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(1) SCOPE OF WORK

SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON THE HYDROELECTRIC COMPLEX
OVER THE TOROLA RIVER
IN
THE REPUBLIC OF EL SALVADOR

AGREED UPON AMONG
Ministerio de Relaciones Exteriores,
Comisión Ejecutiva Hidroeléctrica del Río Lempa
AND
JAPAN INTERNATIONAL COOPERATION AGENCY


SAN SALVADOR, DECEMBER 14, 2000



Lic. José Mauro Iraheta
Director General de
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Exteriores



Mr. Hayao Adachi
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Ing. Guillermo A. Sol
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Lempa

I. INTRODUCTION

In response to the request of the Government of the Republic of El Salvador (hereinafter referred to as "the Government of El Salvador"), the Government of Japan has decided to conduct the Feasibility Study (hereinafter referred to as "the Study") on The Hydroelectric Complex Over The Torola River (hereinafter referred to as "the Project"), in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of El Salvador.

The present document sets forth the scope of work with regard to the Study.

II. OBJECTIVE OF THE STUDY

The Study aims at formulating the optimum plan and assessing technical, economic and financial, social and environmental feasibility of the Project.

III. SCOPE OF THE STUDY

The Study will be carried out in the following three (3) stages :

1. Preliminary Investigation Stage
2. Detailed Investigation Stage
3. Feasibility-grade Design Study Stage

The details at the respective stages are itemized as follows:

1. Preliminary Investigation Stage

The scope of work in this stage covers the following :

(1) Data collection

Collection and review of all existing data, reports and other relevant



information on the Project

(2) Sites reconnaissance

Sites reconnaissance focusing on topography, geology, hydrology, environment and socioeconomic aspects

(3) Electric power survey

- a. Review and analysis of relevant information on growth of power consumption, forecasts of energy and peak demand, characteristics of power consumption pattern, etc., in the system, especially in relevant regions in El Salvador
- b. Review and analysis of power system expansion program including those of transmission lines and substations in the system, especially in relevant regions in El Salvador

(4) Preliminary optimization of the scheme

- a. Review of the existing proposals of the development scheme
- b. Formulation of alternative development schemes and their comparative studies to select the optimum development plan on the dam and powerhouse sites including water way system

(5) Plan of Detailed investigation

Preparation of the detailed investigation plan including environmental survey based on the optimum development scheme derived from above studies

2. Detailed Investigation Stage

Based on the result of the studies in the Preliminary Investigation Stage, the detailed field Investigation works and their analyses will be carried out for the selected sites as mentioned below:

(1) Topographic survey

- a. Aerial photo taking and photogrammetric mapping
- b. Ground survey and mapping for the sites of the main structure components such as dam and spillway, intake, surgetank, penstock route, powerhouse, tailrace, quarry and borrow sites, etc

(2) Geological survey and material tests

- a. Geological reconnaissance of the Project area including landslide area, identification of quarry site for concrete aggregate and other construction materials

- b. Seismic exploration at the sites of the dam and other major structure components such as a penstock route, powerhouse, etc.
 - c. Test drilling and permeability tests at the sites of the dam and other major structure components such as a surgetank, penstock route, powerhouse, etc.
 - d. Test pitting for construction materials and trench excavation for landslide area, etc.
 - e. Physical tests of core and other samples including construction materials
 - f. Data collection and analysis of historical seismicity
- (3) Hydrological survey
- a. Cross section of the river water level gauging station
 - b. Installation of a river water level and rainfall gauges
 - c. Observation of a river water level and rainfall records
 - d. Measurement of sedimentation and river discharge
 - e. Hydrological study and analysis for low and high water
- (4) Environmental survey
- a. Investigation of houses, roads, land utilization and various rights of affected people and industry to be compensated in the Project area including land restoration and resettlement
 - b. Investigation of environmental aspects including socioeconomic and ecological surveys in the Project area with

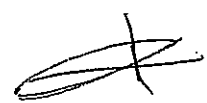
3. Feasibility-grade Design Study Stage

Based on the result of the studies in the Preliminary Investigation and Detailed Investigation Stages, the feasibility-grade design and assessment of technical, economic and financial, and environmental viability will be carried out for the Project, as mentioned below:

- (1) Layout design and optimization
- a. Simulation study and reservoir operation for alternative dam sites, dam height and dam types
 - b. Optimization of the Project, with site selection for the dam and major structure components
 - c. System-wide optimization of the Project including development timing based on the latest load forecast of the system including the Generation Expansion Program, and Power System Expansion Program covering power market research
 - d. Layout design of the major structure components with their ~~_____~~

optimization including turbines, generators and transmission lines

- (2) Feasibility-grade design
 - a. Technical design of all structure components and relevant transmission lines at the feasibility-grade level
 - b. Preparation of relevant drawings
 - c. Preparation of bill of quantities at the feasibility-grade level
- (3) Construction method and time schedule
 - a. Study of the construction method of the structure components with temporary facilities, especially for the river diversion and transportation routes
 - b. Development of the construction schedule
- (4) Environmental Impact Study
 - a. Study of environmental effects including resettlement, existing downstream water and fishery rights and usages, socioeconomic and archaeological aspects and downstream care, especially Fauna and Flora, which are to be caused in the affected area by project components and discharge fluctuation
 - b. Study of environmental measures and monitoring, including establishment of a resettlement program for displaced population by the Project
 - c. Technical study of net balance of greenhouse gasses
- (5) Project cost estimate
Estimation of the Project and environmental measures cost in terms of foreign and local components including price and physical contingencies and development of its annual disbursement schedule
- (6) Economic and financial evaluation
 - a. Economic evaluation with Cost-benefit Analysis Method (B/C) and Economic Internal Rate of Return (EIRR)
 - b. Financial evaluation with the Financial Internal Rate of Return (FIRR)
 - c. Additional economic and financial evaluation considering the concept of transaction in carbon fund certificates
- (7) Recommendation
Formulation of recommendation for future works



b

IV. STUDY SCHEDULE

The Study will be conducted in accordance with Tentative Time Schedule in Appendix 1 attached herewith.

V. REPORTS

JICA shall prepare and submit the following reports with main report and environment impact study report in English and Spanish to the Government of El Salvador, in accordance with Tentative Time Schedule attached in Appendix 1.

1. Inception Report (15 copies)
2. Progress Reports (each 15 copies)
3. Interim Report (15 copies)
4. Draft Final Report and its summary (15 copies)

The Government of El Salvador will provide JICA with written comments on the Draft Final Report, within one month after receipt.

5. Final Report (30 copies), Executive Summary (50 copies) and Environmental Impact Assessment Report (30 copies), with three sets of CD-ROM

VI. DIVISION OF TECHNICAL UNDERTAKINGS

The division of technical undertakings of the Study by JICA and Comision Ejecutiva Hidroelectrica del Rio Lempa (hereinafter referred to as "CEL") is detailed in Appendix 2 attached herewith.

VII. UNDERTAKING OF THE GOVERNMENT OF EL SALVADOR

1. To facilitate smooth conduct of the Study, the Government of El Salvador shall take necessary measures :

- (1) to secure the safety of the Japanese study team,
- (2) to permit the members of the Japanese study team to enter, leave and sojourn in El Salvador for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees,

- (3) to exempt the members of the Japanese study team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into El Salvador and out for the conduct of the Study,
 - (4) to exempt the members of the Japanese Study team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of Japanese study team for their services in connection with the implementation of the Study,
 - (5) to provide necessary facilities to the Japanese study team for remittance as well as utilization of the funds introduced into El Salvador from Japan in connection with the implementation of the Study,
 - (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
 - (7) to secure permission for the Japanese study team to take all data and documents including maps and photographs related to the Study out of El Salvador to Japan,
 - (8) to provide medical services as needed. Its expenses will be chargeable on members of the Japanese study team, and
 - (9) to facilitate prompt clearance through customs and inland transportation of equipment, materials and supplies required for the Study and of the personal effects of members of the Japanese study team.
2. The Government of El Salvador shall bear claims, if any arises, against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Japanese study team.
 3. CEL shall act as a counterpart agency to the Japanese study team and also as a coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.
 4. CEL shall, at its own expense, provide the Japanese study team with the following, in cooperation with other organizations concerned:
 - (1) available data and information related to the Study

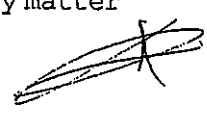
- (2) counterpart personnel,
- (3) suitable office space with necessary equipment and clerical services in San Salvador, and
- (4) credentials or identification cards.

VIII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures :

1. to dispatch, at its own expense, a study team to El Salvador, and
2. to pursue technology transfer to the El Salvadoran counterpart personnel in the course of the Study.

IX. OTHERS

1. The scope of work is prepared on both Spanish and English. In case any doubt arises in interpretation, the English text shall prevail.
 2. JICA and CEL shall consult with each other in respect of any matter that may arise from or in connection with the Study.
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APPENDIX 2 DIVISION OF TECHNICAL UNDERTAKINGS

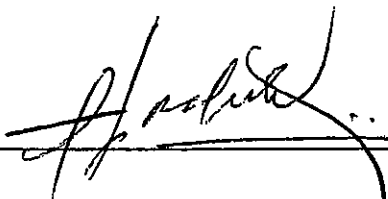
Work Items	Undertaking by JICA	Undertaking by CEL
1. Preliminary investigation stage		
(1) Data collection	to carry out the work	to provide the relevant information
(2) Sites reconnaissance	to carry out the reconnaissance	to provide CEL personnel
(3) Electric power survey	to carry out the survey	to provide the relevant information
(4) Preliminary optimization of the scheme	to carry out the study	to provide the relevant information
(5) Plan of detailed investigation	to carry out the study	to provide the relevant information
2. Detailed investigation stage		
(1) Topographical Survey		
a. Aerial photo taking and photogrametric mapping	to carry out the works	to provide CEL personnel
b. Ground survey and mapping	to carry out the works	to provide CEL personnel
(2) Geological survey and material tests		
a. Geological reconnaissance	to carry out the works	to provide CEL personnel
b. Seismic prospecting	to carry out the works	to provide CEL personnel
c. Test boring and tests	to carry out the works	to provide CEL personnel
d. Exploratory adits (if necessary)	to carry out the works	to provide CEL personnel
(3) Hydrological survey		
a. Observation of suspended solid (SS)	to carry out the works	to provide CEL personnel
b. Hydrological study and analysis based on the existing data	to carry out the analysis	to provide data and information
(4) Environmental survey		
a. Investigation of houses, etc	to carry out the works	to provide CEL personnel
b. Investigation of environmental aspects, etc	to carry out the works	to provide CEL personnel
c. Public consultation	to provide technical support	to carry out the works
3. Feasibility-grade design Stage		
(1) Layout design and optimization	to carry out the study	to provide the relevant information
(2) Feasibility-grade design	to carry out the study	to provide the relevant information
(3) Construction method and time schedule	to carry out the study	to provide the relevant information
(4) Environmental impact study	to carry out the study	to review and give comments
(5) Project cost estimate	to carry out the study	to provide the relevant information
(6) Economic and financial evaluation	to carry out the study	to provide the relevant information
(7) Recommendation	to carry out the works	to provide the relevant information

**ALCANCE DEL TRABAJO
PARA
EL ESTUDIO DE FACTIBILIDAD DEL
COMPLEJO HIDROELÉCTRICO SOBRE EL RÍO TOROLA
DE LA
REPÚBLICA DE EL SALVADOR**

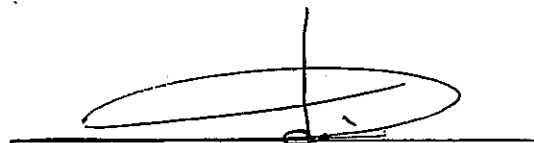
ACORDADO ENTRE

**EL MINISTERIO DE RELACIONES EXTERIORES,
LA COMISIÓN EJECUTIVA HIDROELÉCTRICA DEL RÍO LEMPA (CEL)
Y
LA AGENCIA DE COOPERACIÓN INTERNACIONAL DEL JAPÓN (JICA)**


**SAN SALVADOR
14 DE DICIEMBRE DEL AÑO 2000**



**Lic. José Mauro Iraheta
Director General
de Administración y Finanzas
Ministerio de Relaciones Exteriores**



**Sr. Hayao Adachi
Jefe de la Misión Preparatoria
Agencia de Cooperación
Internacional del Japón (JICA)**



**Ing. Guillermo A. Sol
Presidente
Comisión Ejecutiva Hidroeléctrica
del Río Lempa (CEL)**

I. INTRODUCCIÓN

En respuesta a la solicitud del Gobierno de la República de El Salvador (de aquí en adelante, se denominará el "Gobierno de El Salvador"), el Gobierno del Japón ha decidido ejecutar el Estudio de Factibilidad (de aquí en adelante, se denominará el "Estudio"), para el Complejo Hidroeléctrico sobre el Río Torola (de aquí en adelante, se denominará el "Proyecto") de conformidad con las leyes y reglamentos vigentes en Japón.

Por consiguiente, la Agencia de Cooperación Internacional del Japón (de aquí en adelante, se denominará "JICA"), el organismo oficial responsable de implementar los programas de cooperación técnica del Gobierno del Japón, realizará el Estudio, en estrecha colaboración con las autoridades del Gobierno de El Salvador. El presente documento estipula el alcance de trabajo para el Estudio.

II. OBJETIVO DEL ESTUDIO

El Estudio tiene como objetivo formular el plan óptimo y evaluar la factibilidad técnica, económica, financiera, social y ambiental del Proyecto.

III. ALCANCE DEL ESTUDIO

El Estudio será implementado en las siguientes tres fases:

1. Fase de investigación preliminar
2. Fase de investigación detallada
3. Fase de estudio de diseño a nivel de factibilidad

Los detalles de cada fase se muestran en los siguientes rubros:

1. Fase de investigación preliminar

El Alcance de Trabajo en esta fase cubre las siguientes tareas:

(1) Recopilación de datos

Recopilación y revisión de todos los datos, reportes e información relevantes sobre el Proyecto

(2) Reconocimiento de los sitios

Reconocimiento de los sitios enfocados en los aspectos topográfico, geológico, hidrológico, ambiental y socioeconómico

(3) Estudio de energía eléctrica

- a. Revisión y análisis de información relevante sobre el crecimiento del consumo de energía eléctrica, pronósticos de energía y demanda pico, características del consumo de energía eléctrica, etc. , en el sistema, especialmente en las regiones relevantes de El Salvador.
- b. Revisión y análisis del programa de expansión del sistema de energía eléctrica, incluyendo el de líneas de transmisión y subestaciones del sistema, especialmente de las regiones relevantes de El Salvador.

(4) Optimización preliminar del esquema

- a. Revisión de las propuestas existentes de esquema de desarrollo
- b. Formulación de esquemas alternativos de desarrollo y sus estudios comparativos para seleccionar el plan óptimo de desarrollo para los sitios de las presas y casas de máquinas, incluyendo el sistema de vía fluvial.

(5) Plan de investigación detallada

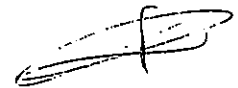
Preparación del plan de investigación detallada incluyendo estudio ambiental basado en el esquema óptimo de desarrollo derivado de los estudios mencionados anteriormente.

2. Fase de investigación detallada

Basado en el resultado de los estudios de la Fase de investigación preliminar, los estudios detallados de campo y sus análisis serán implementados para los sitios seleccionados como se muestra a continuación:

(1) Levantamiento topográfico

- a. Toma de fotografías aéreas y el mapeo fotogramétrico
- b. Estudio terrestre y el mapeo de los sitios de los principales componentes estructurales tales como presa y vertedero, bocatoma, chimenea de equilibrio, tubería forzada, casa de máquinas, canal de descarga, sitios de cantera y préstamo, etc.



(2) Estudio geológico y ensayos de materiales

- a. Reconocimiento geológico del área del Proyecto incluyendo áreas de deslizamiento, identificación de canteras para agregado de concreto y otros materiales para la construcción
- b. Refracción sísmica en los sitios de presa y principales componentes estructurales tales como tubería forzada, casa de máquinas, etc.
- c. Perforación de prueba y ensayos de permeabilidad en los sitios de presa y otros componentes estructurales principales, tales como chimenea de equilibrio, tubería forzada, casa de máquinas, etc.
- d. Pilotaje de prueba para materiales de construcción y excavación en zanja para áreas de deslizamiento, etc.
- e. Ensayos físicos de testigo y otras muestras incluyendo materiales de construcción.
- f. Recopilación y análisis de datos de sismicidad histórica

(3) Estudio hidrológico

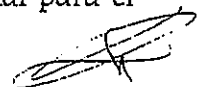
- a. Sección transversal de estación hidrométrica
- b. Instalación de estaciones hidrométricas y pluviométricas
- c. Observación de registros de nivel de agua y precipitación pluvial
- d. Aforos de sedimentación y descarga fluvial
- e. Estudio y análisis hidrológico incluyendo registros de caudales máximos y mínimos

(4) Estudio ambiental

- a. Investigación de viviendas, caminos, uso de terreno y derechos de la gente, industria y el área afectada, para planificar las medidas de mitigación y oportunidad ambiental, incluyendo las medidas para el reacondicionamiento de suelos y reasentamiento
- b. Investigación de aspectos ambientales incluyendo estudios socioeconómicos y ecológicos del área del Proyecto

3. Fase de estudio de diseño a nivel de factibilidad

Basado en el resultado de los estudios de las Fases de investigación preliminar y de investigación detallada, se realizará el diseño a nivel de factibilidad y la evaluación de viabilidad técnica, económica y financiera, y ambiental para el



Proyecto, como se muestra abajo:

- (1) Diseño básico y optimización
 - a. Estudio de simulación y operación de embalse para las alternativas de los sitios de presa, altura y tipos de presa
 - b. Optimización del Proyecto, con la selección de sitios para la presa y principales componentes estructurales
 - c. Optimización del Proyecto a nivel de sistema, incluyendo la oportunidad cronológica basada en el último pronóstico de carga del sistema incluyendo el programa de expansión de generación y el programa de expansión del sistema de energía eléctrica que comprenda un estudio del mercado de electricidad
 - d. Diseño básico de los principales componentes estructurales con la optimización de turbinas, generadores y líneas de transmisión

- (2) Diseño a nivel de factibilidad
 - a. Diseño técnico de todos los componentes estructurales y las líneas de transmisión relevantes a nivel de factibilidad
 - b. Preparación de planos relevantes
 - c. Preparación de listados de cantidades a nivel de factibilidad

- (3) Método de construcción y cronograma
 - a. Estudio del método de construcción para componentes estructurales con instalaciones temporales, especialmente de desviación del río y rutas de transporte
 - b. Desarrollo del cronograma de construcción

- (4) Estudio de impacto ambiental
 - a. Estudio de efectos ambientales incluyendo reubicación, derechos y usos del agua y pesca existentes aguas abajo, aspectos socioeconómicos y arqueológicos; con especial atención a la fauna y flora aguas abajo, por el impacto que será causado en el área a ser afectada por los componentes del Proyecto, considerando las fluctuaciones de descargas
 - b. Estudio de las medidas ambientales y monitoreo, incluyendo el establecimiento del programa de reubicación para la población desplazada por el Proyecto
 - c. Estudio técnico del balance neto de los gases de efecto invernadero

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(5) Estimación de costos del Proyecto

Estimación de los costos del Proyecto y las medidas ambientales en términos de componentes externos y locales incluyendo contingencias físicas y de precios y desarrollo de su cronograma anual de desembolso

(6) Evaluación económica y financiera

- a. Evaluación económica con el método de análisis costo / beneficio (C/B) y la tasa interna de retorno económico (TIRE)
- b. Evaluación financiera con la tasa interna de retorno financiero (TIRF)
- c. Evaluación económica y financiera adicional considerando el concepto de las transacciones de certificados de carbono

(7) Recomendación

Formulación de recomendación para trabajos futuros

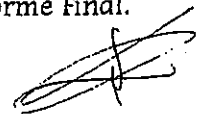
IV. CRONOGRAMA DEL ESTUDIO

El Estudio será implementado de acuerdo con el cronograma tentativo mostrado en Anexo 1.

V. INFORMES

JICA preparará y entregará los siguientes informes al Gobierno de El Salvador, entre los cuales el informe principal y el informe del estudio de impacto ambiental serán en inglés y español, de acuerdo con el cronograma tentativo mostrado en el Anexo 1.

- | | | |
|----|--|-----------------------|
| 1. | Informe Inicial | 15 copias |
| 2. | Informes de Progreso | 15 copias de cada uno |
| 3. | Informe Intermedio | 15 copias |
| 4. | Borrador del Informe Final y su resumen | 15 copias |
| | El Gobierno de El Salvador presentará sus comentarios a JICA por escrito dentro de un mes después de haber recibido el Borrador del Informe Final. | |
| 5. | Informe Final | 30 copias. |



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Resumen Ejecutivo	50 copias,
Informe del Estudio de Impacto Ambiental	30 copias, y
CD-ROM del Informe Final	3 juegos

VI. DIVISIÓN DE COMPROMISOS TÉCNICOS

La división de compromisos técnicos del Estudio entre JICA y la Comisión Ejecutiva Hidroeléctrica del Río Lempa (de aquí en adelante, se denominará la "CEL") está detallada en el Anexo 2, adjunto a este documento.

VII. COMPROMISOS DEL GOBIERNO DE EL SALVADOR

1. Para facilitar la ejecución oportuna del Estudio, el Gobierno de El Salvador tomará las siguientes medidas necesarias para:
 - (1) asegurar la seguridad del Grupo de Estudio japonés;
 - (2) permitir a los miembros del Grupo de Estudio japonés entrar, salir y permanecer en El Salvador durante la realización de su trabajo, y eximirlos de los requisitos de registro de extranjeros y del pago de los derechos consulares;
 - (3) eximir a los miembros del Grupo de Estudio japonés de impuestos, derechos aduaneros, tarifas y cualquier otro cargo sobre equipos, maquinarias y otros materiales introducidos o retirados de la República de El Salvador para la ejecución del Estudio;
 - (4) eximir a los miembros del Grupo de Estudio japonés del pago de impuestos a la renta y otros gravámenes de cualquier naturaleza sobre o en relación con las asignaciones o subsidios pagados a los miembros del Grupo de Estudio japonés por sus servicios relacionados en la ejecución del Estudio;
 - (5) ofrecer las facilidades necesarias al Grupo de Estudio japonés para la remesa, así como también para la utilización de los fondos introducidos a El Salvador desde el Japón en relación con la ejecución del Estudio;
 - (6) asegurar los permisos al Grupo de Estudio japonés para que puedan entrar en las propiedades privadas y áreas restringidas para la ejecución del Estudio;
 - (7) asegurar los permisos al Grupo de Estudio japonés para llevar todos los



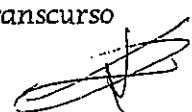

datos y documentos incluyendo mapas y fotografías aéreas relacionadas al Estudio, fuera de El Salvador al Japón;

- (8) suministrar servicios médicos de acuerdo a las necesidades. Los gastos serán cubiertos por los miembros del Grupo de Estudio japonés.
 - (9) facilitar las acreditaciones prontas en las aduanas y el transporte interno de equipos, materiales y suplementos necesarios para el Estudio y de efectos personales de los miembros del Grupo de Estudio japonés.
2. El Gobierno de El Salvador se hará cargo de reclamos, que se presenten eventualmente, en contra de los miembros del Grupo de Estudio japonés, tales como los que surjan en el transcurso de o en relación con el desempeño de sus obligaciones en la ejecución del Estudio, excepto cuando tales reclamos se originen de la total negligencia o mala conducta intencionada de los miembros del Grupo de Estudio japonés.
 3. La CEL trabajará como contraparte del Grupo de Estudio japonés y también como ente coordinador en relación con otras instituciones gubernamentales y no gubernamentales relevantes para la ejecución oportuna del Estudio.
 4. La CEL se compromete a proporcionar al Grupo de Estudio japonés, a su propio costo, en cooperación con otras entidades relacionadas, las siguientes facilidades:
 - (1) datos e información disponibles relacionados con el Estudio,
 - (2) personal de contraparte,
 - (3) oficina adecuada con equipos y servicios de oficina necesarios en la ciudad de San Salvador, y
 - (4) credenciales o tarjetas de identificación.

VIII. COMPROMISOS DE JICA

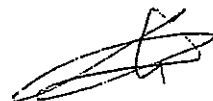
Para la ejecución del Estudio, JICA tomará las siguientes medidas:

- (1) enviar al Grupo de Estudio a El Salvador con presupuesto propio y
- (2) transferir tecnología al personal de contraparte salvadoreño en el transcurso del Estudio.



IX. OTROS

1. El Alcance de Trabajo está escrito en español y en inglés. En caso de que surja cualquier duda en la interpretación, prevalecerá el texto en inglés.
2. JICA y CEL deberán consultarse mutuamente sobre cualquier asunto que pueda surgir de ó en relación al Estudio.



Anexo 2 DIVISIÓN DE COMPROMISOS TÉCNICOS

Rubros de trabajo	Compromisos de JICA	Compromisos de CEL
1. Fase de investigación preliminar		
(1) Recopilación de datos	realizar el trabajo	proporcionar información pertinente
(2) Reconocimiento de sitios	realizar el reconocimiento	proporcionar personal de CEL
(3) Estudio de energía eléctrica	realizar el estudio	proporcionar información pertinente
(4) Optimización preliminar del esquema	realizar el estudio	proporcionar información pertinente
(5) Plan de investigación detallada	realizar el estudio	proporcionar información pertinente
2. Fase de investigación detallada		
(1) Levantamiento topográfico		
a. Toma de fotografías aéreas y mapeo	realizar los trabajos	proporcionar personal de CEL
b. Estudio terrestre y mapeo	realizar los trabajos	proporcionar personal de CEL
(2) Estudio geológico y ensayos de materiales		
a. Reconocimiento geológico	realizar los trabajos	proporcionar personal de CEL
b. Refracción sísmica	realizar los trabajos	proporcionar personal de CEL
c. Perforación de prueba y ensayos	realizar los trabajos	proporcionar personal de CEL
d. Galerías de acceso exploratorias (si es necesario)	realizar los trabajos	proporcionar personal de CEL
(3) Estudio hidrológico		
a. Observación de sólidos en suspensión	realizar los trabajos	proporcionar personal de CEL
b. Estudio hidrológico y análisis basado en los datos existentes.	realizar el análisis	proporcionar información y datos
(4) Estudio ambiental		
a. Investigación de viviendas, etc	realizar los trabajos	proporcionar personal de CEL
b. Investigación de aspectos ambientales, etc	realizar los trabajos	proporcionar personal de CEL
c. Consulta pública	proporcionar asistencia técnica	realizar los trabajos
3. Fase de diseño a nivel de factibilidad		
(1) Diseño básico y optimización	realizar el estudio	proporcionar información pertinente
(2) Diseño a nivel de factibilidad	realizar el estudio	proporcionar información pertinente
(3) Método de construcción y cronograma	realizar el estudio	proporcionar información pertinente
(4) Estudio de impacto ambiental	realizar el estudio	revisar y dar comentarios
(5) Estimación de costos del Proyecto	realizar el estudio	proporcionar información pertinente
(6) Evaluación económica y financiera	realizar el estudio	proporcionar información pertinente
(7) Recomendación	realizar los trabajos	proporcionar información pertinente

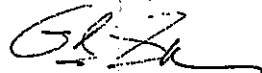
(2) MINUTES OF MEETING

MINUTES OF MEETING
FOR PREPARATORY STUDY
ON HYDROELECTRIC COMPLEX
OVER THE TOROLA RIVER
IN EL SALVADOR

The Preparatory Study Team on Hydroelectric Complex over the Torola River (hereinafter referred to as "the Team") sent by the Japan International Cooperation Agency (hereinafter referred to as "JICA") had a series of discussions with officials concerned of Comision Ejecutiva Hidroelectrica Del Rio Lempa (hereinafter referred to as "CEL") from December 11 to 14, 2000, regarding the Scope of Work for the Feasibility Study on the Hydroelectric Complex over the Torola River.

The salient results of the discussions are as attached and they would technically supplement the Scope of Work.

San Salvador, December 14, 2000



Ing. Guillermo A. Sol
Presidente,

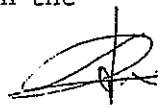
Comision Ejecutiva
Hidroelectrica Del Rio
Lempa



Mr. Hayao Adachi
Team Leader,
Preparatory Study Team

Japan International
Cooperation Agency

1. The Team has suggested that the public hearing should be held by CEL's responsibility and leadership during the feasibility study stage because of possible resettlement of the villagers in the reservoirs and of other environmental factors. CEL commented that the public hearing is necessary.
2. The Team has expressed its concern on bi-national water courses downstream of the dam sites. CEL expressed its opinion that the final idea of the project should carefully avoid any structures in the foreign territories. The Team has requested CEL to take responsibility for consultation with Honduras in due course.
3. The scope of the environmental impact studies for the projects has been discussed. The Team explained the JICA's stand point that the JICA's study team would take responsibility for the technical contents of the studies, and CEL should take responsibilities for any internal governmental procedures on the basis of the JICA's studies.
4. The present situation and future prospective of power sectors' privatization have been explained by CEL. The El Salvador side commented that the hydropower stations have no possibilities to be sold out to private sectors.
5. Both parties have discussed the necessity of additional river water gauging stations in the vicinity of the dam sites and have agreed that this matter would be analyzed by JICA's study team and CEL at the beginning of the study.
6. The original request from the Government of El Salvador has included two dam schemes of Chaparral and La Honda. Both parties have agreed that the target dam scheme(s) for the detailed investigation and feasibility-grade design stages would be discussed in the Progress Report 1, which would be submitted at the 5th month of the Study.
7. Referring to Clause VII, 4, (3) in the Scope of Work, office space, the Team has requested office spaces with basic furniture for the JICA study team. CEL replied that the office space would be prepared in San Salvador and in the vicinity of the project sites.
8. CEL will provide one vehicle with four-wheel-drive for the JICA study team. The Team replied that the transportation would be considered based on the CEL's proposal.
9. Referring to Clause VII, 1, (1) of the Scope of Work, security, CEL will provide the complete security measures during the JICA's study team's stay in the country.



10. Both parties have discussed the technical and environmental details of the terms of reference to be given to the JICA's study team, and have agreed that JICA would provide all the information collected during the JICA's project formation and preparatory studies to the tenderers including CEL's proposal of the technical and environmental terms of reference, and that the details of both terms of reference would be discussed between CEL and the JICA's study team when the inception report is submitted at the beginning of the study.
11. CEL has expressed that the environmental terms of reference are intended to comply with the requirements of the Ministry of Environmental and Natural Resources.

(END)

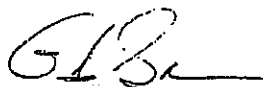


MINUTA DE REUNIÓN
ESTUDIO PREPARATORIO DEL PROYECTO
DEL COMPLEJO HIDROELÉCTRICO SOBRE EL RÍO TOROLA
DE EL SALVADOR

La misión preparatoria para el Complejo Hidroeléctrico sobre el Río Torola (de aquí en adelante, se denominará la "Misión") enviada por la Agencia de Cooperación Internacional del Japón (de aquí en adelante, se denominará "JICA"), mantuvo discusiones con los funcionarios de la Comisión Ejecutiva Hidroeléctrica del Río Lempa (de aquí en adelante, se denominará "CEL") desde el día 11 hasta el día 14 de diciembre del año 2000, respecto al Alcance de Trabajo sobre el desarrollo del proyecto hidroeléctrico sobre el Río Torola.

Los resultados de las discusiones se presentan en el anexo y complementan técnicamente el alcance del trabajo.

San Salvador, 14 de diciembre de 2000



Ing. Guillermo A. Sol
Presidente

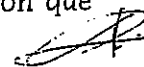
Comisión Ejecutiva Hidroeléctrica
del Río Lempa (CEL)



Sr. Hayao Adachi
Jefe de la Misión Preparatoria

Agencia de Cooperación Internacional
del Japón (JICA)

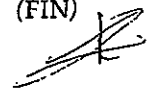
1. La Misión sugirió que la consulta pública debería ser celebrada bajo la responsabilidad y liderazgo de la CEL, durante la etapa del estudio de factibilidad, debido a la posible reubicación de los residentes en el área del embalse y a otros factores ambientales. La CEL comentó que la consulta pública es necesaria.
2. La Misión expresó su preocupación por el tramo binacional aguas abajo de los sitios de presas. La CEL expresó su opinión que la idea final del Proyecto debe cuidadosamente evitar cualquier estructura en territorio extranjero. La Misión solicitó a la CEL que asumiera la responsabilidad de consultar con Honduras.
3. Los alcances para el Estudio de Impacto Ambiental de los proyectos fueron discutidos. La Misión explicó el punto de vista de JICA sobre que el Equipo del Estudio se responsabilizaría de los contenidos técnicos, y que la CEL debería asumir la responsabilidad de cualquier procedimiento gubernamental interno en base a los estudios de JICA.
4. La CEL explicó la situación actual y la perspectiva futura de la privatización del sector de energía eléctrica. La parte salvadoreña comentó que las centrales hidroeléctricas no pueden ser vendidas al sector privado.
5. Ambas partes discutieron la necesidad de estaciones hidrométricas adicionales en la cercanía de los sitios de presa y han acordado que este asunto sería analizado por el Equipo de estudio de JICA y CEL al inicio del Estudio.
6. La solicitud original del Gobierno de El Salvador incluyó dos esquemas de presa: Chaparral y La Honda. Ambas partes acordaron que los esquemas de presa objeto de las fases de investigación detallada y diseño a nivel de factibilidad serían discutidos en el Informe de Progreso 1, el cual sería presentado en el 5^{to} mes del Estudio.
7. Con relación a la cláusula VII, 4, (3) en el Alcance de Trabajo, la Misión solicitó oficinas con muebles básicos para el equipo del estudio de JICA. La CEL respondió que proporcionará oficinas en San Salvador y en la cercanía de los sitios del proyecto.
8. La CEL proporcionará un vehículo todo terreno para el equipo del estudio de JICA. La Misión respondió que el medio de transporte sería considerado en base a la propuesta de la CEL.
9. Con relación a la cláusula VII, 1, (1) del Alcance del Trabajo, CEL proveerá totalmente las medidas de seguridad durante la estadía del Equipo de Estudio de JICA en el país.
10. Ambas partes discutieron los detalles técnicos y ambientales de los Términos de Referencia que serán entregados al Equipo de estudio de JICA, y acordaron que



JICA proporcionaría a los licitantes toda la información recolectada durante los estudios de formulación y preparatorio del proyecto, incluyendo la propuesta de CEL de los Términos de Referencia técnicos y ambientales; los detalles de ambos Términos de Referencia serían discutidos entre CEL y el Equipo de estudio de JICA cuando se presente el Informe Inicial al comienzo del Estudio.

11. CEL expresó que los Términos de Referencia ambientales tienen la intención de cumplir con los requerimientos del Ministerio de Medio Ambiente y Recursos Naturales.

(FIN)



TECHNICAL TERMS OF REFERENCE

OBJECT OF THE STUDY.

The Consultant will elaborate the Technical, Economic, Financial and Environmental Feasibility Study of the Hydroelectric Project, taking into account the new conditions of the electric market, as well as, the terms and conditions in which the different options of financings are granted.

SCOPE OF THE STUDIES.

- A summarized description and not restrictive is made below of the Scope of the Studies and Investigations included in the Feasibility Study of the Hydroelectric Project. The tasks to be executed refer to (not limitative list):

Task A. **PHOTOGRAMETRIC WORKS.**

1. Elaboration of a aero-photogrametric map Esc: 1:5000, covering the area of the reservoirs and the areas where works and borrow areas are located with curved each 5.0 m in areas of abrupt relief and each 2.0 m in areas of plane morphology; the map shall contain all kinds of details and/or topographical accidents, roads, railroads, houses, cultivations, limits of properties, vegetation, rivers, etc.

A network of definitive reference control points shall be established at the work sites with a first order precision. The prepared network will serve for the laying out in the construction stage of the work and as basis for the topographical surveys to execute in further stages.

Task B. **TOPOGRAPHICAL WORKS.**

1. At least six (6) concrete monuments shall be placed in the Project area, the monuments shall be marked out on the basis of the altimetry system of first order with their respective coordinates. The monuments shall be indicated in the Topographical drawings.
2. A topographical survey of the land of the interest areas for design of the works of the area to flood and fluctuating lands shall be made, with a density of tachymetric points each 5.0 m (approximately 400 points per hectare) in very hilly areas, with contour lines each meter in those regions and each 0.50 m in plane areas; in interpolation scale of 1:500 to obtain a definitive scale of 1:1000 through a photographic reduction.
The survey shall be enlarged sufficiently downstream of the hydraulic jump of the spillway.
3. Topographical surveys, with cross sections to the river, which shall have a reach in height of 5 meters higher than the maximum level of the flood shall be carried out for the hydraulic investigations.

The profiles obtained, shall include:

- a) Configuration of the land and of the bottom of riverbed.
 - b) Water level at the moment of maxim flood.
 - c) Type of vegetation at both riverbanks.
4. Cross Sections.SE

Upstream of the projected dam, sections for future control of sedimentation each 300 m shall be surveyed.

5. Topographical surveys Esc: 1:1000, of borrow areas and located in the drawings related to the Project.
6. Topographical surveys at feasibility level -as necessary- to define transmission lines, access roads, highways to flood, etc.
7. If necessary, complementary topographical surveys shall be carried out, preparing programs; the surveys at work sites shall be made to appropriate and compatible scale with the necessities.
8. For the geophysics investigations, perforation and other geological, geotechnical, hydrological investigations necessary to determine characteristics of the works of the Project, the Consultant shall carry out topographical surveys, laying out, levelings and location of those additional places that are necessary.

Task C. **HYDROLOGICAL STUDIES.**

Analysis of Hydrological Information.

The Consultant shall make an appropriate analysis of all available hydro-meteorological information and of the hydrological studies carried out in the pre-feasibility stage.

2. Determination of Series of Flows.

Based on the series of flows generated in the pre-feasibility study, such series of flows shall be up-dated and redefined; justifying its consistency and the selected historical period. Also, an analysis of the historical minimum flows shall be carried out, to contribute in the determination of the ecological flow.

3. Determination of growth.

Based on the pre-feasibility study, the Consultant shall restate the probable maximum flood (P.M.F) at the dam site and downstream of the discharge of the machines room, also it shall describe the used methodology; and shall also determine the floods for appropriate return periods for dimensioning the deviation works.

4. Sedimentology

The Consultant, based on the information of sediment production obtained in the Global Study of Sedimentation in the Lempa River Basin, will simulate a deposition of sediments for a similar period to the estimated for useful life of the reservoir.

Task D. **HYDRAULIC STUDIES.**

1. Generalities.

The Consultant shall properly dimensioning the main structures, if applicable (taking works, spillway, hydraulic jump, aduction roads, deviation tunnels, surge tank, machines room, galleries, scouring areas and bottom unloader, discharge channel, maximum and minimum operation levels, maximum level originated by overload of the probable maximum flow, etc.) based on the information of monthly flows and probable maximum flows at dam site.

The hydraulic calculations made in the pre-feasibility phase for main structures, spillway, tunnels, etc., shall be up-dated and be taken to a detail level, considering eventual modifications in the final design of the works required for a feasibility study.

2. Hydraulic Studies for the Project.

2.1 Analysis of Restitution.

Based on the analysis of the level of restitution of the Pre-feasibility Study, additional cross sections shall be measured at the site, in a section that is adapted to the conditions of the site, downstream of the dam sites.

2.2 Hydraulic calculations for the Spillway.

Necessary hydraulic calculations to design the spillway including the dimensioning of the crown, discharge channels of the springboard and the pond shock, gates, etc. shall be carried out.

For the discharge channels calculations shall be made to determine the profile of the flow, water depth and speed of flow, in order to dimensioning the height of lateral walls.

2.3 Hydraulic calculations for water ways of the Power station.

The Consultant shall carry out the necessary hydraulic calculations for the optimization of the diameter of the aduction tunnel and forced pipe, if it is applicable, to the hydroelectric plants, considering the economic evaluation of the losses by friction versus construction cost for several diameters and for the selected diameter, for this diameter he shall carry out computations of fall loss from the water taking to the admission of the turbines, and also shall carry out a hydraulic analysis for momentary oscillations for the acceptance and rejection of load of the turbines, with the purpose of checking that abnormal pressures don't take place in the water ways, which can result excessive for the regulation of the turbines or for the stability of the aduction tunnel and forced pipe.

2.4 Hydraulic calculations for the deviation tunnels and bottom unloaders.

Hydraulic calculations to optimize the number and diameter of the deviation tunnels shall be carried out; as for the aduction tunnel taking into account the losses by friction corresponding to several diameters and with the routing in the upstream part, the heights of the cofferdams shall be determined.

If the Feasibility Studies suggest a bottom unloader, one or two deviation tunnels could be transformed with a water taking at a higher level than the entrance of the deviation tunnel placing a concrete plug with floodgates; the hydraulic calculations will determine the discharge capacity of the bottom unloader.

A free superficial flow for all the conditions of operation of the bottom unloader shall be guaranteed in the downstream section of the floodgates.

Task E. GEOLOGIC, GEOTECHNICAL, GEOPHYSICAL AND SEISMIC STUDIES.

The Consultant will revise and analyze the geologic, geotechnical, geophysical and seismic studies made in the Pre-Feasibility phase and all information of that kind inherent to the area, the necessary studies to complete and refine to detail the surveys and studies made previously

shall be programmed and executed. The future field and laboratory investigations shall be programmed in function of such studies.

The geologic-geotechnical studies for the Feasibility phase shall cover the following activities (not limitative list):

- Definition of the investigation activities, preparation of contract documents of the works to be subcontracted.
- Detailed geologic survey of the dam areas and surrounding sectors, along the aduction tunnel, forced pipe, machines room, discharge channel, with emphasis in the tectonic and geomorphology of the area.
- Supervision by the Consultant of all site activity of the area where the main structures are founded: dams, tunnels, machines rooms (scale to be selected, according to the necessities).
- Geophysical prospecting in areas of important structures (dam sites, tunnels, forced pipe, machines rooms, discharge channel, etc.) using the method that provides the best resolution in areas of this kind.
- Perforations for obtaining of nucleus in areas of the dams, spillways, aduction tunnel, forced pipe, borrow areas, machines room. The Consultant will analyze the nucleus and results of the tests executed in the dam sites, structures, tunnels, forced pipe (in order to defining foundation level and type of structures) and borrow areas, presenting at the end a report with graphic documentation, photographic of the nucleus and stratigraphic maps.
- Injections; the Consultant will define the necessities of an injection screen-wall in an area along the dam; for this he will design the mixture and injection method. At the end he will evaluate the results and will present a report with the proposal for the optimum design of the screen-wall.
- Excavation of trenches and open pits, shall be carried out in areas of interest (structure, borrow areas, etc.). The Consultant will supervise the works at the site, will take samples for laboratory test, mechanics of rocks, of soil in situ, mapping the geologic-geotechnical conditions found. The Consultant will supervise the rock and soils test determining their main parameters. The Consultant will evaluate the results and will elaborate the design parameters for the different works and will include them in his reports.
- The Consultant will evaluate all data of office studies (photogrametric evaluation, satellite images, reports, etc.) of field and laboratory on the whole and will elaborate the corresponding verdict of the feasibility, geologic - geotechnical of the Projects.

To explore the conditions of stability of the rocks mass in the area of the machines room, the Consultant will carry out test of big plate, will evaluate and if necessary galleries will be dug to execute dilatometer test, will evaluate the data and will design the design parameters for the machines room which will be included in a report.

The Consultant, in areas of interest (dam, tunnel, forced pipe, machines room, discharge channel) where investigations will be carried out, will supervise the works, taking sample for testing (of mechanics of rocks, of soils in situ and laboratory) mapping the geologic-geotechnical conditions and will present them in sections and registrations.

In the optimization of the deviation works of the river, during the construction phase of the main dams, a similar process of routing shall be applied for the pass of the deviation flood by the small reservoir originated by the upstream cofferdam.

Task G. OPTIMIZATION OF THE PROJECT.

1) Generalities.

In the optimization to be carried out the consultant will analyze:

- a) Optimization of dam height, of the maximum normal levels of the reservoirs, of the installed power and of the useful volume of each reservoir. Optimization of the spillway and of the retention volume.
- b) Optimization of the deviation structures of the river in the construction stage.
- c) Selection of the number of units.
- d) Optimization of the individual structures of the project, especially of the water ways.
- e) In all the previous cases, the ecological flow shall be taken into account which incorporates a power station on the bottom of the dam to turbine such flow.

2) Valuation of the energy benefits for the optimization.

For the optimization where incremental energy benefits intervene, these shall be valued as the sum of benefits of power and incremental energy benefits.

The benefit of power will be applied to the guaranteed power and the energy benefit to the annual mean generation.

The valuation of the benefits of power and energy will be made based on the behavior of the national and regional electricity market for different ranges of plant factors with sizes of competitive units.

3) Optimization of the deviation of the river in the construction phase.

After determination of the maximum flood and its hydrographs, an optimization of the group of deviation structures will be made, by means of the routing of floods by the reservoir volume formed by the upstream cofferdam. The optimization will be made based on the total minimum cost of cofferdam and deviation tunnel.

In a case limitations that can exist due to the maximum volume of cofferdam susceptible of being placed in a dry season could be taken into account.

The Consultant shall evaluate the possibility to eventually transform the deviation tunnels into a permanent structure of bottom unloader and issue his recommendation.

4) Optimization of the level of the reservoirs and installed capacity.

The Consultant shall carry out a combined optimization of the maximum operation level of the reservoirs, of the installed power and of the useful volume, besides determining the storage capacity of each reservoir (GWh); at the end he shall present in his report the rule of operation of each reservoir.

5) Optimization of the spillway and retention volume.

After determination of the probable maximum floods and its hydrographs, an optimization of the spillway and of the retention volume shall be made, through a routing of the A.M.F.

by the reservoirs for diverse retention degrees. The optimization will be made based on the total minimum cost of the spillway and incremental height of the dam (for the retention volume). The optimization of the spillway will include number and size of floodgates, applying criteria of operation safety.

6) Selection of the number of units.

When being determined the optimum installed power, an analysis of the number of units jointly with the number of aduction of water ways shall be made for that installed power.

7) Optimization of individual structures of the Project.

The Consultant shall carry out an optimization of the dimensions of the main structures of the Projects, especially of the diameter of the conduction water ways to the turbines.

Task H. ENERGY CALCULATIONS.

When finishing the optimization of the Projects and once the main characteristics of the turbines have been determined, the Consultant will analyze and specify the energy production of the Projects, by means of an appropriate simulation model of coordinated operation of reservoirs, based on monthly series of entrance flows to the reservoir for a period not smaller than 30 years.

The energy production will be determined in terms of:

- Installed or nominal power.
- Annual mean generation.
- Mean factor of plant (referred to the installed power).
- Guaranteed power during the hours of maximum demands.

Also he will determine the energetic production of power and energy in monthly way for the dry, mediate and humid hydro-conditions.

Task I. DESIGN OF CIVIL WORKS.

When finishing the works of field investigation (topography, geology, geotechnic, materials investigations and geophysical) the design at feasibility level of the civil works of the previously optimized Project will be prepared.

The objective of the design task is to clarify any doubt about the technical feasibility of the selected main works, to dimensioning such works in order to establish its localization and fundamental characteristics, allowing in this way with enough precision to calculate the amount of the costs and its execution chronogram.

It will be looked for to optimize the different basic works, with the purpose of choosing the best scheme, avoiding in this way fundamental changes in the final design phase and elaboration of technical specifications; obtaining general and detailed drawings at feasibility level, in appropriate scales.

1) Design criteria.

The Consultant will define the criteria and design standards for the main civil works, (dam, bottom unloader, machines room, spillway, deviation tunnels, taking works, forced pipe, discharge channel, cofferdam, etc.) the parameters of seismic and hydraulic design, etc.

2) Design of civil works.

For the civil works of each Project, the civil design will be prepared and the corresponding determination of volumes and quantities of resources as basis for the cost estimation according to the following detail, without being limitative to:

a) Deviation works.

Design flow, number and main dimensions of deviation tunnel, height and volume of cofferdam. The possible incorporation to the dam of the cofferdam for the deviation shall be considered.

b) Main dam.

Typical section, dam type, type of materials, filter sections, slopes waterproofing form (surface layer), excavation depth, injection screen-wall (characteristic) and auscultation equipment.

c) Spillway.

Dimensions of the crest of the spillway, number type and dimensions of the floodgate, bulkheads (type and number, dimensions) board closings, sections of the discharge channel, bucket, dimensions of the pond shock, crane, maintenance bridge, etc.

d) Bottom unloader.

The Consultant will recommend the construction of a bottom unloader and the possibility of partially using a deviation tunnel; discharge channel, closing type.

e) Taking works.

Shape and dimensions of the taking, type of floodgates, emergency closings, rack and rack-cleaner, entrance speed, vortexes (elimination), traveling crane for maintenance, etc.

f) Deviation tunnel.

Inner diameter, thickness, maximum speed in the conduit, excavation method, lining type, armor, conduits, etc.

g) Forced pipe.

Inner diameter, thickness, maximum speed in the conduit, armor, foundations, anchorage blocks, etc.

h) Discharge channel.

Typical section, slope of the channel, slope grade, type of materials, excavation method, etc.

i) Machines room.

Location, type, access, main locations, platform of transformers, etc.

j) Discharge structures.

Type, shape and dimensions of the work, access, closing type, discharge speed, etc.

k) Generation unit at dam bottom.

Location, type, access, main locations, platform of transformers, etc.

l) High voltage substation.

It shall be located free of influence of floods, collapse and as close as possible of the machines room.

m) Transmission lines.

Layout (taking into account, topography, geology, environment, tension, connection points, capacity of transport, etc.).

n) Access highway.

The design will include access highway to each one of the structures of the Projects and its connection with the existent road network, it should consider the maximum weights, minimum radius in order to avoid obstacles in the transport of the electromechanical equipment.

o) Camp-yard and other civil works that are considered necessary.

3) Construction materials.

The areas or borrow sites for construction materials (material for filler of the dam, for the nucleus, aggregates for concrete) shall be located. The areas for excavation waste materials, temporary and permanent camp-yards shall be located.

Task J. ELECTRIC EQUIPMENT

1. Activities.

- Revision of existent Studies.
 - To optimize and dimensioning the main components of equipment (of power, of measurement and indication, of control, auxiliary panels, transformers, transmission lines, etc.).
 - Selection and dimensioning of equipment.
 - Design at feasibility level.
 - Arrangements of equipment, location in the power station and auxiliary structure.
 - Cost estimation.
 - Chronology of production and assembly.
2. Electric equipment of the power stations.

The Consultant will detail:

- Generator and accessories.
- System of ducts of bars.
- Transformer of power.
- Equipment of half tension.
- Auxiliary systems.
- Systems of distribution of low tension, alternating current.
- Distribution of continuous current and U.P.S.
- System of illumination, plug and motive power.
- System of cables.
- Setting to earth system and lightning rod.
- Control, protection and communication system.
- Others that are considered necessary.

2.1 Generators and accessories.

For the design and dimensioning of generators and their accessories it should be considered:

- Type and number of units.
- Design axis arrangement and bearings.
- Operation in isolated system or in parallel with other units.

- Main dimensions.
- Nominal power.
- Nominal tension.
- Regulation of tension.
- Nominal frequency.
- Potential feasibility.
- Nominal speed.
- Racing speed.
- Flywheel effect (G.D.)²
- Isolation class.
- Refrigeration system.
- System of lubrication.
- Excitement system.
- Drainage system.
- System against fire.
- Others that are considered necessary.

2.2 Transformers of power.

The design of transformers elevators (for the generators) will take into account:

- Limitations of transport.
- Installation place.
- Type and number of units.
- Nominal power.
- Transformation ratio.
- Regulation of tension.
- Connection group.
- Refrigeration type.
- Connections of high and low tension (H.T. /L.T.).
- System against fire.
- Others that are considered necessary.

2.3 Equipment of mean tension.

The Consultant shall define the appropriate configuration and technical characteristics of the equipment of mean tension including:

- Armored facilities linked with the generation units.
- Neuter equipment.
- Armored facilities of auxiliary service.
- Group of auxiliary transfer of different applications.

2.4 Auxiliary systems.

The auxiliary systems shall be designed based on operation aspects, safety of energy supply, levels of tension, short circuit and capacity.

The configuration of auxiliary system shall comply the requirements of the hydroelectric plants.

The auxiliary systems will consist of the following equipment and facilities:

- Distribution of L.T., alternating current (A.C.), with main distribution board, sub-boards, diesel group, for the emergency feeding.
- Distributors of continuous current (C.C.) and uninterrupted power source (U.P.S.) with batteries, automatic loaders, distribution boards and U.P.S. systems.
- Illumination system, plugs and motive force.
- System of cables, setting to earth and lightning rod.

2.5 Control system.

With purpose of guaranteeing the reliable operation of the hydroelectric plants in local way to remote way, control systems shall be investigated and defined, considering the following aspects:

- Control system to register the energy, transmission and auxiliary systems.
- The philosophy and configuration of the control systems shall consider the integration and compatibility to the supervision systems of CEL.
- Local control from one control room and remote control of a load dispatch or from another control center.
- Centralized or decentralized system.
- Hierarchy and automation degree of the control systems.
- To design an alternative with a totally automated power station.

2.6 Protection system.

For the design it will consider:

- System of individual protection for the following components:
 - * Generation units.
 - * Transmission lines.
 - * Systems of cables.
 - * Bars and couplings.
 - * System of auxiliary services.
 - * Others that are considered necessary.
- Equipment of protection of digital or static type.
- Compatibility and coordination with installed systems.

2.7 Communication systems.

For the transmission of the signals, the audible communication and the supervision, the Consultant will take into account:

- System of SCADA (U.T.R.).
- Microwave system.
- System of carrier wave.
- Telephone, people searching.
- Fire alarms.
- Safety system.
- Others that are considered necessary.

Task K. **MECHANICAL EQUIPMENT.**

In the feasibility phase of the mechanical and hydro-mechanical equipment, the Consultant will detail:

1) Mechanical equipment of the power stations:

- Hydraulic turbines and regulators (turbine type, specific speed, turning speed of turbine, number of poles of the generator, turbine size and rotors, power of the generator, etc.).
- Admission valves and floodgates to the exit of the aspiration tubes.
- Cranes, chain blocks, auxiliary systems of the power stations as:
 - * System of bulkheads (of taking, spillway, aspiration pipe).
 - * Water and refrigeration systems.
 - * Drainage systems and sewage.
 - * Systems of compressed air.
 - * Systems against fire.
 - * Ventilation and air conditioning systems.
 - * Water systems for general services.
 - * Others that are considered necessary.

2) Hydromechanical Equipment

- Floodgates in the spillways of the dams.
- Floodgates and grids in the water takings and device to clean the grids of the taking.
- Steel armor in pressure wells.
- Floodgates of bottom drainage.
- Others that are considered necessary.

Besides the dimensioning and the design at feasibility level of this equipment, the Consultant will carry out activities as:

❖ Machine and turbines room:

Independent of the parameters defined in the pre-feasibility phase, the Consultant will carry out an optimization of the nominal speed and of the installation level, therefore the shape and values of the curve of efficiency of the turbine and the costs of the civil work shall be taking into account. It shall be secured that the turbine is usually operated in its optimum range of efficiency, with the purpose of obtaining the maximum of energy.

With the purpose of guaranteeing the efficient operation of the hydroelectric plants, even under very adverse conditions, the necessity of isolated operation of each one in the electric system will be investigated. The capacity of the power stations to maintain the frequency of generation operating alone and also of supporting abrupt changes in the demand of the system.

❖ Valves of admission of the turbines (if required):

The Consultant will study if butterfly type valves are appropriate as admission valves, in case several turbines are connected to one pressure well.

❖ Main crane of the Power stations:

Depending on the type of machines room, number of generating groups, required lifting capacity and dimensions corresponding of the crane, it will be defined if only one crane with the total capacity or two individual cranes will be installed.

❖ Armor for pressure well:

Direct costs and energy losses and the requirements of operation of the turbines for the optimum dimensioning of the armor for pressure well shall be contemplated.

❖ Bottom unloader.

According to operation conditions that will be defined in the Feasibility Study, schemes of the bottom unloader shall be studied, combining two slipping floodgates or combination of a slipping floodgate and a radial floodgate.

Task L. **TRANSMISSION LINES AND SUBSTATIONS.**

1) Development of transmission systems.

- It will determine the basic scheme of the transmission between the central/raising substation and the existent system.
- Analysis of the transmission system based on the number and power of the defined generating units.
- Flow of power for one configuration.
- Short circuit levels in the main collector bars of the connected electric system.
- Transitory stability of the electric system.
- Geologic, topographical and environmental impact studies shall be included for this task.

2) Transmission lines.

The design of this type of lines, will consider:

- Collection of existent information of the electric system, such as:
 - * Tentative layout of lines considering topographical, geologic and environmental aspects.
 - * Transmission tensions.
 - * Connection points.
 - * Capacity of transport of the lines.
 - * Availability of lands for lines and substations.
- Definition of electric, geographical and structural criteria.
- Definition of the configuration of the transmission system to implement the hydroelectric power stations, taking into account length of transmission lines, tension, conduit type, number of insulators, number of circuits per tower, protection against risks, topology of the net, etc.
- Selection and elaboration of the layout and dimensions of the transmission system with detail degree, taking into account existent access road and making emphasis on:
 - * Selection and definition of appropriate tower type.
 - * Determination of the economic section of conductors, number and section of sub-conductor in each phase.
 - * Selection of guard cables and of setting to earth.
 - * Optimization of the isolation and selection of insulators.
 - * Study of influence of transmission lines on other facilities.
 - * Analysis of transportation problems.
 - * Environmental impact assessments (EsIA).

The Consultant shall analyze the incidence that the addition of new generating power stations has on the national transmission net, including for this an analysis of flows of power, short circuits, transitory and dynamic stability. All these analyses are necessary to identify the addition of new transmission lines and/or reinforcement of the existent ones, in order to transport the energy coming from those mentioned stations to the consumption centers.

3) Substations.

To design the substations it will consider:

- Development of one-wire schemes.
- Analysis and definition of the locations of substations in function of the location of the Power stations and interconnections with the national and regional net, environmental impact.
- Selection and definition of the equipment arrangement and configuration and equipments considering the topography, resistivity of the ground and available space.
- Selection and definition of characteristics for:
 - * Transformers of power, of current and of tension.
 - * Switches.
 - * Isolating switch.
 - * Lightning rod.
 - * Conductor bars and connections.
 - * Setting to neuter earth.
 - * Setting to earth of the substation.
 - * Supply of auxiliary and emergency energy.
 - * Wired.
 - * Remote Terminal unit (R.T.U.).
 - * Auxiliary systems.
 - * Local and remote control.
 - * Protection systems.
 - * Metallic structures.
 - * Civil works (control room, etc.).
 - * External illumination.
 - * Others that are considered necessary.

Task M.

ESTIMATE OF INVESTMENTS, COST AND REVENUES.

1) Generalities.

The Consultant will establish the necessary parameters to satisfy the design concepts and to proceed efficiently in the cost estimation stages.

He will take into account the variation of costs for materials, manpower, construction equipment, fuel, transportation and other cost that can influence the basic costs of the Projects.

The Consultant will make studies of cost, to provide necessary parameters for the optimization program and to determine construction cost which will be the basis for budgetary,

economic and financial aspects for the Projects implementation (disbursement program during the construction phase).

For all the above-mentioned he shall follow with all the guidelines, methodology and standards recommended by the World Bank for this type of studies carrying out necessary budgets, using the up-dated cost of the Consultant's database.

2) Estimation of investments, work quantities and costs.

In this section the Consultant shall make an analysis in detailed form on the required work quantities, associated cost, in economic, social and environmental terms; investments, being these fixed or nominal, for both those that are carried out in advance to the setting in operation, as well as those that are made during the operation. Also, he shall include the forecast of the operation and maintenance costs and the administration expenses during the useful life of each project, and consideration on the work capital that the projects will require.

2.1 Investments.

The Consultant will estimate the whole investment required for the execution of the work, which will be detailed according to the concepts internationally accepted, such as:

Fixed investments: These are defined as all those that are made in the acquisition of tangible goods which are used in the obtaining of the good or service that it is intended to render, or that serves as support for the normal operation of the project. The lands and natural resources; physical works (buildings, administrative rooms, access roads, etc.) plant and office equipment as well as the infrastructure of support services (potable water, drain, electric net, etc.) constitute this type of investments among others.

Nominal investments: These are all those that are made on assets constituted by the services or acquired rights necessary for the setting in operation of the project, such as organization expenses, patents and licenses, setting in operation expenses, training and incidentals.

Work Capital: although it doesn't always imply a disbursement in its entirety, before beginning the operation it is considered as an expense at the moment of beginning of operations and it is constituted by the group of necessary monetary resources, for the normal operation of the project during a productive cycle.

Besides the investments in work capital and prior to the setting in operation, it is necessary to forecast the substitution reinvestments and the new investments for extension that are considered necessary.

2.2 Work Quantities, Equipment and Costs.

Based on all the considerations related to the design, generation, operation, maintenance, administration of the construction, the Consultant will determine the work quantities and will present in detailed form an estimated budget of the investment costs of the civil works, based on the design at feasibility level of the works of the projects, as well as the list and costs of the electromechanical equipment to be installed in the power station and other complementary works required for the good operation of this.

The budget will include the direct costs for material, equipment, labor, engineering costs, including a forecast for the incidentals and others that are considered pertinent.

The Consultant will also include, the fixed and variable operation and maintenance costs, as well as the administration expenses.

It will be understood as operation costs and administration expenses all those expenditures that direct and indirectly participate in the production of this service such as materials (spare parts, fuels and lubricant, etc.), telephone, fax, insurance, rentals, etc., labor (chiefs, personnel of repair, surveillance, storekeepers, etc.). The tax and financial expenses shall be included.

2.3 Determination of the components of costs.

At the beginning of the cost estimation tasks, the Consultant will determine those costs that required to be detailed, analyzed and the main components for costs breakdowns and preparation of the general budget to determine conditions of accesses and its influence in the costs and those rehabilitations that impact in the budgets.

The visit to the sites by the Engineer of the consultant company will allow to determine the method and appropriate equipment for earthworks.

The Consultant will investigate at the beginning of the studies the average salaries of the country and in the work sites, in order to adjust in a precise way the unitary costs that depend on the labor costs and will also prepare a list of frequent unitary prices and of more importance which will be used in the computations in the bill of costs and budgets, he will also determine costs of construction machinery to be used and other construction equipment that are required in order to use hourly unitary costs for his use.

The Consultant at the same time of determining the important unitary costs of each project, will determine work quantities and volumes based on the designs of feasibility that will be available, which will allow to prepare bills and its respective budget by work items.

The Consultant will present the results of the costs studies in a report that will include the above mentioned elements, including cash flows for the construction phase of civil works and of implementation of hydro-electromechanical equipment in one year intervals.

The investment costs shall include:

- Total direct costs of civil works.
- Indirect costs product of civil works.
- Production, transport and assembly costs of electromechanical and hydro-mechanical equipment.
- Costs of transmission lines and of substation.
- Incidental costs.
- Engineering and administration costs.
- Costs of access roads, camp-yards, etc.
- Environmental and social costs.
- Others that are considered necessary.

For effects of the economic and financial studies, the following will be analyzed:

- Variation of costs scaling, for which its methodology shall be included.
- Taxes and custom fees if that is the case.
- Financial costs at feasibility level, according to standards of World Bank.

The bill of costs and budgets will be prepared in components of national and foreign currency already broken-down, valid this for civil works and hydro-electromechanical equipment. The component in local currency will be expressed in national currency as its equivalent in US \$Dollars.

2.4 Determination of costs of civil works.

For this activity the Consultant will prepare construction chronograms of the project, choosing the most efficient work times, the most appropriate machinery and equipment.

The work chronogram will allow to determine the breakdowns of items to use in the development of the works for each main component; the total cost of construction will be broken-down in the following lines:

- Primary construction costs, covering actual production quantities.
- Costs of the construction company which include in-situ installation costs and operation costs and the constructor's maintenance.

For the applicable costs lines, information of the usual costs in El Salvador will be collected.

The actual cost of the considered item will be estimated starting from these costs lines, for example the in-situ placed concrete costs or finished enrockment.

Special attention shall be given to the materials transportation costs, to the determination of unitary costs to be used in the bills and budgets in order to obtain optimum unitary costs depending on the work methods, suitable machinery and equipment to be used.

General expenses that affect those items and that are originated in the preparation of the works, in the installation of equipment and in the costs or expenses of operation of them shall be added to these costs.

The sum of the primary costs of construction and installation and maintenance of them, will allow to conform the total direct cost of the civil works of the considered items.

Finally the contractor's indirect costs that possesses a general nature (insurance, guarantees, financial costs, costs for risks, contractor's profit, etc.) shall be taken into account

The incorporation of the Contractor's indirect costs to the direct costs of construction, will determine the total construction cost of the component in study.

He shall also breakdown the costs of personnel, machinery, materials and fuels.

2.5 Determination of costs of supplies.

The cost of supplies will include: hydro-mechanical equipment, steel structures and electromechanical equipment, which will be estimated separately from the civil work, which include the following elements:

- Steel hydraulic structure (armored steel) floodgates and valves.
- Electromechanical equipment for machines room, including costs of cranes and auxiliary equipment.
- Equipment for exit and connection substations.
- Equipment for transmission lines, including costs of towers and their foundations.
- Equipment for telecommunications, measurement and remote control.
- Supervision of the assembly.

The estimations of these costs will be based on statistical international data for equipment installed in other projects under similar conditions, which will be up-dated to the date of the study.

2.6 Costs related to the project.

2.6.1 Engineering and Administration Costs.

Factibilidad del Proyecto Hidroeléctrico Torola

The engineering costs will be estimated for the construction period, including eventual additional costs for field investigations and necessary test, during that phase. These costs will be estimated as a fixed percentage of the works to execute.

The administration costs will be those incurred for the realization of the projects, including the supervision of the consultancy, contractors and/or suppliers of equipment for control and coordination of the projects.

2.6.2 Costs of the environmental measures, social and relocation of affected residents.

The costs resulting from the preventive measures to avoid that the environment can be negatively affected by the execution of each project and/or to mitigate unavoidable effects on the environment caused by the construction of the different elements of the projects, as well as the compensation costs, transferring, relocation of affected residents by these projects, will be estimated separately, based on the experience of similar projects.

2.6.3 Financial cost.

The financial costs will be calculated by the Consultant, but these shall be excluded from the budgets of the direct costs of each project. The financial costs will be included in the financial analysis. These costs refer to those in which the contractors and equipment suppliers will incur for financing of their work capital. The costs in which the contractors and equipment suppliers incur shall not be included in the evaluation of these projects, since these are already included in the offered prices.

All those financial costs arising during the construction of the Project, after the beginning of the works and of the operation of the project are part of the financial evaluation and shall not be included as direct costs of construction.

2.6.4 Taxes, customs fees.

All basic budgets will be estimated excluding the payments of taxes and customs fees in the Republic of El Salvador.

2.6.5 Chronogram of investments.

The chronogram will be established for all the main components of each project and its development in the time based on the corresponding works chronogram, in order to define the corresponding flow of funds, in function of the construction progress, of the equipment production and assembly of them. The initial payments will cover the disbursements for advance payments and cost of the constructor's installation, fatherly the payments related with the effective production of the contractors and suppliers shall be included, considering the reimbursement of the corresponding advance payments.

The chronogram of investments will be broken-down in local currency and foreign currency and its intervals will represent three-months and annual payments.

2.6.6 Breakdown in individual contracts.

The projects will be broken-down in individual lots of work, constituting in this way a work guide for the subsequent phase of final design and elaboration of technical specifications.

3) Revenues.

The most relevant revenues to consider are those derived from the sale of the service that each project will produce; however, if there are other revenues, they shall necessarily be considered to evaluate it with more objectivity. The Consultant shall support himself on the resulting information of the carried out market study.

Task N. **CHRONOGRAM OF IMPLEMENTATION OF WORKS.**

The Consultant will prepare a chronogram for implementation of works, which will include both the civil work, as production and assembly of all mechanical, electric, hydro-mechanical equipment, transmission lines and substations. This chronogram of works will be prepared jointly with the tasks of design of the civil work, mechanical, electric, hydro-mechanical design and including considerations of the tasks referred to the environmental measures, for which the Consultant will take into account the most appropriate methodology.

The chronogram will be presented in form of bars diagram (Gantt diagram) and critical route (C.P.M.) for the main activities, the chronogram will detailed each project in the different main subcontracts.

The work chronogram will allow to estimate the respective disbursements during all the phases of the project for each one of the selected items, based on the total cost estimated for each item which will be distributed in the time required for its realization.

The total sum of those items will provide the total disbursement required to carry out the works according to its design.

The disbursements corresponding to the items in which will be necessary to make the initial payments shall be considered, to be introduced in the first period of payments, reducing the subsequent payments in proportional parts to the initial payment.

Separately the Engineering and Administration costs shall be taken into account as a percentage already determined of the value of the works in such period, the costs of incidentals will be introduced according to the corresponding determined percentages, depending on the type of works.

The corresponding annual sums will provide the necessary cash flow for the estimated direct costs.

Task O. **ECONOMIC-FINANCIAL EVALUATION.**

- 1) The Consultant shall carry out an analysis of risk of the business.
- 2) The Consultant will determine the competitiveness of the Project, simulating the behavior of the market of contracts and SPOT market.
- 3) Financial Analysis.

The Consultant will present all the elements that are considered indispensable in the financial analysis of a project, in a competitive environment, which is defined as the part that determines which is the amount of the necessary economic resources for the realization of it, as well as the presentation of the financial solidity. He shall include in his analysis all the financial flows, such as: cash flow, rate of capital recovery, countable profitability and its index; sources and uses of funds, cost per installed kW, cost per generated kWh, net present value, internal return rate, benefit/cost ratio (B/C), possible financing sources and its paying-off, yield rate and also, to explain the used methodology and results obtained.

The Consultant will carry out a final evaluation at feasibility level for each project; presenting a description of the forecast of energy demand.

The final evaluation will determine the financial viability of each project in terms of its internal return rate (IRR), net present value (NPV), cash flow and B/C ratio. For the financial costs he

shall apply market prices in local and foreign currency with scaling, taxes, rights and interests during the construction. The financial evaluation will at least include a sensibility analysis with variations of the investments, electric power sale and the possibility of a delay of the project. In order to evaluate the financial situation, the Consultant will analyze and prepare financial forecast for short, medium and long term, considering at least: results statements, cash flow, situation state, origin and application of funds.

The Consultant shall analyze different financing options for the financial evaluation.

4) Economic evaluation.

The Consultant will economically evaluate the Project, taking into account the national and regional competitive electricity market. He will also take into account the macroeconomic context, the economic impact of the Projects in the economy of the country, quantitative and qualitatively evaluated.

The economic evaluation has as objective to examine the economic viability of these Projects, in terms of the IRR and of the B/C ratio, and the NPV.

The Consultant will consider national and international economic parameters in his analysis, he will also include as minimum an analysis of sensibility of the investments and of the generation, including an eventual delay of the projects, determining costs and necessary economic evaluations to optimize dimensions and location of the works included in each project.

The Consultant will make an analysis that allows to know the kindness of the project, being necessary that this present a reasonable scheme to what would be the reality in the event of executing it, from the economic and social point of view; in such way to comparatively analyze the possible existent alternatives for the construction of the works and to select the most attractive alternative, in order to subjecting it to the final design.

5) Sensibility analysis.

The Consultant will present the costs and benefits by means of economic and social or socioeconomic evaluation of the Project, in such way that involves the main indicators.

From the point of view of the economic evaluation he will calculate and present the optimum time when the investment should be made and as well as its optimum size, the net present value (NPV), benefit-cost ratio(B/C) and the internal return rate (IRR) where the evidence of the economic advantages of this projects is shown.

The Consultant will make a sensibility analysis in the economic evaluation, using, among other, the following criteria:

- Variation in the associate costs.
- Variation in the time of construction.
- Analysis of economic-financial risk, taking into account the national and regional competitive market.

6) Economic, Social and Environmental evaluation.

In this section the results of the economic and social evaluations will be presented, which will be used to evaluate the convenience of the execution of the hydroelectric project.

The social or socioeconomic evaluation, has as purpose to identify and measure the costs and benefits attributable to the execution of the project for the national well-being, identifying the socio-economic and environmental impacts of the selected alternative.

The social or socioeconomic evaluation, shall be carried out by means of the use of efficiency prices (shade or social), pointing out the source of such information; to calculate and explain the identified indicators as: NPV, B/C, IRR and the coefficient of distributive impact (of the projects, of the investor, of the sectors of low revenues and of the government).

The economic justification of an electric power project shall be made examining if the projected works are part of the minimum cost solution among all the alternatives of electric generation and as much as possible carrying out a cost-benefit analysis that demonstrates that the prospective benefits are higher than the costs. In general, both procedures shall be considered complementary.

On the other hand, in the appraisalment of the costs the alternative use of the used resources (opportunity costs) shall always be considered.

In the projects that imply people's displacement, flood of agricultural lands, environmental or other impacts, the evaluation shall include the involved social costs.

The economic benefits of an electric power project are determined in general, by the value that the consumers grant to the bigger available electric power and by the saving of resources, which implies the realization of the project. As much as possible, the changes in the confidence of the electric system will be determined and to quantify the benefits produced by the development of the electric system and the socioeconomic and environmental benefits of the project not related with the energy supply.

7) Certificates of Carbon.

The economic aspects of the project under the perspectives of application of the sale of certificates of carbon shall be analyzed.

TERMS OF REFERENCE FOR THE ENVIROMENTAL
IMPACT ASSESSMENTM OF
EL CHAPARRAL HYDROELECTRIC PROJECT

MINISTERIO DE MEDIO AMBIENTE Y RECURSOS NATURALES

DIRECCION DE GESTIÓN AMBIENTAL

TERMS OF REFERENCE FOR THE ENVIRONMENTAL IMPACT ASSESSMENT OF EL CHAPARRAL HYDROELECTRIC PROJECT, LOCATED IN SAN MIGUEL DEPARTMENT

1. BACKGROUND

El Salvador has three operating Hydroelectric Power Stations located on Lempa river. Cerrón Grande, 5 de Noviembre and 15 de Septiembre, plus Guajoyo Hydroelectric Power station on Desague river, tributary of the same Lempa river, projects that almost represent 100% of the hydroelectric resource (388 MW) of the hydroelectric capacity installed in the country, considering that some hydroelectric mini-power stations exist.

At this moment, the **Comisión Ejecutiva Hidroeléctrica del Río Lempa -CEL** is executing the rehabilitations of 5 de Noviembre and Guajoyo Hydroelectric Power Stations, and is studying the re-powering of 5 de Noviembre and Cerrón Grande Hydroelectric Power Stations, with the purpose of increasing the hydroelectric energy generation capacity and in some cases the useful life; also, other hydroelectric potential projects have been studied on Lempa river as: Zapotillo, Paso del Oso, El Tigre, San Marcos and El Cimarrón.

Under this framework the MINISTRY ENVIRONMENT AND NATURAL RESOURCES (MARN), has received on September 9, 2000 from the Engineer Salvador Novellino in his quality of Acting Executive Director of CEL, the Environmental Form with the **basic information related to the "EL CHAPARRAL HYDROELECTRIC PROJECT"**, with the purpose of **beginning the procedure to obtain the Environmental Permission.**

The referred project is located on the Torola river channel, in the municipalities of San Luis de la Reina, Carolina and San Antonio del Mosco, in San Miguel Department, and it was pre-selected after that the Comisión Ejecutiva Hidroeléctrica del Río Lempa (CEL), during a period of 18 months (Dec/1997-Mar/1999), executed the **"Pre-Feasibility Study of the "Hydroelectric Complex Project on Torola River"**, which was developed in a 58 km section of Torola river in Salvadoran territory, to the North of the oriental area, which included eight (8) alternative of dam sites denominated: Las Cruces, Maroma, Las Mesas, Cerro Pando, Las Marias, La Honda, Carolina and El Chaparral; and additionally three of these sites with tunnel. As a result from the technical, economic, social and environmental point of view, two alternatives were determined as more favorable and appropriate, to execute the feasibility study: La Honda Hydroelectric Project and El Chaparral Hydroelectric Project.

The study was developed in two phases: Phase 1A "Identification and sieved of alternatives", and Phase 1B "Evaluation and selection" and it consists of eight (8) appendixes, identified as Appendixes from "A" to "H". The "D" corresponds to "Environmental and Social Aspects", which has been determined should be considered as basis or beginning for the **Environmental Impact Assessment (EsIA)** in the feasibility stage of each one of the two pre-selected projects (sites).

The dam as been projected with the following characteristics:

Drainage area at the site	1,258	km ²
Average Annual Flow	50.0	m ³ /s
RESERVOIR		
♦ Maximum Normal Level	202	msnm
♦ Surface Area	8.18	km ²
♦ Minimum Level	179.10	msnm
♦ Surface Area	3.26	km ²
♦ Active Volume	130.51	MMC
♦ Dead Storage Volume	60.81	MMC
♦ Total Volume	191.32	MMC
DAM		
♦ Elevation of Crest	204.0	msnm
♦ Estimated Bottom of the Natural Channel of the River	131.5	msnm
♦ Expected Depth Excavation in River Channel	5.0	m
♦ Maximum Height	77.5	m
♦ Length of Crest	257	m
♦ Concrete Volume (1000 m ³)	239	x 10 ³
MACHINES ROOM		
♦ Discharge Elevation- Maximum Discharge Generation	137.10	msnm
♦ Maximum Fall	69	m
♦ Minimum Fall	46.1	m
♦ Estimated Losses of Fall	2.70	m
♦ Discharge Capacity	115	m ³ /s
♦ Nominal Net Fall	58.7	m
Installed Capacity	58.8	MW

2. TECHNICAL ANALYSIS

On November 3 of this year, an inspection was carried out by technicians of the Dirección de Gestión Ambiental, verifying that EL CHAPARRAL HYDROELECTRIC PROJECT, is planned in an area located inside the Lempa river basin, named Sub-basin Torola river, hydric body that is born in the territory of Honduras and flows toward El Salvador, it has an extension of 1,575

km² shared with the Republic of Honduras; of which 1,019 km² equivalent to 64.7% of the total correspond to El Salvador. The proposal was originated from the pre-feasibility analysis of the "Hydroelectric Complex Project on Torola river" and in the pre-feasibility stage, the dam site is located at 6 km from the city of San Luis de la Reina (approximately at 13.4 km downstream of dam site of La Honda Hydroelectric Project, approximately at 300 m up of the border point with Honduras, in San Miguel Department), at 48 Km from departmental capital San Miguel and at 140 Km from the capital San Salvador. All components of the project would be located in Salvadoran territory.

3. CONCLUSIONS

Due to the environmental conditions of the site and to the magnitude of the project, **the Holder shall present an environmental impacts assessment** with the purpose of:

- To build a tool that helps to decisions makers to consider the environmental viability of the project;
- To facilitate the determination of the most appropriate environmental measures, considering that for the success of the project its economic viability is fundamental, looking to design and outlining of environmental measures that prevent or mitigate the negative impacts and optimize the positive ones, to be caused for the same.
- To facilitate the economic comparison of the project and its alternatives, including in the exercise the economic valuation of the environmental impact and supportability of the project.

The study shall be elaborated following the specifications detailed ahead, but without being limited to the tasks described in the present terms of reference - TOR-, the additional studies or investigations necessary to supplement, to strengthen or to deepen in aspects that the EsIA requires and those specified by CEL.

4. ENVIRONMENTAL IMPACT ASSESSMENT

The information required in these terms of reference shall contain a technical, analytic and integral focus of the components of the project; it should be concise and limited to the evaluation of environmental impacts -EIA - of the components of it. The main text shall concentrate on the results, conclusions and recommended actions.

The EsIA shall be able to satisfy the following criteria: to be understanding, flexible, to detect the relevant impacts generated by the proposed action, objective, to include the contribution of an interdisciplinary group of experts, to use evaluative technology, to use clear and well defined criteria, to allow the calculation of magnitude and significance of the negative environmental impacts,

to allow the determination of the total effect of the impacts for each evaluated component (alternative).

It shall also detect environmentally sensitive areas, which will facilitate the determination of most appropriate environmental measures, considering that for the success of the project its economic viability is fundamental, which transforms it in sustainable action and facilitate the taking of decision for its execution by economic comparison of the project and its alternatives, including in the exercise the economic valuation of the environmental impact.

To achieve the objectives of the EIA, the requirements of the Environment Law and the requirements of CEL on this regard, the studies or additional investigations necessary to supplement, strengthen or deepen in aspects that it requires and those specified in Appendix D "Environmental and Social Aspects" of the Pre-feasibility Study, taking as basis the content of this Appendix and their annexes, shall be developed, but without being limited to the tasks described in these TOR.

It shall also incorporate the additional necessary studies, as the case of the Study of Eligibility for the Sale of Carbon Certificates, taking into account the estimate of gases of hothouse effect that the project can emit and the estimate of gases of hothouse effect that the project and its components can displace or capture.

The Holder shall present to the Ministry of Environment and Natural Resources, one original and two copies of the report, which will be used in the revision by the Dirección de Gestión Ambiental.

5. CONSULTING TEAM

The holder of the project SHALL hire a consulting company that is registered in the Registro de Prestadores de Servicios de Estudios Ambientales kept by this Ministry (or to register prior of signing the contract for this consulting), to coordinate and prepare the Environmental Impact Assessment; because the analysis of environmental impacts requires a multi and interdisciplinary analysis, it is required that this consulting company creates a team of professionals duly registered in the MARN, with training in the areas of the EsIA involved in the project. The coordinator or coordinators of the team shall have experience in the preparation of environmental evaluations for similar projects.

On the basis of the registration guidelines, it is noticed to the Holders of the project that the public officials which participates in any way in the application of the Environment Law, its Regulations or in the related with the environmental assessments, cannot participate directly or through third parties in the elaboration of studies.

6. CONTENTE OF THE ENVIRONMENTAL IMPACT ASSESSMENT DOCUMENT (EsIA)

6.1 Cover: Title and Authors. It shall contain the name of the study, Holder of the project and the name, signature and inscription number as natural person in the Registro de Prestadores of the coordinator of the study and of each one of the professionals participating in the elaboration of the study, according to the work area.

6.2 Table of Content.

6.3

Executive Summary. In a content not bigger than 20 pages, a summary of the work shall be made where the environmental analysis of the project is synthesized, linking its activities with the environment at the site, the environmental impacts to generate and the palliative measures to be incorporated during its execution.

6.4 Introduction. To describe the referential framework of the Study and of the project, accompanied by the objectives of the Study, Justification of the project (in the social, economic, regional, national, local, technical and environmental) which shall consider as minimum:

- Relationship of the project with the land use plans and with the existent regional and local development policies for the area.
- Identification, evaluation and priority of the potential significant environmental impacts to be caused by the several construction, operation and maintenance activities of the projected hydroelectric power station, and of other complementary activities and works.
- To incorporate in the Feasibility Study, the determination and proposal of the environmental measures necessary to be incorporated in the different stages of the project (construction, operation, maintenance and abandonment of the temporary components) of the projected hydroelectric power station, to prevent, correct, mitigate or compensate the significant negative environmental impacts.
- To propose a Environmental Handling Program –PMA-, with its monitoring program for the execution, control and follow-up of the environmental measures to be applied during the construction, operation and maintenance of the projected hydroelectric power station and the re-suitability of the sites at the closing of temporary activities.
- To incorporate the cost-benefit analysis of these environmental measures to the technical, economic and financial study, in order to be considered for the

selection and design of the components of the project and its environmental and financial viability.

- To make a project proposal according to the affected communities, making in its preparation process the necessary local and regional social consultations, briefing the project to those affected, to both civil society as for local authorities, involved entities and to non-governmental organizations of the area; in such way that the project doesn't have relevant objections that can negatively influence in its development.

6.5 Environmental Law and Regulations Applicable to the Project.

The juridical interrelations of the project with laws, regulations and national, local and international technical standards which regulate its execution in each one of the activities incorporated in its development shall be determined, analyzing as minimum:

- The Environment Law, its General Regulation and other laws, regulations and normative that apply to the project.
- Those agreed with the Organism that finances the project, which can be: of the World Bank (WB), Japan International Cooperation Agency (JICA), Interamerican Development Bank (IDB), Central American Bank for Economic Integration (BCIE), etc.
- The international agreements ratified by the Government of El Salvador, related with the project.

6.6 Description of the Project and its Evaluated Alternatives

to) Description of the Project. To explain on what it consists and its scope, detailing future infrastructure that will be built and its area (m²) for each one of its components, with emphasis in the following aspects:

- Design, construction and operation of the dam: basic characteristic, parts which conform it and construction systems.
- Design, creation and operation of the reservoir: geometric characteristic and operation model (levels, discharges, minimum flow, etc.)
- Design, construction and operation of the generation facilities: load tunnels, machines room, turbines, generators, transformers, substation, transmission lines, discharge channels, etc.
- Complementary works: roads, utilities, offices, warehouses, workshops, camp-yard, sites and works for human resettlement, and others.

Flow charts of the construction, operation and maintenance works shall be included, with schedule of all activities, assignment of personnel, required investments outside and in the site, years of useful life of the projected hydroelectric power station, etc.

Also, maps, schemes and drawings at appropriate scale to illustrate the project (Design, location, distribution, dimensions, etc.), works or complementary parts, as well as the surrounding areas that are affected by the project (borrow areas, population, industrial or relevant developments, bodies or intervened sources of water, etc.) shall be included.

- b) Project Area and Influence Area:** to delimit the project area and its direct and indirect influence evaluated area of the different components of the project.

Geographical and political location - administrative: cantons, municipalities and departments; to present localization of the land where the project is projected to be developed. To present figure supported in the cartographic sheets (1:50,000), indicating with its geographical coordinates, and in 1:10,000 scale, the location of the Project area (PA) and the Direct Influence Area (DIA) related with it, in a distance not less than 1000 m radial to the perimeter of the land.

The analysis shall take into account the information contained in the Pre-Feasibility Study and especially that of the Appendix D: "Environmental and Social Aspects"; and it shall supplement, up-date and take the information to a higher detail, mainly as for the direct influence area of **El Chaparral Hydroelectric Project**.

The Torola River basin has a total area of 1,575 km², shared with the Republic of Honduras, which is located between the latitudes 13° 42 ' and 14° 05 ' north and longitudes 87° 47 ' and 88° 29' west; the basin of **El Chaparral Hydroelectric Project** is located within this area, and according to Appendix D it has an approximate area of 1,258 km², which represents 79.87% in relation to the total area of Torola River basin.

Considering the projected location for the hydroelectric dam, which will drain in the low part of Torola river and this immediately up-stream of the reservoir of the 15 de Septiembre Hydroelectric Power station in the river Lempa, the EsIA shall consider its influence on the low part of Torola river, the 15 de Septiembre hydroelectric power station and the river Lempa, down-stream, until the outlet to the sea; it shall also consider the influence that La Honda Hydroelectric Project, projected up-stream, will receive.

IMPORTANT CONSIDERATION:

The additional studies recommended in the Appendix D "Environmental and Social Aspects", and others that are considered necessary at that moment, to develop the different topics of the EsIA, are the following (but the consulting shall not be limited to them):

- ◆ **Investigation of the Socioeconomic Conditions and of the Community Development Necessities of Direct Affected Population:** to characterize the population to be affected, government institutions and non-governmental organizations of the area, demonstrating their participation in the consultation process that includes recommendations of compensation measures.
- ◆ **Identification of Potential Places for Resettlement of Residents,** considering the necessities of the residents, the facilities for utilities and basic services and width in the spaces, follow-up programs for affected population.
- ◆ **To identify Additional Necessities of Transportation Infrastructure** (i.e.: In substitution of altered places of the river used for people crossing and their goods, mainly cattle).
- ◆ **Coordination of Development of Infrastructure with the Necessities of Municipalities,** considering sustainable development with visualization of new sources of permanent work,
- ◆ **Location of temporary camp-yard** in places that benefits the development of the near populations.
- ◆ **Archaeological and Anthropological investigation (Study of the Archaeological Resources and Historical and Cultural Patrimony):** to carry out this investigation according to the recommendations, resolutions and requirements of the Dirección Nacional de Patrimonio Histórico y Cultural, of the Ministry of Education (Investigation and more detailed documentation, precise mapping and excavations). The recommendations, resolutions and requirements will be part of the present TOR.
- ◆ **To investigate on other sites of Importance:** to define current places used by the population for recreation, customs, fishing and possibility of eco-tourism development or other projects.
- ◆ **Investigation of the Land Fauna:** Seasonal monitoring or sampling to establish the presence and relative abundance mainly in the flood area, with emphasis in the significant species as indicative of environmental quality, establishing monitoring programs and actions for their protection
- ◆ **Investigation of Aquatic Fauna:** seasonal sampling of diversity and abundance in the area of the project with emphasis in the species used for feeding, indicating propagation programs and actions for their protection.
- ◆ **Investigation of the Quality of Water emphasizing in the variations of stationary sedimentation:** application of forecast computer models of the behavior of the contamination of water for the presence of the reservoir, the influence of the sedimentation in the useful life of it and the regulation of the flow and their impacts down-stream of the discharge. To continue the investigation started in the Pre-feasibility, to estimate the annual discharges of nutritious and organic material into the river and reservoir, and its stabilization necessities before entering to the reservoir of the 15 de Septiembre Dam, to quantify those poured and to develop appropriate models to determine the effects of such discharges and another type of contamination considering the modifications that Torola River will have when the project is carried out

- ◆ **Study of Risks and Contingencies.** Identification and determination of the activities that represent the possibility and probability of risks or threats for the population's health and the structure of ecosystems and other contingencies:
 - Identification of dangerous materials or substances that will be used during construction, operation and closing of operation stages.
 - possible failures during construction, operation and closing of operation stages.
 - The risk of the users of the Torola river, down-stream of the project, when water is discharged in pick hours, consequences of maximum flood, opening of gates and dike collapse.

- ◆ **Other Studies:**
 - **Study of Eligibility for the Sale of Carbon Certificates:** taking into account the estimate of gases of hothouse effect that the project can emit and the estimate of gases of hothouse effect that the project and its components can displace or capture.
 - **Relationship of the project with other projects that determine environmental benefits,** as: Mitigation of Gases of Hothouse Effect and/or Increment in areas for deposits of Carbon, Increment of forest areas, Meso-American Biological Corridor, agriculture by irrigation, fishing, tourism, development of the area, among others.

During the execution of the EsIA, the consulting company to be hired will support CEL in the realization of the necessary consultations and of the explanations of the project to those affected, to the involved entities, to the authorities of the municipalities of influence of the project and the non-governmental organizations of the area, according to that required by the Environment Law; in such way that the project doesn't have relevant objections that can negatively influence in its development.

6.7 ANALYSIS OF BIOPHYSIC ENVIRONMENT

(Establishment of Base Line)

Physical Environment:

- a) Hydric Resources: hydrology, uses and quality of surface and underground waters (important sources of pollutants).
- b) Limnologic aspects: water temperature, quantity of oxygen, type of repelled gases, thickness and visual surface, nutritious content, mineral content, cleaning of the waters, productivity of the species, wealth and variety of the plants and aquatic animals, tróficas relations and the eutrofización degree.
- c) Atmospheric resources: local meteorology with emphasis in evaporation processes and evapo-transpiration, distribution of rain-falls (daily and

annual), winds, air humidity, temperature, duration of the days, atmospheric pressure, solar radiation and precipitation, noise levels.

- d) Regional Hydrology: configuration of drainages, oscillation in water levels, overflow, quantity of water in disposition, speed of water in the channel, reception volume, gulches and tributary rivers, formation of sedimentary layers, type of aquatic surface that originates, quantity and quality of flooded surface, level differences between the regulated part in the course of the river and the not regulated one.
- e) Morphology of the aquatic riverbeds: surface type adapted for drainages, depth and shape of the sub-aquatic lands.
- f) Land resources: Formation of new channels (meandering of a stream); Erosion (in margins and bottom of the tributary rivers); localization of blooming of geothermal energy.
- g) Sedimentological aspects: considering, the sedimentation itself, distribution of sediments in reception basins, movement of the waters in the existent areas, under the current layers, modifications experienced by the arrival areas, especially erosion, modifications suffered by the deltas due to the haulage loss, pressure or push.
- h) Soils: pedologic classification, capacity of use of lands.
- i) Geologic and geotechnical aspects (description and location of tectonic failures in the region).
- j) Tectonic aspects: possibility of seismic movements, possible displacement in the base of the dike, weight exercised by retained waters, weight of the dike.

As much as possible this characterization shall be made based on secondary or available information and if necessary activities of field sampling or specific studies shall be made.

Biotic Environment:

- a) Aquatic resources: fish farming, aquatic biology and benthos of courses or deposits of superficial water affected by the project.
- b) Land resources (biotics): existent biological systems, protected and/or fragile areas, migratory routes (to consider the meso-american biological corridor), with indication of florist composition and general fauna, determination of the existence of species declared in danger of extinction. For the quantification of the flora and fauna, the necessary field samplings shall be made.

In general, properly justified sampling campaigns shall be made in case that information doesn't exist or that it is not complete, distributed in dry and rainy seasons.

Human Environment:

- a) Socio-demographic aspects: population, health and education levels, type and employment level, and patterns of revenues.

- b) Services and infrastructure (water supply, health, education, energy, communication, etc.)
- c) Economic aspects: Current land use, basis of local economy (importance of each one of the different branches of the economy), distribution of revenues, current and projected development activities.
- d) Socio-cultural aspects: Community structures, rooting, customs, historical or archaeological resources, attitudes and concerns of affected human groups.
- e) Public health aspects (description of current situation): existence and frequency of illnesses, accidents and risks; people's vulnerability, environmental factors that impact in illnesses, facilities and capacity of the services and infrastructure to assist the demand of health, rural attention of health.
- f) Aesthetics: Special landscape values.

To achieve the objectives of the EsIA and the requirements of CEL on this regard, the Additional Studies according to that previously detailed in "IMPORTANT CONSIDERATION" shall be developed.

During the execution of the EsIA, the consulting company to be hired will support CEL in the realization of the necessary consultations and of the explanations of the project to those affected, to the involved entities, to the authorities of the municipalities of influence of the project and the non-governmental organizations of the area, according to that required by the Environment Law; in such way that the project doesn't have relevant objections that can negatively influence in its development.

6.8 Development Phases of the Project:

Main activities to develop in each stage of the Project.

List and brief description of the activities that will be carried out in the execution of the project: preparation of the site, construction and operation; and only for the temporary components (used to execute the construction of the project) the activities of abandonment shall be described.

Also, due to the characteristics of the project, for the alternative that is selected it shall be necessary to incorporate the design of the work, and the above described activities with all possible detail, regarding to:

- Dam, basic characteristics, parts that conform it and constructive systems.
- Spillway.
- Machines turbines room, generators, transformers
- Transmission substation.
- Line (s) of transmission.
- Access roads: temporary and permanent.

- Reservoir, geometric characteristics and operation model (levels, discharges, minimum flow, etc.).
- Camp-yard: temporary and permanent.
- Works for the relocation and compensation of population conductive of water, etc.
- Load tunnels.
- Discharge channels, etc.
- Complementary works: roads, utilities, offices, warehouses, workshops.
- Places and works for human resettlement, and others.

6.9 Benefit – Cost Analysis.

Interpretation of results of the benefit-cost analysis, profitability and efficiency, considering technical, economic and environmental factors. The results obtained in the pre-feasibility study shall be analyzed in deeper way, therefore the considerations made in the section of the technical analysis of this document shall be evaluated.

The results obtained in other studies related with the environment, focused to quantify the economic benefits of increment in natural resources and biophysical environment, as mitigation of hothouse effect, goods generated in national bills by environmental services, among others, shall be incorporated.

6.10 Evaluation of Environmental Impacts

A. Identification of Environmental Impacts.

Identification of positive environmental and negatives impacts derived of the interaction between the components (activities of the project) and their natural environment (environmental factors).

The identification of impacts shall be made at potential level, this means, analyzing from the qualitative point of view the possibility of occurrence of relevant changes in the different environmental factors.

This stage shall be made with full and active participation of the complete interdisciplinary team of professionals, respecting the specialty of each one, and the uncertain impacts shall be additionally listed, since in the following stages of the EsIA they will be evaluated and sieved, by the same specialists.

Since the identification of impacts is the product of the interaction between an action of the project (to impact potentially) and an environmental factor (potentially to be impact), this is the basis of an interaction matrix and identification of impacts, methods of identification of impacts can be used as: questionnaires, check list, compared scenarios, overlapping of maps or other methods proposed by the experts.

The importance of the impacts in front of the norms and environmental criteria established in the Environment Law and other applicable regulations to the Project shall be considered.

B. Assessment of Environmental Impacts.

To evaluate (calculation of the magnitude and significancy of the impacts) and to prioritize the potential environmental impacts of the different construction, operation and maintenance activities of the projected hydroelectric power station, and of the other activities and complementary works. As well as the closing of the temporary activities (necessary to execute the construction: temporary camp, disposition of sewage and other waste, borrow sites, etc.) and the environmental restoration at the site, allowing the determination of the total effect of the impacts for each evaluated component (alternative), as well as the determination of environmentally sensitive areas.

To predict and evaluate the behavior of each identified impact, through time and space, this means, to anticipate to the changes that each environmental component would experience if the project or each one of the components (alternative) is carried out, in such way of defining with the highest certainty if the significant impacts are direct, indirect, positive or negative.

Mathematical models, quali-quantitative matrix, cartographic systems, experts' judgments or others proposed by the specialists can be used, and to apply criteria that consider at least the magnitude, importance, extension, duration, reversibility, accumulation, and others that should be considered in the specialists' opinion.

The evaluation shall be made quantitative whenever it is possible, except for the case of intangible impacts or in critical cases, when the impact is tangible, but it is necessary to make it in qualitative terms, therefore rigorous technical and quantitative and qualitative methods shall be used.

To achieve an appropriate prediction and evaluation of impacts, knowledge, specific studies and/or technical and simulation tools are required, in example:

- Models of behavior of water quality for dam, at the reservoir and downstream.
- Effects on aquatic life.
- Models of quality of life that include economic, social and physical indicators that determines it to establish impacts on social environment; public participation and social investigation techniques are indispensable.
- Effects on health. This task shall consider the following probable impacts: changes in epidemiology of the direct influence area, changes in quality of neighboring residents' life.
- Impacts on the hydric resources: regimen change, auto-depuration, eutrofización, thermal stratification, discharge of the generation flows or

other, in function of the characteristics of the project and other projects down-stream.

- Impacts on the atmospheric resources: changes in the micro-weather, contamination by emanation of gases.
- Impacts on the levels of noise: noise contamination due to the construction and operation of the power station.
- Impacts on the land resources: induced seismicity, desestabilization of hillsides and margins, others.
- Impacts on the ecological resources: direct loss of the habitat, substitution of species in existent communities, invasion of areas cleared by other species aloctonas to the area, effects to short and long term on the biota (positive and negative).
- Socioeconomic impacts: appropriation of lands and use changes, affectation of uses of the water, changes in the economy and social conditions (morbidity, education, employment levels and other), changes in the utilities, affectations in the communities (indigenous, if any), in their cultural and traditional values; affectations to those relocated.
- Impacts on the landscape and affection to the development of natural tourism.

The opinion of the neighbors affected by the project shall be considered during the valuation of the impacts, therefore interaction meetings which facilitate the process of taking of decision in proposed compensation measures shall be held.

6.11 Elaboration of the Program of Environmental Handling:

The Program of Environmental Handling is obtained (PMA) as a result of the analysis that is carried out through the environmental evaluation, which considers the following components:

- **Environmental measures:** It shall contain the function foreseen for each one of the proposed environmental measures (prevention, attenuation, compensation and correction, including the measures for the stage of abandonment of the temporary components explained above), accompanied by its pre-design, description, location, as well as the responsible to execute and of the supervision of the implementation of each one of them, accompanied by its variable subject to monitoring. The section of the Company or the responsible technician's position, of following-up the implementation of the measures and interaction with the MARN shall be indicated.
- **Monitoring:** It will be applied during the construction and operation stages and will have as objective to guarantee the efficiency of the implemented environmental measures. The frequency of the monitoring will be determined by the nature of the project.
- **The Flowchart of Application of Measures** will have as objective to foresee the execution and the implementation flowchart of each one of the

determined environmental measures. It will contain the pre-design, description, location, as well as the responsible to execute and of the supervision of the implementation of each one of the measures that will be carried out.

6.12 Amount of Investments of the Environmental Mitigation.

To indicate inside the Feasibility Study the results and/or environmental requirements in the construction, operation and maintenance of the projected hydroelectric power station, giving an estimate of the amounts of the necessary expenditures to implement each one of the proposed measures to prevent, attenuate or compensate the foreseen negative impacts, and the necessary costs so that they can be included in the technical, economic and financial study, in order to consider them for the selection and design of the components of the project and its viability.

6.13 Elaboration of the Program of Contingencies and Prevention of Accidents.

The necessity to elaborate the Plan of Prevention and Contingencies and its scope, shall be based in the contingencies and identified risks and the commands of the Environment Law (Art. 55) and the National Plan of Contingencies of the National Emergency Committee (COEN), with the purpose of responding to the emergencies and accidents with effectiveness, minimizing the damages to the community and the atmosphere. It shall contain as minimum:

- Definition of objectives and scope.
- Operative organization for the plan.
- Determination of the functions of the different levels, organisms and others involved.
- Formulation of the action plan
- Description of safety measures
- Information on the mechanisms and intervention measures and communication in cases of urgency.
- Determination of the techniques and control team.
- Formulation of a follow-up and evaluation system of the plan.
- Training program and mockeries.
- Design of the logistical information for the execution of the plan.
- Up-dating of the contingency measures.
- Types of reports to be submitted (relating to each contingency that happens).
- Database conformation for the plan.
- Cost estimation,
- Evaluation and revision.

6.14 Program of Closing and Abandonment.

Because the time of useful life of the project has been considered of 50 years, in this section it will only describe the environmental measures for re-adequacy of the places that were used to make temporary facilities in all the activities of the project (specifically in the execution of the construction).

6.15 Inter-institutional Coordination and Participation of those affected of the Non-Governmental Organizations (ONG's).

- To coordinate the works with the personnel of CEL, with the Technical, Economic and Financial Study, and with the necessary institutions.
- To obtain the points of view of the local ONG's and affected groups, and to keep records of the meetings and other activities, communications and comments, as well as of its disposition.
- The consulting company shall be responsible of incorporating the observations and requirements established in the revisions of the document of EsIA and in the Public Audiences.

6.16 Annexes.

To incorporate photographs, schemes, and any information that in opinion of the consulting team helps to expose the project and its interaction with the environment as components of the project and complementary works or parts, as well as the surrounding areas that are affected by the project (borrow areas, population, industrial or relevant developments, bodies or intervened sources of water, bibliography consulted etc.)

6.17 Operative aspects.

The Applicant or candidate to the execution of the EsIA will inform the following aspects, without being limited to:

- Operative organization that will adopt for the realization of the EsIA, attaching the respective flowcharts.
- Personal that will use for the development of each one of the activities of the EsIA, with indication of the time in man month and man hour. The respective CV sheets will be attached, including the number of "Registro de Prestadores de Servicios de Estudios Ambientales" of MARN (a multi-disciplinary team shall be conformed with professionals of known experience that cover the different specialties according to the nature of the Project and of the influence area).
- Duration of the EsIA and chronogram of activities of it, with indication of the duration and operational sequence of each activity, including the estimated time for revisions, public consultations and the inclusion of the observations and/or requirements.
- The Applicant's experience in similar studies, attaching those crowded respective.

MINISTERIO DE MEDIO AMBIENTE Y RECURSOS NATURALES

DIRECCION DE GESTIÓN AMBIENTAL

TERMS OF REFERENCE FOR THE ENVIRONMENTAL IMPACT ASSESSMENT OF LA HONDA HYDROELECTRIC PROJECT, LOCATED IN MORAZAN AND SAN MIGUEL DEPARTMENTS

1. BACKGROUND

El Salvador has three operating Hydroelectric Power Stations located on Lempa river. Cerrón Grande, , 5 de Noviembre and 15 de Septiembre, plus Guajoyo Hydroelectric Power station on Desague river, tributary of the same Lempa river, projects that almost represent 100% of the hydroelectric resource (388 MW) of the hydroelectric capacity installed in the country, considering that some hydroelectric mini-power stations exist.

At this moment, the **Comisión Ejecutiva Hidroeléctrica del Río Lempa -CEL** is executing the rehabilitations of 5 de Noviembre and Guajoyo Hydroelectric Power Stations, and is studying the re-powering of 5 de Noviembre and Cerrón Grande Hydroelectric Power Stations, with the purpose of increasing the hydroelectric energy generation capacity and in some cases the useful life; also, other hydroelectric potential projects have been studied on Lempa river as: Zapotillo, Paso del Oso, El Tigre, San Marcos and El Cimarrón.

Under this framework the MINISTRY ENVIRONMENT AND NATURAL RESOURCES (MARN), has received on September 9, 2000 from the Engineer Salvador Novellino in his quality of Acting Executive Director of CEL, the Environmental Form with the **basic information related to the "LA HONDA HYDROELECTRIC PROJECT"**, with the purpose of **beginning the procedure to obtain the Environmental Permission**.

The referred project is located on the Torola river channel, between the municipalities of San Antonio del Mosco, in San Miguel Department, San Isidro, Torola, El Rosario, Gualococti, Meanguera y Osicala, in Morazan Department, and it was pre-selected after that the Comisión Ejecutiva Hidroeléctrica del Río Lempa (CEL), during a period of 18 months (Dec/1997–Mar/1999), executed the **"Pre-Feasibility Study of the "Hydroelectric Complex Project on Torola River"**, which was developed in a 58 km section of Torola river in Salvadoran territory, to the North of the oriental area, which included eight (8) alternative of dam sites denominated: Las Cruces, Maroma, Las Mesas, Cerro Pando, Las Marias, La Honda, Carolina and El Chaparral; and additionally three of these sites with tunnel. As a result from the technical, economic, social and

environmental point of view, two alternatives were determined as more favorable and appropriate, to execute the feasibility study: La Honda Hydroelectric Project and El Chaparral Hydroelectric Project.

The study was developed in two phases: Phase 1A "Identification and sieved of alternatives", and Phase 1B "Evaluation and selection" and it consists of eight (8) appendixes, identified as Appendixes from "A" to "H". The "D" corresponds to "Environmental and Social Aspects", which has been determined should be considered as basis or beginning for the **Environmental Impact Assessment (EsIA)** in the feasibility stage of each one of the two pre-selected projects (sites).

The dam as been projected with the following characteristics:

Drainage area at the site	1,075.0 km ²
Average Annual Flow	43.2 m ³ /s
RESERVOIR	
♦ Maximum Normal Level	285.0 msnm
♦ Surface Area	11.57 km ²
♦ Minimum Level	257.5 msnm
♦ Surface Area	5.46 km ²
♦ Active Volume	228.65 MMC
♦ Dead Storage Volume	116.60 MMC
♦ Total Volume	345.25 MMC
DAM	
♦ Elevation of Crest	287.0 msnm
♦ Estimated Bottom of the Natural Channel of the River	202.3 msnm
♦ Expected Depth Excavation in River Channel	3.0 m
♦ Maximum Height	87.7 m
♦ Length of Crest	470 m
♦ Concrete Volume (1000 m ³)	808 x 10 ³
MACHINES ROOM	
♦ Discharge Elevation- Maximum Discharge Generation	206.7 msnm
♦ Maximum Fall	81.2 m
♦ Minimum Fall	53.7 m
♦ Estimated Losses of Fall	3.60 m
♦ Discharge Capacity	100 m ³ /s

◆ Nominal Net Fall
Installed Capacity

68.4 m
59.6

MW

2. TECHNICAL ANALYSIS

On November 3 of this year, an inspection was carried out by technicians of the Dirección de Gestión Ambiental, verifying that **LA HONDA HYDROELECTRIC PROJECT**, is planned in an area located inside the Lempa river basin, named Sub-basin Torola river, hydric body that is born in the territory of Honduras and flows toward El Salvador, it has an extension of 1,575 km² shared with the Republic of Honduras; of which 1,019 km² equivalent to 64.7% of the total correspond to El Salvador. The proposal was originated from the pre-feasibility analysis of the "Hydroelectric Complex Project on Torola river" and in the pre-feasibility stage, the dam site is located at 4 km from the city of San Antonio del Mosco (approximately at 13.4 km upstream of dam site of El Chaparral Hydroelectric Project, in San Miguel Department), at 45 Km from departmental capital San Miguel and at 135 Km from the capital San Salvador. All components of the project would be located in Salvadoran territory.

3. CONCLUSIONS

Due to the environmental conditions of the site and to the magnitude of the project, **the Holder shall present an environmental impacts assessment** with the purpose of:

- To build a tool that helps to decisions makers to consider the environmental viability of the project;
- To facilitate the determination of the most appropriate environmental measures, considering that for the success of the project its economic viability is fundamental, looking to design and outlining of environmental measures that prevent or mitigate the negative impacts and optimize the positive ones, to be caused for the same.
- To facilitate the economic comparison of the project and its alternatives, including in the exercise the economic valuation of the environmental impact and supportability of the project.

The study shall be elaborated following the specifications detailed ahead, but without being limited to the tasks described in the present terms of reference - TOR-, the additional studies or investigations necessary to supplement, to strengthen or to deepen in aspects that the EsIA requires and those specified by CEL.

4. ENVIRONMENTAL IMPACT ASSESSMENT

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The information required in these terms of reference shall contain a technical, analytic and integral focus of the components of the project; it should be concise and limited to the evaluation of environmental impacts -EIA - of the components of it. The main text shall concentrate on the results, conclusions and recommended actions.

The EsIA shall be able to satisfy the following criteria: to be understanding, flexible, to detect the relevant impacts generated by the proposed action, objective, to include the contribution of an interdisciplinary group of experts, to use evaluative technology, to use clear and well defined criteria, to allow the calculation of magnitude and significance of the negative environmental impacts, to allow the determination of the total effect of the impacts for each evaluated component (alternative).

It shall also detect environmentally sensitive areas, which will facilitate the determination of most appropriate environmental measures, considering that for the success of the project its economic viability is fundamental, which transforms it in sustainable action and facilitate the taking of decision for its execution by economic comparison of the project and its alternatives, including in the exercise the economic valuation of the environmental impact.

To achieve the objectives of the EIA, the requirements of the Environment Law and the requirements of CEL on this regard, the studies or additional investigations necessary to supplement, strengthen or deepen in aspects that it requires and those specified in Appendix D "Environmental and Social Aspects" of the Pre-feasibility Study, taking as basis the content of this Appendix and their annexes, shall be developed, but without being limited to the tasks described in these TOR.

It shall also incorporate the additional necessary studies, as the case of the Study of Eligibility for the Sale of Carbon Certificates, taking into account the estimate of gases of hothouse effect that the project can emit and the estimate of gases of hothouse effect that the project and its components can displace or capture.

The Holder shall present to the Ministry of Environment and Natural Resources, one original and two copies of the report, which will be used in the revision by the Dirección de Gestión Ambiental.

5. CONSULTING TEAM

The holder of the project SHALL hire a consulting company that is registered in the Registro de Prestadores de Servicios de Estudios Ambientales kept by this Ministry (or to register prior of signing the contract for this consulting), to

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coordinate and prepare the Environmental Impact Assessment; because the analysis of environmental impacts requires a multi and interdisciplinary analysis, it is required that this consulting company creates a team of professionals duly registered in the MARN, with training in the areas of the EsIA involved in the project. The coordinator or coordinators of the team shall have experience in the preparation of environmental evaluations for similar projects.

On the basis of the registration guidelines, it is noticed to the Holders of the project that the public officials which participates in any way in the application of the Environment Law, its Regulations or in the related with the environmental assessments, cannot participate directly or through third parties in the elaboration of studies.

6. CONTENTE OF THE ENVIRONMENTAL IMPACT ASSESSMENT DOCUMENT (EsIA)

6.1 Cover: Title and Authors. It shall contain the name of the study, Holder of the project and the name, signature and inscription number as natural person in the Registro de Prestadores of the coordinator of the study and of each one of the professionals participating in the elaboration of the study, according to the work area.

6.2 Table of Content.

6.3

Executive Summary. In a content not bigger than 20 pages, a summary of the work shall be made where the environmental analysis of the project is synthesized, linking its activities with the environment at the site, the environmental impacts to generate and the palliative measures to be incorporated during its execution.

6.4 Introduction. To describe the referential framework of the Study and of the project, accompanied by the objectives of the Study, Justification of the project (in the social, economic, regional, national, local, technical and environmental) which shall consider as minimum:

- Relationship of the project with the land use plans and with the existent regional and local development policies for the area.
- Identification, evaluation and priority of the potential significant environmental impacts to be caused by the several construction, operation and maintenance activities of the projected hydroelectric power station, and of other complementary activities and works.

- To incorporate in the Feasibility Study, the determination and proposal of the environmental measures necessary to be incorporated in the different stages of the project (construction, operation, maintenance and abandonment of the temporary components) of the projected hydroelectric power station, to prevent, correct, mitigate or compensate the significant negative environmental impacts.
- To propose a Environmental Handling Program –PMA-, with its monitoring program for the execution, control and follow-up of the environmental measures to be applied during the construction, operation and maintenance of the projected hydroelectric power station and the re-suitability of the sites at the closing of temporary activities.
- To incorporate the cost-benefit analysis of these environmental measures to the technical, economic and financial study, in order to be considered for the selection and design of the components of the project and its environmental and financial viability.
- To make a project proposal according to the affected communities, making in its preparation process the necessary local and regional social consultations, briefing the project to those affected, to both civil society as for local authorities, involved entities and to non-governmental organizations of the area; in such way that the project doesn't have relevant objections that can negatively influence in its development.

6.5 Environmental Law and Regulations Applicable to the Project.

The juridical interrelations of the project with laws, regulations and national, local and international technical standards which regulate its execution in each one of the activities incorporated in its development shall be determined, analyzing as minimum:

- The Environment Law, its General Regulation and other laws, regulations and normative that apply to the project.
- Those agreed with the Organism that finances the project, which can be: of the World Bank (WB), Japan International Cooperation Agency (JICA), Interamerican Development Bank (IDB), Central American Bank for Economic Integration (BCIE), etc.
- The international agreements ratified by the Government of El Salvador, related with the project.

6.6 Description of the Project and its Evaluated Alternatives

to) Description of the Project. To explain on what it consists and its scope, detailing future infrastructure that will be built and its area (m²) for each one of its components, with emphasis in the following aspects:

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- Design, construction and operation of the dam: basic characteristic, parts which conform it and construction systems.
- Design, creation and operation of the reservoir: geometric characteristic and operation model (levels, discharges, minimum flow, etc.)
- Design, construction and operation of the generation facilities: load tunnels, machines room, turbines, generators, transformers, substation, transmission lines, discharge channels, etc.
- Complementary works: roads, utilities, offices, warehouses, workshops, camp-yard, sites and works for human resettlement, and others.

Flow charts of the construction, operation and maintenance works shall be included, with schedule of all activities, assignment of personnel, required investments outside and in the site, years of useful life of the projected hydroelectric power station, etc.

Also, maps, schemes and drawings at appropriate scale to illustrate the project (Design, location, distribution, dimensions, etc.), works or complementary parts, as well as the surrounding areas that are affected by the project (borrow areas, population, industrial or relevant developments, bodies or intervened sources of water, etc.) shall be included.

- b) Project Area and Influence Area:** to delimit the project area and its direct and indirect influence evaluated area of the different components of the project.

Geographical and political location - administrative: cantons, municipalities and departments; to present localization of the land where the project is projected to be developed. To present figure supported in the cartographic sheets (1:50,000), indicating with its geographical coordinates, and in 1:10,000 scale, the location of the Project area (PA) and the Direct Influence Area (DIA) related with it, in a distance not less than 1000 m radial to the perimeter of the land.

The analysis shall take into account the information contained in the Pre-Feasibility Study and especially that of the Appendix D: "Environmental and Social Aspects"; and it shall supplement, up-date and take the information to a higher detail, mainly as for the direct influence area of **La Honda Hydroelectric Project**.

The Torola River basin has a total area of 1,575 km², shared with the Republic of Honduras, which is located between the latitudes 13° 42 ' and 14° 05 ' north and longitudes 87° 47 ' and 88° 29' west; the basin of **La Honda Hydroelectric Project** is located within this area, and according to

Appendix D it has an approximate area of 1,075 km², which represents 68.25% in relation to the total area of Torola River basin.

Considering the projected location for the hydroelectric dam, which will drain in the low part of Torola river and this immediately up-stream of the reservoir of the 15 de Septiembre Hydroelectric Power station in the river Lempa, the EsIA shall consider its influence on the low part of Torola river, the 15 de Septiembre hydroelectric power station and the river Lempa, down-stream, until the outlet to the sea; it shall also consider the influence that La Honda Hydroelectric Project, projected up-stream, will receive.

IMPORTANT CONSIDERATION:

The additional studies recommended in the Appendix D "Environmental and Social Aspects", and others that are considered necessary at that moment, to develop the different topics of the EsIA, are the following (but the consulting shall not be limited to them):

- ◆ **Investigation of the Socioeconomic Conditions and of the Community Development Necessities of Direct Affected Population:** to characterize the population to be affected, government institutions and non-governmental organizations of the area, demonstrating their participation in the consultation process that includes recommendations of compensation measures.
- ◆ **Identification of Potential Places for Resettlement of Residents,** considering the necessities of the residents, the facilities for utilities and basic services and width in the spaces, follow-up programs for affected population.
- ◆ **To identify Additional Necessities of Transportation Infrastructure** (i.e.: In substitution of altered places of the river used for people crossing and their goods, mainly cattle).
- ◆ **Coordination of Development of Infrastructure with the Necessities of Municipalities,** considering sustainable development with visualization of new sources of permanent work,
- ◆ **Location of temporary camp-yard** in places that benefits the development of the near populations.
- ◆ **Archaeological and Anthropological investigation (Study of the Archaeological Resources and Historical and Cultural Patrimony):** to carry out this investigation according to the recommendations, resolutions and requirements of the Dirección Nacional de Patrimonio Histórico y Cultural, of the Ministry of Education (Investigation and more detailed documentation, precise mapping and excavations). The recommendations, resolutions and requirements will be part of the present TOR.

- ◆ **To investigate on other sites of Importance:** to define current places used by the population for recreation, customs, fishing and possibility of eco-tourism development or other projects.
- ◆ **Investigation of the Land Fauna:** Seasonal monitoring or sampling to establish the presence and relative abundance mainly in the flood area, with emphasis in the significant species as indicative of environmental quality, establishing monitoring programs and actions for their protection
- ◆ **Investigation of Aquatic Fauna:** seasonal sampling of diversity and abundance in the area of the project with emphasis in the species used for feeding, indicating propagation programs and actions for their protection.
- ◆ **Investigation of the Quality of Water emphasizing in the variations of stationary sedimentation:** application of forecast computer models of the behavior of the contamination of water for the presence of the reservoir, the influence of the sedimentation in the useful life of it and the regulation of the flow and their impacts down-stream of the discharge. To continue the investigation started in the Pre-feasibility, to estimate the annual discharges of nutritious and organic material into the river and reservoir, and its stabilization necessities before entering to the reservoir of the 15 de Septiembre Dam, to quantify those poured and to develop appropriate models to determine the effects of such discharges and another type of contamination considering the modifications that Torola River will have when the project is carried out
- ◆ **Study of Risks and Contingencies.** Identification and determination of the activities that represent the possibility and probability of risks or threats for the population's health and the structure of ecosystems and other contingencies:
 - Identification of dangerous materials or substances that will be used during construction, operation and closing of operation stages.
 - possible failures during construction, operation and closing of operation stages.
 - The risk of the users of the Torola river, down-stream of the project, when water is discharged in peak hours, consequences of maximum flood, opening of gates and dike collapse.
- ◆ **Other Studies:**
 - **Study of Eligibility for the Sale of Carbon Certificates:** taking into account the estimate of gases of hothouse effect that the project can emit and the estimate of gases of hothouse effect that the project and its components can displace or capture.
 - **Relationship of the project with other projects that determine environmental benefits,** as: Mitigation of Gases of Hothouse Effect and/or Increment in areas for deposits of Carbon, Increment of forest areas, Meso-

American Biological Corridor, agriculture by irrigation, fishing, tourism, development of the area, among others.

During the execution of the EsIA, the consulting company to be hired will support CEL in the realization of the necessary consultations and of the explanations of the project to those affected, to the involved entities, to the authorities of the municipalities of influence of the project and the non-governmental organizations of the area, according to that required by the Environment Law; in such way that the project doesn't have relevant objections that can negatively influence in its development.

6.7 ANALYSIS OF BIOPHYSIC ENVIRONMENT

(Establishment of Base Line)

Physical Environment:

- a) Hydric Resources: hydrology, uses and quality of surface and underground waters (important sources of pollutants).
- b) Limnologic aspects: water temperature, quantity of oxygen, type of repelled gases, thickness and visual surface, nutritious content, mineral content, cleaning of the waters, productivity of the species, wealth and variety of the plants and aquatic animals, tróficas relations and the eutrofización degree.
- c) Atmospheric resources: local meteorology with emphasis in evaporation processes and evapo-transpiration, distribution of rain-falls (daily and annual), winds, air humidity, temperature, duration of the days, atmospheric pressure, solar radiation and precipitation, noise levels.
- d) Regional Hydrology: configuration of drainages, oscillation in water levels, overflow, quantity of water in disposition, speed of water in the channel, reception volume, gulches and tributary rivers, formation of sedimentary layers, type of aquatic surface that originates, quantity and quality of flooded surface, level differences between the regulated part in the course of the river and the not regulated one.
- e) Morphology of the aquatic riverbeds: surface type adapted for drainages, depth and shape of the sub-aquatic lands.
- f) Land resources: Formation of new channels (meandering of a stream); Erosion (in margins and bottom of the tributary rivers); localization of blooming of geothermal energy.
- g) Sedimentological aspects: considering, the sedimentation itself, distribution of sediments in reception basins, movement of the waters in the existent areas, under the current layers, modifications experienced by the arrival areas, especially erosion, modifications suffered by the deltas due to the haulage loss, pressure or push.
- h) Soils: pedologic classification, capacity of use of lands.

- i) Geologic and geotechnical aspects (description and location of tectonic failures in the region).
- j) Tectonic aspects: possibility of seismic movements, possible displacement in the base of the dike, weight exercised by retained waters, weight of the dike.

As much as possible this characterization shall be made based on secondary or available information and if necessary activities of field sampling or specific studies shall be made.

Biotic Environment:

- a) Aquatic resources: fish farming, aquatic biology and benthos of courses or deposits of superficial water affected by the project.
- b) Land resources (biotics): existent biological systems, protected and/or fragile areas, migratory routes (to consider the meso-american biological corridor), with indication of florist composition and general fauna, determination of the existence of species declared in danger of extinction. For the quantification of the flora and fauna, the necessary field samplings shall be made.

In general, properly justified sampling campaigns shall be made in case that information doesn't exist or that it is not complete, distributed in dry and rainy seasons.

Human Environment:

- a) Socio-demographic aspects: population, health and education levels, type and employment level, and patterns of revenues.
- b) Services and infrastructure (water supply, health, education, energy, communication, etc.)
- c) Economic aspects: Current land use, basis of local economy (importance of each one of the different branches of the economy), distribution of revenues, current and projected development activities.
- d) Socio-cultural aspects: Communitary structures, rooting, customs, historical or archaeological resources, attitudes and concerns of affected human groups.
- e) Public health aspects (description of current situation): existence and frequency of illnesses, accidents and risks; people's vulnerability, environmental factors that impact in illnesses, facilities and capacity of the services and infrastructure to assist the demand of health, rural attention of health.
- f) Aesthetics: Special landscape values.

To achieve the objectives of the EsIA and the requirements of CEL on this regard, the Additional Studies according to that previously detailed in "IMPORTANT CONSIDERATION" shall be developed.

During the execution of the EsIA, the consulting company to be hired will support CEL in the realization of the necessary consultations and of the explanations of the project to those affected, to the involved entities, to the authorities of the municipalities of influence of the project and the non-governmental organizations of the area, according to that required by the Environment Law; in such way that the project doesn't have relevant objections that can negatively influence in its development.

6.8 Development Phases of the Project:

Main activities to develop in each stage of the Project.

List and brief description of the activities that will be carried out in the execution of the project: preparation of the site, construction and operation; and only for the temporary components (used to execute the construction of the project) the activities of abandonment shall be described.

Also, due to the characteristics of the project, for the alternative that is selected it shall be necessary to incorporate the design of the work, and the above described activities with all possible detail, regarding to:

- Dam, basic characteristics, parts that conform it and constructive systems.
- Spillway.
- Machines turbines room, generators, transformers
- Transmission substation.
- Line (s) of transmission.
- Access roads: temporary and permanent.
- Reservoir, geometric characteristics and operation model (levels, discharges, minimum flow, etc.).
- Camp-yard: temporary and permanent.
- Works for the relocation and compensation of population conductive of water, etc.
- Load tunnels.
- Discharge channels, etc.
- Complementary works: roads, utilities, offices, warehouses, workshops.
- Places and works for human resettlement, and others.

6.9 Benefit - Cost Analysis.

Interpretation of results of the benefit-cost analysis, profitability and efficiency, considering technical, economic and environmental factors. The

results obtained in the pre-feasibility study shall be analyzed in deeper way, therefore the considerations made in the section of the technical analysis of this document shall be evaluated.

The results obtained in other studies related with the environment, focused to quantify the economic benefits of increment in natural resources and biophysical environment, as mitigation of hothouse effect, goods generated in national bills by environmental services, among others, shall be incorporated.

6.10 Evaluation of Environmental Impacts

A. Identification of Environmental Impacts.

Identification of positive environmental and negatives impacts derived of the interaction between the components (activities of the project) and their natural environment (environmental factors).

The identification of impacts shall be made at potential level, this means, analyzing from the qualitative point of view the possibility of occurrence of relevant changes in the different environmental factors.

This stage shall be made with full and active participation of the complete interdisciplinary team of professionals, respecting the specialty of each one, and the uncertain impacts shall be additionally listed, since in the following stages of the EsIA they will be evaluated and sieved, by the same specialists.

Since the identification of impacts is the product of the interaction between an action of the project (to impact potentially) and an environmental factor (potentially to be impact), this is the basis of an interaction matrix and identification of impacts, methods of identification of impacts can be used as: questionnaires, check list, compared scenarios, overlapping of maps or other methods proposed by the experts.

The importance of the impacts in front of the norms and environmental criteria established in the Environment Law and other applicable regulations to the Project shall be considered.

B. Assessment of Environmental Impacts.

To evaluate (calculation of the magnitude and significancy of the impacts) and to prioritize the potential environmental impacts of the different construction, operation and maintenance activities of the projected hydroelectric power station, and of the other activities and complementary works. As well as the closing of the temporary activities (necessary to execute the construction: temporary camp, disposition of sewage and other waste, borrow sites, etc.) and the environmental restoration at the site, allowing the

determination of the total effect of the impacts for each evaluated component (alternative), as well as the determination of environmentally sensitive areas.

To predict and evaluate the behavior of each identified impact, through time and space, this means, to anticipate to the changes that each environmental component would experience if the project or each one of the components (alternative) is carried out, in such way of defining with the highest certainty if the significant impacts are direct, indirect, positive or negative.

Mathematical models, quali-quantitative matrix, cartographic systems, experts' judgments or others proposed by the specialists can be used, and to apply criteria that consider at least the magnitude, importance, extension, duration, reversibility, accumulation, and others that should be considered in the specialists' opinion.

The evaluation shall be made quantitative whenever it is possible, except for the case of intangible impacts or in critical cases, when the impact is tangible, but it is necessary to make it in qualitative terms, therefore rigorous technical and quantitative and qualitative methods shall be used.

To achieve an appropriate prediction and evaluation of impacts, knowledge, specific studies and/or technical and simulation tools are required, in example:

- Models of behavior of water quality for dam, at the reservoir and downstream.
- Effects on aquatic life.
- Models of quality of life that include economic, social and physical indicators that determines it to establish impacts on social environment; public participation and social investigation techniques are indispensable.
- Effects on health. This task shall consider the following probable impacts: changes in epidemiology of the direct influence area, changes in quality of neighboring residents' life.
- Impacts on the hydric resources: regimen change, auto-depuration, eutrofización, thermal stratification, discharge of the generation flows or other, in function of the characteristics of the project and other projects down-stream.
- Impacts on the atmospheric resources: changes in the micro-weather, contamination by emanation of gases.
- Impacts on the levels of noise: noise contamination due to the construction and operation of the power station.
- Impacts on the land resources: induced seismicity, desestabilization of hillsides and margins, others.
- Impacts on the ecological resources: direct loss of the habitat, substitution of species in existent communities, invasion of areas cleared by other species aloctonas to the area, effects to short and long term on the biota (positive and negative).

- Socioeconomic impacts: appropriation of lands and use changes, affectation of uses of the water, changes in the economy and social conditions (morbidity, education, employment levels and other), changes in the utilities, affectations in the communities (indigenous, if any), in their cultural and traditional values; affectations to those relocated.
- Impacts on the landscape and affection to the development of natural tourism.

The opinion of the neighbors affected by the project shall be considered during the valuation of the impacts, therefore interaction meetings which facilitate the process of taking of decision in proposed compensation measures shall be held.

6.11 Elaboration of the Program of Environmental Handling:

The Program of Environmental Handling is obtained (PMA) as a result of the analysis that is carried out through the environmental evaluation, which considers the following components:

- **Environmental measures:** It shall contain the function foreseen for each one of the proposed environmental measures (prevention, attenuation, compensation and correction, including the measures for the stage of abandonment of the temporary components explained above), accompanied by its pre-design, description, location, as well as the responsible to execute and of the supervision of the implementation of each one of them, accompanied by its variable subject to monitoring. The section of the Company or the responsible technician's position, of following-up the implementation of the measures and interaction with the MARN shall be indicated.
- **Monitoring:** It will be applied during the construction and operation stages and will have as objective to guarantee the efficiency of the implemented environmental measures. The frequency of the monitoring will be determined by the nature of the project.
- **The Flowchart of Application of Measures** will have as objective to foresee the execution and the implementation flowchart of each one of the determined environmental measures. It will contain the pre-design, description, location, as well as the responsible to execute and of the supervision of the implementation of each one of the measures that will be carried out.

6.12 Amount of Investments of the Environmental Mitigation.

To indicate inside the Feasibility Study the results and/or environmental requirements in the construction, operation and maintenance of the projected hydroelectric power station, giving an estimate of the amounts of the necessary expenditures to implement each one of the proposed measures

to prevent, attenuate or compensate the foreseen negative impacts, and the necessary costs so that they can be included in the technical, economic and financial study, in order to consider them for the selection and design of the components of the project and its viability.

6.13 Elaboration of the Program of Contingencies and Prevention of Accidents.

The necessity to elaborate the Plan of Prevention and Contingencies and its scope, shall be based in the contingencies and identified risks and the commands of the Environment Law (Art. 55) and the National Plan of Contingencies of the National Emergency Committee (COEN), with the purpose of responding to the emergencies and accidents with effectiveness, minimizing the damages to the community and the atmosphere. It shall contain as minimum:

- Definition of objectives and scope.
- Operative organization for the plan.
- Determination of the functions of the different levels, organisms and others involved.
- Formulation of the action plan
- Description of safety measures
- Information on the mechanisms and intervention measures and communication in cases of urgency.
- Determination of the techniques and control team.
- Formulation of a follow-up and evaluation system of the plan.
- Training program and mockeries.
- Design of the logistical information for the execution of the plan.
- Up-dating of the contingency measures.
- Types of reports to be submitted (relating to each contingency that happens).
- Database conformation for the plan.
- Cost estimation,
- Evaluation and revision.

6.14 Program of Closing and Abandonment.

Because the time of useful life of the project has been considered of 50 years, in this section it will only describe the environmental measures for re-adequacy of the places that were used to make temporary facilities in all the activities of the project (specifically in the execution of the construction).

6.15 Inter-institutional Coordination and Participation of those affected of the Non-Governmental Organizations (ONG's).

- To coordinate the works with the personnel of CEL, with the Technical, Economic and Financial Study, and with the necessary institutions.

- To obtain the points of view of the local ONG's and affected groups, and to keep records of the meetings and other activities, communications and comments, as well as of its disposition.
- The consulting company shall be responsible of incorporating the observations and requirements established in the revisions of the document of EsIA and in the Public Audiences.

6.16 Annexes.

To incorporate photographs, schemes, and any information that in opinion of the consulting team helps to expose the project and its interaction with the environment as components of the project and complementary works or parts, as well as the surrounding areas that are affected by the project (borrow areas, population, industrial or relevant developments, bodies or intervened sources of water, bibliography consulted etc.)

6.17 Operative aspects.

The Applicant or candidate to the execution of the EsIA will inform the following aspects, without being limited to:

- Operative organization that will adopt for the realization of the EsIA, attaching the respective flowcharts.
- Personal that will use for the development of each one of the activities of the EsIA, with indication of the time in man month and man hour. The respective CV sheets will be attached, including the number of "Registro de Prestadores de Servicios de Estudios Ambientales" of MARN (a multi-disciplinary team shall be conformed with professionals of known experience that cover the different specialties according to the nature of the Project and of the influence area).
- Duration of the EsIA and chronogram of activities of it, with indication of the duration and operational sequence of each activity, including the estimated time for revisions, public consultations and the inclusion of the observations and/or requirements.
- The Applicant's experience in similar studies, attaching those crowded respective.