on April and May, Study shall be performed once during a rainy season.

- 4 Data on water quality of Naranjo river which ICE collected until now shall be given to JICA.
- 5 Study results shall be sent to Japan by Fax, immediately.

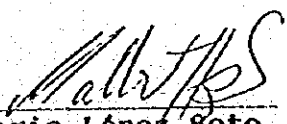
* The additional geological investigations

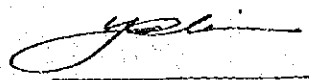
- 1 Drillhole "A" : Penstock route No.1 (El 297.2m) was inspected that hard rock (conglomerate) is confirmed from below 9m depth.
Drillhole "B" : Powerhouse 2W will be finished on end of March.
- 2 Field inspections were made a priority investigation on the original water way route with the new topography map.
- 3 Most of necessary data including with topographic, geologic and geotechnic conditions have been obtained by this term, but the rest results will be sent to Japan on and after the beginning of April by ICE.

[II] 5 copies of PROGRESS REPORT ANNEX has been submitted to ICE on 10th March. (Ref. LL 6310/039/YE)

* There are two chapters which Examination of Development Plan and Field Investigation Works contains in the Report. (see attached CONTENTS)

- 1 Explanation of alternative plants (not divided to the Paquita) are proof of an appropriate of original plan.
- 2 There is a possibility of the Tocori reservoir that is supplied water to the Naranjo river basin in the dry season from the tributary of Paquita river. It will be studied on the new map by JICA who suggested the solution of the supply water for the irrigation.
- 3 Explanation of the evaluation of survey results entrusted to FUNDEVI, is pointed out that will probably be faced with serious restrictions.


Mario López Soto
Coodinador de ICE


Yasumasa Ebi
Team Leader of JICA

MEMORANDUM ON DISCUSSION NO.5

between ICE and JICA
from 19th May to 2nd June
on Feasibility Study for
Los Llanos Hydroelectric Power Development Project

[I] The Optimum Development Plan

The major points raised during the discussion in this term are as follows:

PARTICIPANTS

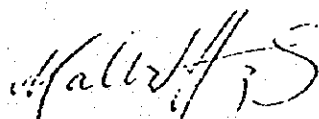
JICA

Y. Ebi
S. Hakoshima
M. Kato
M. Shibata

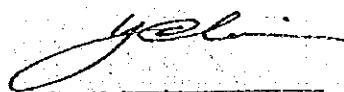
ICE

Agustín Rodríguez M.
Mario López S.
José Ant. Aragón S.
Jorge Salazar A.
Héctor Vargas F.
Roberto Jiménez VP.
German Freer H.
Carlos Amador Q.
Irene Cañas D.

- 1 As to the maximum installed capacity, about 90MW will be adopted. The capacity is estimated on the conditions of 5 hours of peak running time and 5 days of weekly operation, as well as the result of sensitive analysis of firm discharge.
- 2 A supply of water for the down stream area could not be included in this project. The decreasing production of the palm fruits will be compensated with a reasonable fee.
- 3 As to the Dam, the concrete gravity dam with crest gates for flood discharge and sand flashing at the down stream axis will be adopted.
- 4 As to the tunnel route the most economical route will be selected considering the construction method including access road.
- 5 JICA has been submitted to ICE a set of new topographic mapping results and satellite images on 19th May.



Mario López Soto
Coordinador del ICE



Yasumasa Ebi
Team Leader of JICA

[II] Meteorology and Hydrology

Persons concerned

JICA
K. Mishima
S. Hayakawa

ICE
Luis Acuña
Rafael Nunez Mesen
Alexia Pacheco Hernandez

- 1 Meteorological Observation Equipment including IC convector was completely installed at Napoles on June 1, 1995. Monitoring was commenced immediately after installation. ICE engineers has become well acquainted with the operation of the equipment by the date.

On the other hand, confirmation was made on monitoring data recorded in an IC card being converted to a floppy disk through a personal computer.

- 2 Hydrological and Meteorological Analysis

Participants

JICA
K. Mishima
S. Hayakawa
T. Hirahara

ICE
R. Enrique Chachon
Manuel Sanabria S.
Mario López S.
Roberto Jiménez VP.
Carlos Amador
José Ant. Aragón
Irene Cañas Diaz
Julio Matamoros A.
Edogar Mesen Aroya

Methodology on hydrological and meteorological analysis, as well as the results, was explained on May 30 and 31, 1995. After discussion, the contents were agreed.

Main Results

Average Inflow Discharge at the Los Llanos Dam Site:
14.95m³/s

Firm Discharge at the Los Llanos Dam Site (95%):
3.91m³/s

Design Flood Discharge for the Dam Spillway (PMF):
1,600m³/s

3 Mini-Seminar

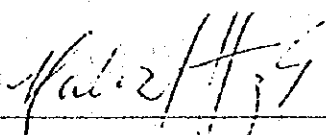
A seminar on hydrology and meteorology was held on May 29, 1995. The theme and the participants are described below:

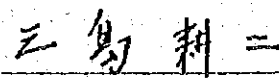
Theme; Optimization of Reservoir Capacity and Method of Operation (Approach from hydrological data)

Participants:

Mario López S.	Depto. Proyectos de Generacion
R. Enrique Chachon M.	Depto. Hidrologia
Carlos Picado B.	Oficina Estudios Hidrologicos
Manuel Sanabria S.	Oficina Estudios Hidrologicos
Carlos Roberto Rodríguez	Oficina Estudios Hidrologicos
José Alberto Zuniga M.	Oficina Estudios Hidrologicos
Jorge Granados C.	Oficina Estudios Hidrologicos
Roberto Jiménez V.	Oficina Proyectos Hidroelectricos
Carlos Amador Q.	Oficina Proyectos Hidroelectricos
German Freer H.	Oficina Proyectos Hidroelectricos
José Antonio Aragón S.	Oficina Proyectos Hidroelectricos
Julio Matamoros A.	Oficina Proyectos Hidroelectricos
Irene Cañas Díaz	Oficina Proyectos Hidroelectricos
Daniel Acuña P.	Depto. Proyectos de Generacion
Héctor Vargas Fallas	Estudios Economicos y Financieros
Edogar Mesen Aroya	Depto. Asuntos Internacionales
Finn Hansen	Danish Hydraulics Institute

San José, June 2, 1995


Mario López Soto
Coordinador de ICE


Koji Mishima
Member of JICA Teame

MEMORANDUM ON DISCUSSION NO.6

between ICE and JICA
from 3rd July to 8th August
on Feasibility Study for
Los Llanos Hydroelectric Power Development Project

[I] The Interim Report

Twenty (20) copies of INTERIM REPORT has been submitted to ICE on 19th July. (Ref. LL 7719/008/YE)
JICA team presented the Report on 19th, 20th and 21st of July at ICE.

PARTICIPANTS

<u>JICA</u>		<u>ICE</u>
Y. Ebi	Mario López S.	José A Rodríguez B.
S. Hakoshima	Robert Jiménez V.	Javier Romero B.
M. Kato	José Ant. Arogón	Gesman Frece H.
M. Shibata	Jorge Salazar A.	Carlos Amador Q.
H. Sudo	Luis Fdo.Saenz S.	Irene Caños D.
T. Fujiuchi	Adolfo Estrada	Carlos Rodríguez
K. Kikuchi	Alexis Cerdas S.	Miguel Bolaños S.
N. Hamano	Carlos Llobet R.	Fernando Chavarría P.
N. Okamoto	Rodolfo Brenez G.	Mario Alfaro Zúniga
	Alejandro Luna B.	Arutro Ordoñez
	Pablo Alvarado G.	Javier Romero B.

The report reflected the results of the preliminary and detailed investigation data such as new aero-photographic survey, meteorology & runoff data, geological/geotechnical investigations data (borehole tests, exploratory adits & pits, geophysical prospecting, in-situ bedrock tests etc.). The demand forecast and power supply plan are described in Chapter 5 based on the power development program in Chapter 4. Depend upon the above conditions concerned, the optimum development plan is as follows.

Maximum Discharge : 27 m³/s
Effective Head : 354.6m
Installed Capacity: 81 MW (for Pelton)
Annual Available E: 371 GWh
Dam C.G. type : 62.4m(H) x 108m(L)
Storage Capacity : 653 x 10³m³
Headrace : 3.1m x 5,600m
Surge Tank : 8.0m x 55m
Penstock (tunnel) : 2.6m x 1,650m
Powerhouse (open)

Initial Environmental Evaluation (IEE) was executed by the FUNDEVI, which presume the important influence for the development schemes in Chapter 13.

[II] Discussion for the feasibility design grade stage

A) Structural Design

Date: 1st and 4th August
ICE: Sr. Ing. Roberto Jiménez V.
JICA: Mr. M. Kato, (Mr. T. Fujiuchi)

1 Location and scale of Outlet works

The outlet works will be provided at the center of the spillway direction below EL 461.00m for purpose of the maintenance of the dam and intake structure.

2 Surge Tank and Butterfly Valve

Depend on the comparison study of the turbine types, the surge tank will be omitted in case of the Pelton turbine adopted.

The butterfly valve installed at beginning of the penstock is to be excluded.

B) Estimation of Construction Costs

1 Estimation Time

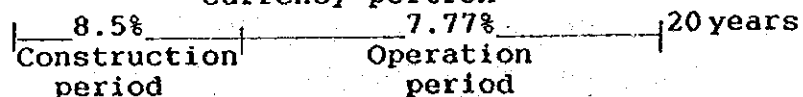
The time of estimation is to be as of January 1995, with exchange rate of 1880 Colones/US\$ given by ICE.

2 Cost Estimation Items

The items is the same of Pirris Project, and coefficients for costs calculation are as follows;

Camp facilities = 6% of direct costs of Civil works
Engineering and Administrative Cost = 18.5% of direct construction cost
Contingency = 15%-25% of civil works cost + 5% of hydraulic equipment cost + 10% of engineering and administrative cost

Interest during Construction = 8.5% for the foreign currency portion and 0% for the local currency portion



Engineering and Administrative Cost = 89% of local currency and 11% of foreign currency

C) Construction Planing

1 Access to Project Sites

Access to the dam site and power plant site will be made from Quepos city as base point, and no access

from San Marcos town to the dam site is to be considered.

Access to the dam site is using the existing road from Quepos to Cerros through Naranjito and Villa Nueva, and from Cerros to the dam site will be used approach road newly constructed on the right bank of Naranjo river. In addition, the bridge cross over the Paquita river at near Vado is constructed as permanent structure.

Access to the power plant site is using the existing road from Quepos to near the power plant pass through Vado, Cotos and Paso Real. However, the existing power plant approach road has very steep gradient, therefore the length of 900m as new approach road is to be constructed on the left bank of Paquita river.

2 Temporary Facilities

The location and scale of the temporary facilities such as quarry, aggregate plant, batcher plant, camps etc. are to be studied based on the draft plan shown in "Fig. Los Llanos Scheme (1), Water Way" prepared by JICA.

3 Location of Disposal Areas

The disposal areas are setting at the each jobsites as shown in above expressed drawing.

D) Electro-Mechanical Equipment

Date: 31st July and 1st August
ICE: Sr. Ing. Rodolfo Brenes G.
Sr. Ing. Carlos Llobet R.
Sr. Ing. Mario Alfaro Z.
Sr. Ing. Arturo Ordoñez
JICA: Mr. Hisao Sudo

1 JICA explained the outline of main electro-mechanical facilities of the Los Llanos power plant on the Interim Report Stage as shown in the following items.

- 11.3.5 Powerhouse and Switchyard
- 11.4 Electric Equipment
 - 11.4.1 Selection and Conditions of Main Equipment
 - 11.4.2 Principal Equipment Data and Specifications
 - 11.4.3 Outline of Facility

2 The selection and adoption of main equipment were discussed as follows;

(1) Turbine

AS to the selection of turbine type (Francis or Pelton), JICA has roughly checked.

But on this design stage, the parameters of powerplant like normal dam water level, tailrace water level, loss of water way (especially pressure tunnel) etc. have not fixed yet.

Therefore, comparison of the turbine type including the output has not done in details. In the present situation, JICA assumes that (a) Francis type is more advantageous taking higher maximum efficiency and effective head into consideration. (b) Pelton type may be adopted taking account of the omission of surge chamber. (c) Annual Generating Energy (KWh) is influenced by the operation of powerplant like peak load supply or partial load supply. This is related to not only the selection of turbine type but also the adoption of number of unit.

According to the opinion of ICE's mechanical group, the adoption of two units will be generally fitted to the Los Llanos powerplant from the maintenance and operation point of view.

JICA team requested that ICE's definite opinion on the fundamental items of the turbine is stated before their leave to Japan.

(2) Generator

(a) ICE proposed to change the power factor from 0.9 to 0.8 (lag) as adopted the Pirris powerplant.

Since there will be some demerit like increase of the initial construction cost due to bigger generator capacity (MVA), JICA requested to be informed on this matter as soon as possible, after confirmed to ICE's transmission system engineers.

(b) ICE proposed to adopt the condenser operation for the generator operation mode.

(3) Main Transformer

Although JICA recommended two units (two sets of 3

single phase plus one reserve unit) in the same design conception as the Pirris powerplant, two units of three phase without standby unit will be adopted taking decrease of initial construction cost, transportation and maintenance problems into consideration.

JICA requested that ICE's definite opinion on this matter is informed as soon as possible.

(4) Others

JICA requested that ICE confirms the following.

(a) Number of outgoing transmission line including future extension.

(b) Bus construction of switchyard

JICA recommended the single bus construction in the Los Llanos project from the scale and position of powerplant on the transmission system.

A transfer bus system can not be recommended because the reliability of GCB is higher enough and the construction of switchyard will be complicated.

(c) Scope of communication line to be adopted the optical ground wire system will be informed by ICE.

E) Environment

Date: 28th, 31st July and 4th August
ICE: Sr. Biol. Fernando Chavarria P.
Sr. Biol. Roland Nuñez
FUNDEVI: Sr. Luis Gmo. Brenez Quesada
JICA: Mr. Kiyoshi Kikuchi
Mr. Nobuyuki Hamano

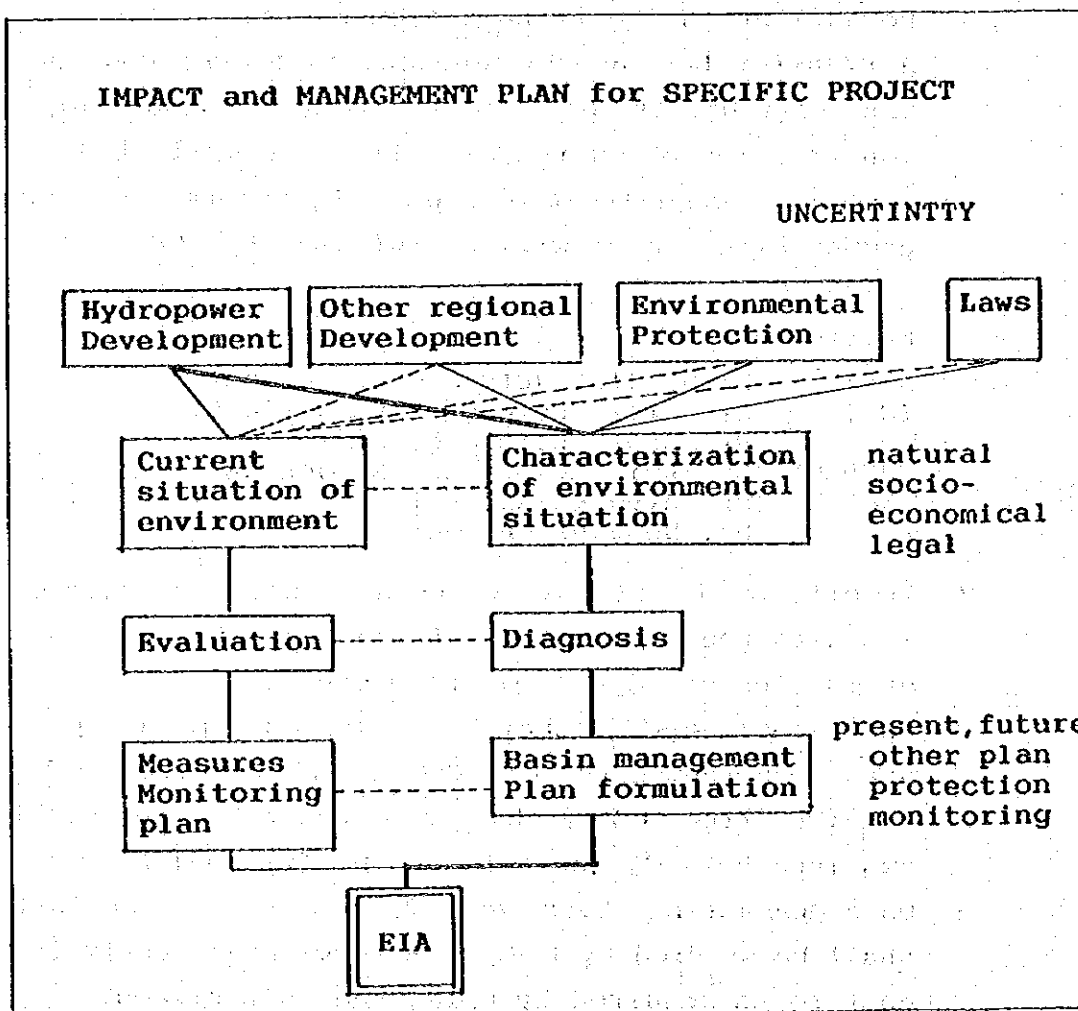
- 1 Interim report of environmental study was accepted by ICE with the explanation of the content including the evaluation of Impact by the project.
- 2 Additional small study on socio-economy of project area was requested to ICE. These results shall be received from ICE by the end of September and shall be examined by JICA teams in the Draft Final Report.
- 3 On compensation study, Unit Prices on land acquisition shall be studied by ICE. JICA teams shall estimate the cost to be required by using the unit prices.

4 Particle EIA study was entrusted to FUNDEVI (Costa Rica University) as the watershed management plan for Naranjo and Paquita River Basins.

This part shall be supplemented to the evaluation of impact assessment for the implementation of Los Llanos Project on the before and after construction standing at the development side.

Result of the diagnosis on the environment shall be examined in details, in order to cope with the uncertainty on the present and the future natural and social environmental situations and also legal trend in Costa Rica.

By these reasons, basin management plan on the Hydroelectric development is necessary to enforce the Project.



F) Demand Forecast and Power Supply Plan

Date: 1st August

ICE: Sr. Ing. Mario López S.
Sr. Lic. Héctor Vargas F.
Sr. Lic. Pabro Alvarado G.
Sr. Lic. Laureano Montero

JICA: Mr. Y. Ebi
Mr. T. Fujiuchi

1 Demand Forecast

The demand forecast estimated by ICE will be used for demand and supply plan of the Project.

2 Power Supply Plan

(a) It will be operated in 2005 of the starting year for the operation of Los Llanos project.

(b) It will be followed ICE's Decommissioning plan of existing thermal power station.

G) Power Transmission Plan

Date: 4th and 7th August

ICE: Sr. Ing. Alejandro Hidalgo
Sr. Ing. Alejandro Luna B.

JICA: Mr. T. Fujiuchi

The Specification of Transmission Line will be as follows;

1 Inter-connection Substation

The power transmission line from Los Llanos power plant will be connected to San Rafael Substation.

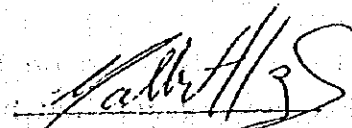
2 Power Transmission Line

It will be adopted the alternative route B from Los Llanos to San Rafael.

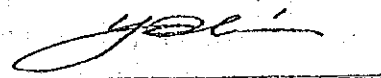
3 Number of Circuits: 2 circuits

4 Power Transmission Voltage: 230 KV

5 Transmission Line Cable Type and Size: ACSR 954MCM



Mario López Soto
Coodinador de ICE



Yasumasa Ebi
Team Leader of JICA

MEMORANDUM ON DISCUSSION NO.7

between ICE and JICA
on Feasibility Study for
Los Llanos Hydroelectric Power Development Project

PARTICIPANTS

JICA

Y. Ebi
K. Kikuchi
N. Hamano

Mario López S.
Fernando Chavarria P.
Hector Vargas F.
Alejandro Luna B.

ICE

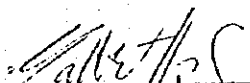
Roberto Jiménez V.
Roland Nuñez
Rodolfo Brenez G.

The third meeting and field inspection in this year was performed from 28th November to 7th December.

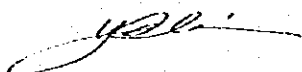
The major points raised during the discussions and inspection at field in this term are as follows;

- 1 Unit price on several land types relating to land acquisition for Los Llanos project was obtained from ICE.
- 2 Site inspection relating to the compensation to be required for houses and public facilities was performed on the 5th to 6th, December. By this survey, number of houses, etc. to be resettled was obtained.
- 3 Information of the production (Ton/ha/year) from non-irrigated and irrigated firm of Palm Plantation was obtained.
- 4 Report on basin environmental management plan which is one part of environmental impact assessment, entrusted to FUNDEVI was received on 7th, December 1995. After reviewed by JICA team, a report of the above was handed over to ICE on same day.
- 5 Confirmation of the method for economic evaluation to the project is checked by ICE, and will be send the comment by Faximil, if any.
- 6 Dimension of the facilities of electric-mechanical on the final design of the Project is checked by ICE, and will be send the comment by Faximil.

7 ICE submitted the request letter to hand over from JICA for the equipment which are supplied by JICA, on 7th December.



Mario López Soto
Coodinador de ICE



Yasumasa Ebi
Team Leader of JICA

THE UNIVERSITY OF CHICAGO
DIVISION OF THE PHYSICAL SCIENCES
DEPARTMENT OF CHEMISTRY

1955

1955



MEMORANDUM ON DISCUSSION No 8

between ICE and JICA
 from 1st february to 9th february 1996
 on Feasibility Study for
 Los Llanos Hydroelectric Power Development Project

I. DRAFT FINAL REPORT

Twenty (20) copies DRAFT of FINAL REPORT, APPENDIX AND SUMMARY, were submitted to ICE on 2nd february. (Ref.117202/043/YE).

JICA team presented the report on 2nd,5th,6th,7th and 8th of february to ICE team.

II. COROBICI PRESENTATION.

Corobici Hotel presentation for the DRAFT FINAL REPORT (summary), was carried out from 9 a.m to 4 p.m.

From 9 a.m. to 10.30, some peoples gave differents speech: Mr. Akimoto Kenshiro Ambassador of the Japan, Dr. Roberto Dobles Executive President of the ICE, Engineer Carlos Obregón Subgerente Develops Energy, and Engineer Mario López coordinating Project ICE.

From 11 a.m. to 3 p.m Mr. Yasumasa Ebi, JICA Team Leader presented the total Summary DRAFT FINAL REPORT, chapter by chapter.

From 3p.m.to 4p.m. some comments from: Engineer Egerico Porras from MIDEPLAN , Ings. Edgar Robles and Guillermo Rivera from ICE.

During closing ceremony ICE gave plates to JICA expert, JICA and Japan Embassy expressing gratitude for the execution and support on the feasibility study on Los Llanos project.

PARTICIPANTS

JICA	JAPAN EMBASSY	ICE	MIDEPLAN
K. ZENKOU	AKIMOTO KENSHIRO	see attachment	E. PORRAS
Y. EBI	FUSAICHI YACHI		
M. KATO	NORIYUKI AYUKAWA		
H. SUDO			
T. FUJIUCHI			
K. KIKUCHI			
T. HIRAHARA			
N. OKAMOTO.			

III. PROJECT SITE VISIT

The JICA MISION visited the project site during 3th and 4th of february attended by Engineer Mario López from ICE.

IV. DISCUSSION OF DRAFT FINAL REPORT

A) CHAPTER 7 AND 8: GEOLOGY AND CONSTRUCCION MATERIAL AND SEISMICITY.

DATE: 5th february.

ICE: Guillermo Alvarado, Miguel Bolaños, Allan López, Carlos Rodríguez, Luis Fernando Sáenz, Jorge Salazar, Alexis Cerdas, Roberto Jiménez and Mario López.

JICA: Y.Ebi, M. Kato, T. Fujiuchi, H. Sudo, K. Kikuchi, T. Hirahara, N. Okamoto.

Geol. Allan López, submitted to JICA team a report named "INFORME GENERAL DE AVANCE A LA FACTIBILIDAD DEL P.H. LOS LLANOS" February 1996. On that, geologies and geotechnics aspects carried out by ICE up dated. And in the second part they point out some comments regarding INTERIM REPORT CHAPTER 7 AND 8.

After some comments and discussions ICE request to JICA to consider some points enclosed in the report for the final report, specially new investigation. Also geologies and geotechnics of ICE have made comments on the selection of power house site choosed by JICA team.

B) CHAPTER 9,6,4 AND 5: DEVELOPMENT PLAN, METEOROLOGY AND HYDROLOGY, PRESENT STATE OF ELECTRIC POWER INDUSTRY AND DEMAN FORECAST AND POWER SUPPLY PLAN.

DATE: 6th february.

ICE: José Aragón, Carlos Amador, Julio Matamoros, Javier Romero, Rodolfo Ulloa, Roberto Jiménez, Alexis Rodríguez, Manuel Sanabria, Héctor Vargas and Mario López.

JICA: And Ebi, M. Kato, T. Fujiuchi, H. Sudo, K. Kikuchi and H. Hirahara.

Discusión on Development Master Plan rio Naranjo and benefits according to firm and secondary energy.

Discussion on technical criteria in order to select the optimun dam axis. Criteria to choose between arch and gravity dam.

Discussion to calculate discharge for African Palm Palmatica.

Engineer Alexis Rodríguez comments that Gumbel extreme Type used for JICA team does not the more appropriate calculating the probable flood.

Beside he pointed out that PMF is to low compared with Log Pearson 3 1: 10000.

Engineer Rodríguez considers that it is better to use the data from Log Pearson 3 instead Gumbel. Mr. Ebi requests the new dates in order to check and review in Japan.

Mr. Fujiuchi comments some present state of electric power industry in Costa Rica, and he has to change table 4-5 for 5-4. And then he explains about the method of demand forecast used by JICA team. The result of JICA shows no substantial difference from tha value estimated by ICE. Finally Mr. Fujiuchi explains to ICE the optimun power development plan obtained in table 5-8 by ICE and JICA teams. The study showed that the Los Llanos power Station should start operation in 2005.

C) CHAPTER 11 AND 12: FEASIBILITY DESIGN

DATE: 6th February

ICE: Julio Matamoros , Javier Romero, Rodolfo Ulloa, Roberto Jiménez, Rodolfo Brenes, Mario López and Mario Alfaro.

JICA: and. Ebi, M. Kato, T. Fujiuchi, H. Sudo, K. Kikuchi, H. Hirahara and N. Okamoto.

Design of civil works was discussed, beginning for selection of the type of dam. Mr. Kato explained that he selected the concrete gravity dam for economical looks according to expressed in the table NO 11.1. He also cleared that the axis of dam was selected for economical conditions mainly and geometry of the traverse sections.

He also argued about the looks of design of the tunnel of conduction and of the penstock. They considered the constructive systems and costs, accesses to all the sites of interest. He will correct the access at power house following in route to breaking Tocorí, since the proposal by JICA demand construct a very long bridge in the Paquita river.

Mr. Kato explained the design of stability of the gravity dam and design of diversion tunnel and cofferdam.

Then they continued revising the design of electromechanical equipment. ICE suggests to carry out a composition a little different from this table 11.4.

JICA accepts to correct the figure 11.18 so that same present to the case of the Pirris project.

D) CHAPTERS 13 AND 14: ENVIRONMENTAL ASPECTS AND ECONOMIC AND FINANCIAL EVALUATION.

DATE: 7th February

ICE: Fernando Chavarria, Alfredo Calderón, Allan López, Roberto Jiménez, Mario López, Julio Matamoros, Héctor Vargas, Pablo Alvarado, Javier Guillén and Loyal José.

JICA: Y. Ebi, M. Kato, T. Fujiuchi, H. Sudo, K. Kikuchi, T. Hirahara, N. Okamoto.

Mr. Kikuchi makes a presentation of the principal environmental looks of the project, marking the most important points to be considered during the stages of the project as well as a monitoring program. He pointed out the consideration of the costs of the environmental measurements in order to calculate the relationship cost/ benefit. Mr. Kikuchi solicits to the ICE that it continue with the monitoring programs during construction and operation of the plant.

He also explained a summary of impacts according to the table 13.57.

He should highlight that FUNDEVI delivered two copies of the report in English titled LAND USE MANAGEMENT OF THE PAQUITA AND Los Llanos WATERSHED. This will be part of the appendix of the final report.

Finally Mr. Kikuchi explains thoroughly on the calculation of the compensation especially corresponding to the payment to the property of African Palm.

The Mr. Hirahara explains chapter economical and financial evaluation. The table 14.3 should be substituted for a new that prepared Mr. Hirahara. He explains concept of utilizing two thermal plants, one of gas and another of motor low speed. ICE recommend that they are included the calculations of the thermal plant in the report. A phrase will also be included that it mark clearly that the projects Los Llanos should be constructed after the Pirris project. The same phrase will be included in the chapter of recommendations.

As for the financial evaluation, ICE accept the outputs but consultation on costs that they will be the same in the tables 14.5 14.7. value that should be 1.190 in both cases. The costs include administrative costs.

JICA will carry out a financial sensibility considering an service life of 40 years. He will also carry out a calculation utilizing an active rate of 5.75% in order to consider the costs of opportunity. In the table 14.7 will work hard percentages on period of commitment and interest supervision during the construction and eliminate during operation.

They also suggested to annotate more conclusions according to the boards. Also annotate in table 14.9 (1) that they is countable states.

V. ICE DELIVERY OFICIAL LETTER TO JICA RECEIPT DONATED EQUIPMENT.

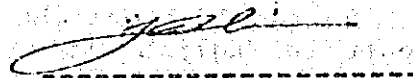
The Submanager of Development of Energy, Engineer Carlos Obregón makes delivery to the official Mr. Kenji Zenko of JICA, the note of receipt and gratefulness to JICA for the equipments donated for the execution of the studies of feasibility of the project LOS LLANOS. REF.DPG-096-SE.

VI. CONCLUSIONS

Then having discussed the several topics of the report of feasibility during these days, the dependences of the ICE that have participated actively in the project and in the revisions and analysis of the document, ICE accepted the conclusions made by the experts of the JICA team on the definition and characterization of the project LOS LLANOS, demonstrating the technical, economical, financial and environmental feasibility. ICE solicited respectfully JICA to consider all ICEs recommendations and it is included in the final report.



MARIO LOPEZ S.
COORDINATOR ICE



YASUMASA EBI
TEAM LEADER OF JICA

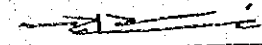
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ANOTADO 0 2 FEB. 1996

**CORFIRMACION ASISTENCIA
SEMINARIO FACTIBILIDAD P.H. LOS LLANOS
ICE - JICA**

PRESIDENCIA / SUBGERENCIA

Dr. Roberto Dobles

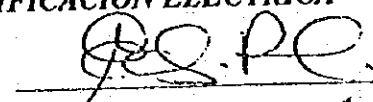


Ing. Carlos Obregón

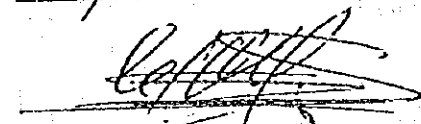
Si, Yes

DIRECCION PLANIFICACION ELECTRICA

Ing. Edgar Robles



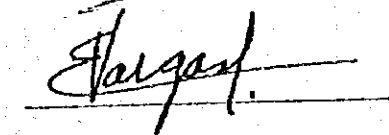
Lic. Sadi Laporte



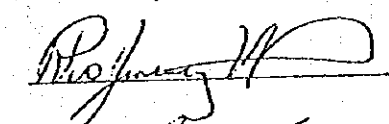
Ing. Jorge Monge



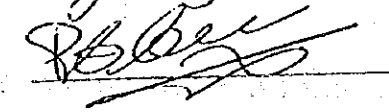
Ing. Héctor Vargas



Ing. Roberto Jiménez



Ing. Pablo Alvarado



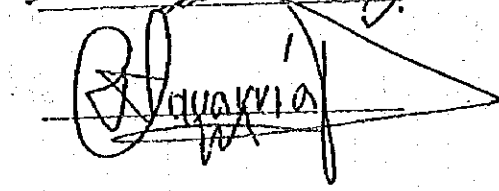
Ing. Aleixis Rodríguez



Ing. Manuel Sanabria



Biól. Fernando Chavarría



DIRECCION INGENIERIA CIVIL

Ing. Guillermo Rivera

Ing. José Rodríguez

Geól. Guillermo Alvarado

Ing. Miguel Bolaños

Geól. Allan López

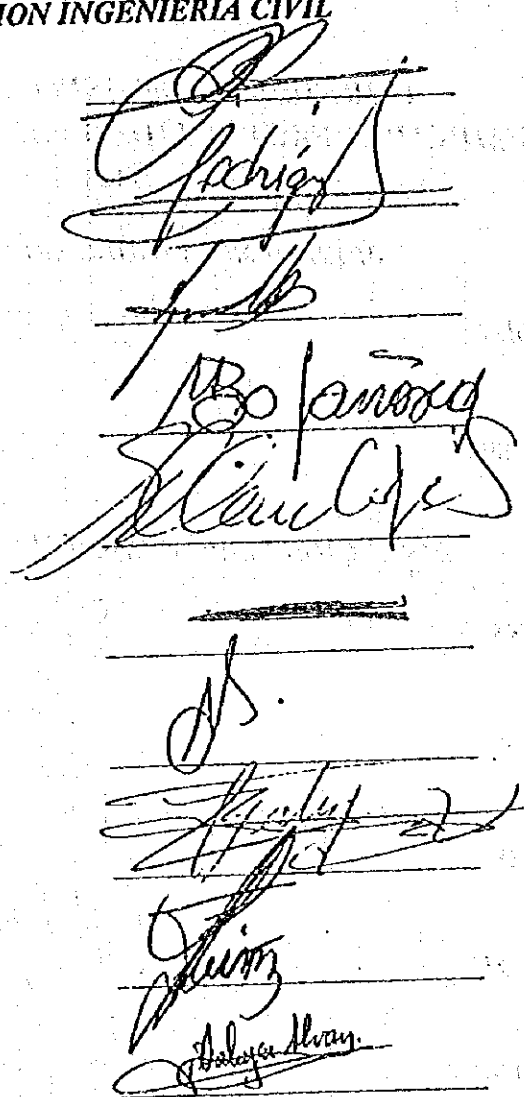
Geól. German Leandro

Geól. Alexis Cerdas

Geól. Carlos Rodríguez

Geól. Fernando Sáenz

Ing. Jorge Salazar

A series of handwritten signatures on lined paper, corresponding to the names listed on the left. The signatures are written in dark ink and are somewhat stylized. The names are: Guillermo Rivera, José Rodríguez, Guillermo Alvarado, Miguel Bolaños, Allan López, German Leandro, Alexis Cerdas, Carlos Rodríguez, Fernando Sáenz, and Jorge Salazar.

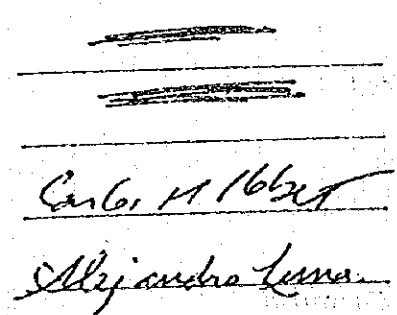
DIRECCION INGENIERIA ELECTROMECHANICA

Ing. Jorge Zamora

Ing. Alejandro Hidalgo

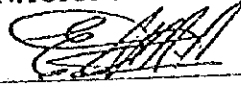
Ing. Carlos Llobet

Ing. Alejandro Luna

A series of handwritten signatures on lined paper, corresponding to the names listed on the left. The signatures are written in dark ink. The names are: Jorge Zamora, Alejandro Hidalgo, Carlos Llobet, and Alejandro Luna.

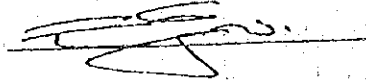
COOPERACION INTERNACIONAL - ICE

Sr. Edgar Mesén



COOPERACION INTERNACIONAL - MIDEPLAN

Ing. Egérico Porras

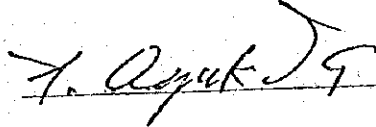


EMBAJADA DEL JAPON

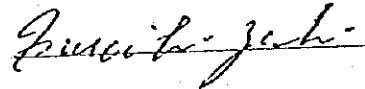
Sr. Akimoto Kenshiro

Si, Yes

Sr. Noriyuki Ayukawa



Sr. Fusaichi Yachi



February 5, 1996

Managing Director
Mining & Industrial Development
Cooperation Development
JICA

Dear sir :

I would like to express our sincere gratitude for your kind cooperation in Los Llanos Hydroelectric Power Development Project. ICE has duly received the following equipment :

Vehicles

TOYOTA Land Cruiser 4WD Station Wagon STD	
Back door swing out type	2 units
Spare parts	2 sets

Meteorological observation equipment

Wind direction and anemometer transmitter (WS-D32)	1 unit
Temperature and humidity transmitter (P-HMP-35A)	1 unit
Solar radiation transmitter (P-CM-6E)	1 unit
Rainfall transmitter (RS-102)	1 unit
Sunshine transmitter (SS-500)	1 unit
Evaporation transmitter (ES-100)	1 unit
Pressure transmitter (P-PTB-100)	1 unit
Meteorological Converter (UC-7B)	1 unit
Data logger "mini" (P-DL-101M)	2 units
IC card (ML-256PC)	1 unit
Memory card driver (P-CA-302)	1 unit
Solar battery	1 unit
Battery with case	1 unit
Bracket for each Transmitter	1 unit
Lighting conductor	1 unit
Signal cable	1 set
File converter (Software)	1 set
Automatic recording thermo-humidmeter (AR-1023-7)	3 units
Instrument Screen	3 units

Personal Computer

<i>IBM Think Pad 330CJVW</i>	<i>1 unit</i>
<i>Printer IBM 5584HO2 with cable</i>	<i>1 unit</i>
<i>Toner Cartridge (6pcs/set)</i>	<i>1 set</i>
<i>Paper (500pcs/box)</i>	<i>2 boxes</i>

River-flow Gauging Equipment

<i>Water level meter (LR-1021-1)</i>	<i>1 unit</i>
<i>Observation box for water level meter</i>	<i>1 unit</i>
<i>Consumables</i>	<i>1 set</i>
<i>Current meter (CM-1BX)</i>	<i>1 unit</i>


It should be noted that the equipment was very useful and effectively used for executing the feasibility study and the continuous use by ICE will not doubt contribute much for the smooth implementation of the Project in the next stages.

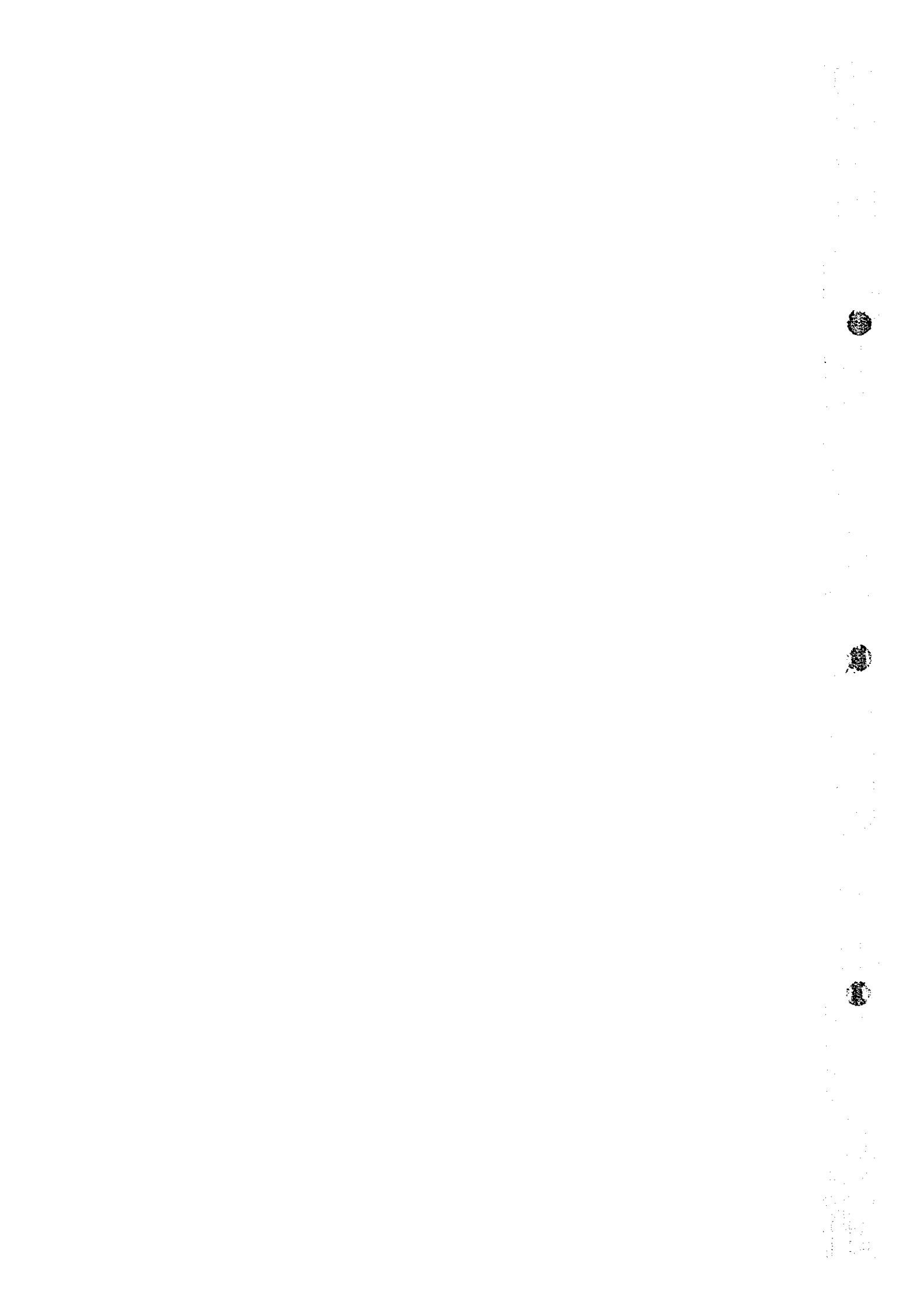
I would like to repeat our thanks for your kind cooperation.

Sincerely yours,

Ing. Carlos Obregón
Manager
Development Energy Sector
INSTITUTO COSTARRICENSE DE ELECTRICIDAD

cc: *Sector Desarrollo Energía*
Mr. Yasumasa EBI, JICA Team Leader
Direcc. Planificación Eléctrica - SE
Depto. Proyectos Generación - SE
DPG-096-SE

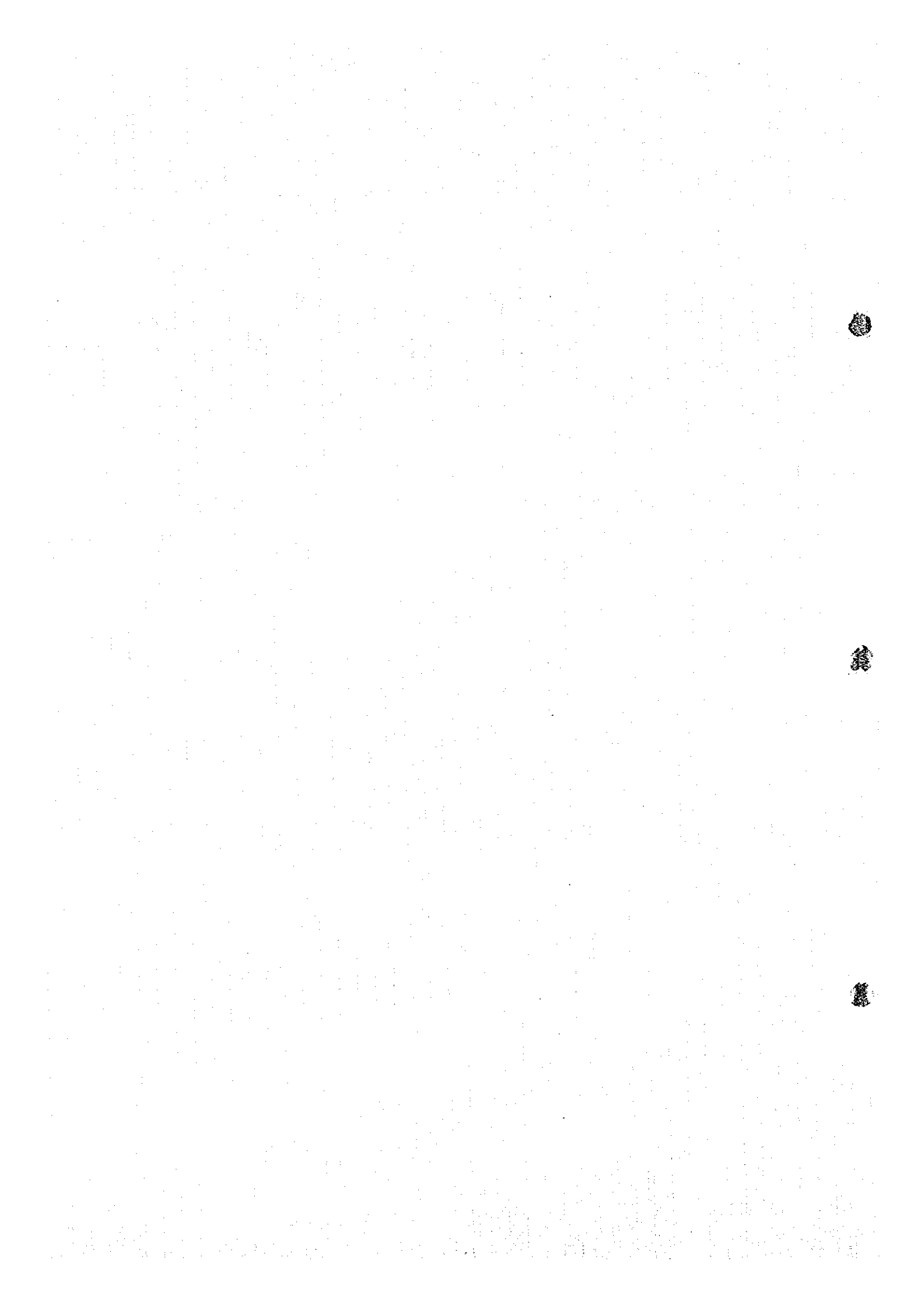


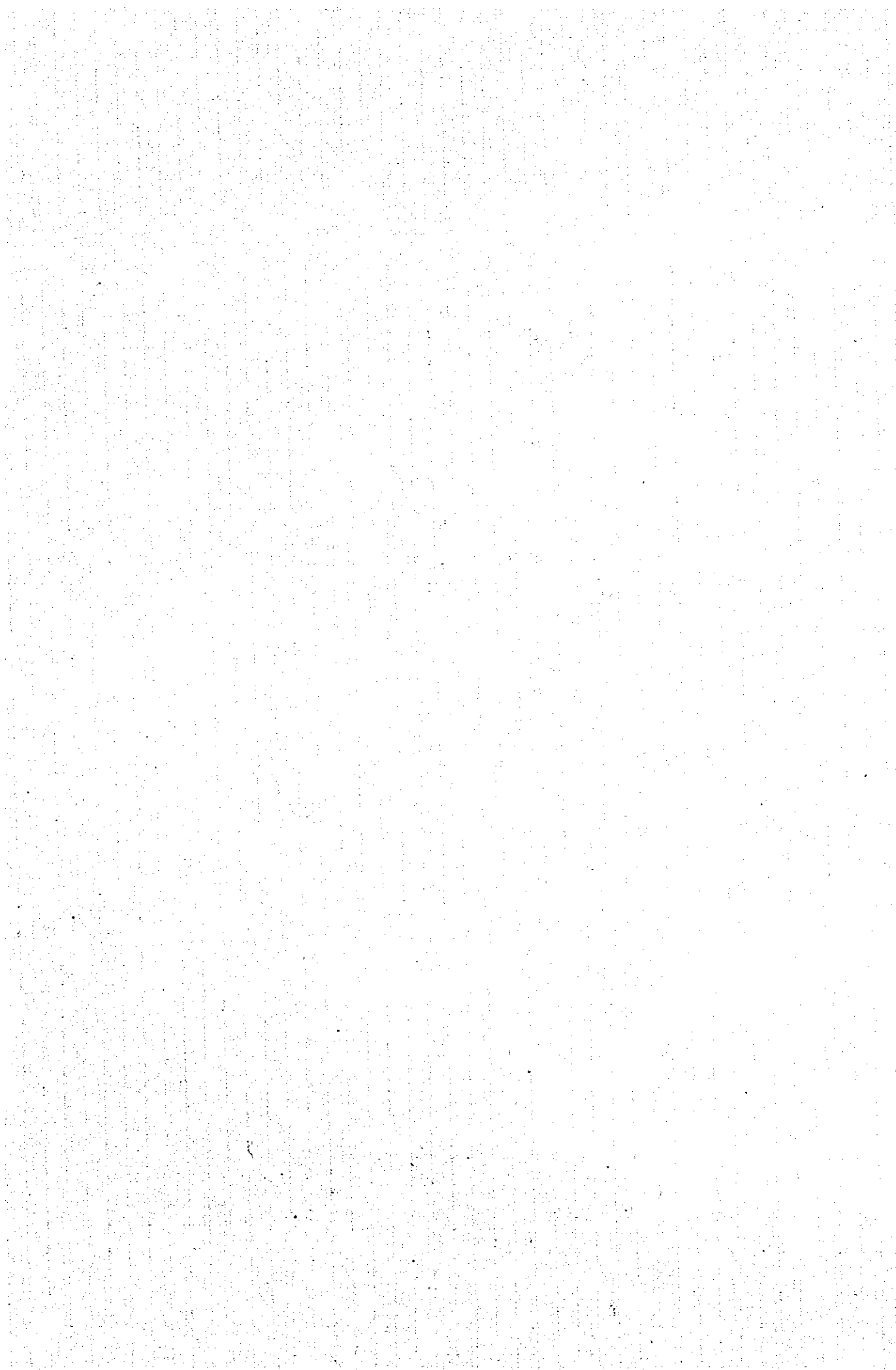




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