

## VII ENVIRONMENTAL FORECASTS AND EVALUATION OF ALTERNATIVES

Based on the information that allowed to analyze and describe the structure and function of the Regional Environmental System its Environmental Diagnosis (Chapter IV), the association of the ecosystem units identified with the project's activities (Chapter V), it is possible to know the current status of the natural elements and the pressure put on them by the population and their economic activities, in the region that involves the municipalities of San Juan Texhuacan, Mixtla de Altamirano and Zongolica – Veracruz.

Environmental factors such as the climate, the geologic substrate and the relief (geo-forms) form a dynamic complex that determines the stability or fragility of the terrestrial environments and the status of decisive elements developed therein such as the loss of land fertility, changes therein which may vary their current use conception and future potential, the vegetation and its direct influence on habitats, fauna composition, among other.

The Proyecto Hidroeléctrico Veracruz, will occupy an effective construction surface of 4.89 Ha, from a total of 243,758 m<sup>2</sup> (24.38 Ha) which is featured by the presence of predecessors of Mountain Mesophyll Forest, arboreal elements of gallery forest and riparian vegetation.

The major part of the impacts will be temporary and punctual, specially during the stages of site preparation and construction.

In general terms, the current scenario where the project will be developed will have environmental affectation degrees during its activities, which Electricidad de Golfo, S. de R.L. de C.V, shall prevent, mitigate or compensate through the implementation of the necessary measures to minimize the negative impacts which might be generated during the project works.

In the posing of the environmental forecasts (Table VII.1), the impacts of the works and activities (Table V.2 Chapter V) to be generated because of the Proyecto Hidroeléctrico Veracruz on the hierarchically arranged environmental factors and indicators (Table V.3. Chapter V) were considered, and which includes the construction of a dam with an approximate capacity of 200,000 m<sup>3</sup>; the construction of a conduction tunnel 2,790 m long and a "Portal" section with a surface of 9 m<sup>2</sup> with a transversal section 3.0 m width and 3.0 m height, that will cross in a straight line a hill; oscillation ditch 30 m height and an area of 60 m<sup>2</sup>, in circular section; water will be conducted through a steel pipeline with a diameter of 1.22 m which will be at pressure in an external ramp of about 2,300 m long, that initiates in the elevation 1347 masl in the tunnel's exit and will be placed throughout the Tepetzala ravine to the power house; the construction of the power house and of the substation that will receive the power generated, and lastly, the installation of the transmission line of a circuit 4.3 km long with which the link to the national electric network of CFE in the Zongolica substation will be made. The foregoing will also allow to compare changes in the current and future conditions motivated by the implementation of the project and in the surface to be occupied.

With an *ad hoc* methodology, the scenarios of these factors are quantified by virtue of the environmental quality expected with the project without the application of an Environmental

Handling Plan (PMA), with the PMA described in section VI.3 (Chapter VI), and the Capacity of such environmental factors to support the project. Herein below, the scope thereof is extended:

Forecast of the current scenario, without Project. It is de description of the current environment status, without the establishment of the project. For that the description developed in Chapter IV, the biotic and abiotic environment is taken into account, which is characterized because it presents predecessors of Mountain Mesophyll Forest, gallery forest arboreal elements and riparian vegetation, as well as a fauna of great regional meaning. The analysis of the structure and functionality of the environmental system, acknowledges that the region will invariably have modifications to its current conditions, but there will be of low magnitude, little perceptible given their local nature; however, in the project's property in particular it will result in a modification to its biotic components an to its relief due to the removal of superficial material above the lode seam, including the vegetation and land horizons in actions such as excavations, for example.

The water resource that will be utilized because of its volume, more that serving as contaminants receiver, has considered the ecologic consumption that at all times drips downstream from the dam, the monthly medium ecologic consumption will vary from 10% to 36% and lastly that the annual medium ecologic consumption represents between 20% and 29% of the annual medium income consumption of the dam. It will be important in this aspect to consider the time required to attain the total re-change of water in the interior, mostly regarding an open water corps, with a water storage capacity of 194,430 m<sup>3</sup> at NAMO, opens the possibility of the ecologic-social benefit of a water activity.

Forecast of the future scenario with project without PMA. A second scenario required considers the execution of the project without the application of the mitigation, prevention and compensation measures, based on the environmental responses that have been considered in the future, derived from the modifications caused by the project, in accordance with the models proposed by Canter, Gómez Orea y Conesa, among other authors.

Forecast of the future scenario with PMA. The last scenario includes the qualification of the alterations on the environmental factors and indicators, within the preparation, construction and operation stages of the project, under a strict compliance with preventive and mitigation measures, as well as the future scenario under the hypothesis of monitoring, restoration and/or compensation programs, as proposed in section VI.3 (Chapter VI).

Within the scenarios assessment, the impact's nature is taken into account. The capacity of supporting the project implies that it goes together with the efficient and supervised execution of the Environmental Handling Plan.

Then, the aspects to be assessed within the scenarios are defined:

Alteration factor degree. With this we will refer to the alteration degree of the natural conditions of each of the factors.

---

The evaluation quantitative levels will be:

High. Referred to those factors that are found with important or total environmental alterations.

Medium. With this term we will describe the moderate affectation where the main natural conditions of the environmental factors still prevail.

Low. With this the minimum and barely detectable affectations in the assessment will be indicated.

Inexistent. As inexistent will be considered the lack of any kind of alteration to the factors.

**TABLE VII.1. SCENARIOS FORECAST OF THE PROYECTO HIDROELÉCTRICO VERACRUZ**

ENVIRONMENTAL FACTOR	INDICATOR	FACTOR ALTERATION DEGREE		CAPACITY TO SUPPORT THE PROJECT
		Without PMA	With PMA	
<b>Terrestrial / aquatic vegetation</b>	Abundance	High	Low	Medium
	Composition	High	Low	Medium
	Dominance	High	Low	Medium
	In conservation status	High	Low	Medium
	Loss of fertile land	High	Medium	Medium
	Current use	Medium	Medium	Medium
	Potential sue	Medium	Low	High
<b>Land</b>	Erosion	High	Medium	Medium
	External drainage	High	Medium	Medium
	Stability of slopes	High	Medium	Medium
	Geo-forms	Medium	Low	Medium
	Dripping	High	Low	Medium
	Infiltration	High	Low	High
<b>Water</b>	Phreatic level	Medium	Medium	High
	Superficial water quality	Medium	Medium	Medium
	Underground water quality	Medium	Low	Medium
	Habitat	High	Medium	Medium

ENVIRONMENTAL FACTOR	INDICATOR	FACTOR ALTERATION DEGREE		CAPACITY TO SUPPORT THE PROJECT
		Without PMA	With PMA	
<b>Terrestrial / aquatic Fauna</b>	Abundance	High	Medium	Medium
	Trophic chains	Medium	Low	Medium
	Shifting	High	Low	Medium
	In conservation status	High	Low	Medium
<b>Atmosphere</b>	Gas emission	High	Medium	High
	Suspended particles	High	Medium	High
	Micro-climate	Medium	Medium	Medium
	Visibility	Medium	Low	High
<b>Landscape</b>	Noise	High	Medium	High
	Panoramic view	Medium	Low	Medium
	Naturalness	Medium	Low	Medium
	Traffic	Medium	Medium	Medium
	Demography	Medium	Medium	Medium
	Land use change	Medium	Medium	Medium
	Services demand	Medium	High	High
	Employment	Medium	High	High
<b>Socio-economic</b>	Local economy	Medium	High	High
	Transportation and communication service	Medium	Medium	High
	Safety	Medium	Medium	High
	Public Health	Medium	High	High

The scenario results favorable, among others, because of the following conclusions derived from the Regional Environmental Diagnosis (Chapter IV), and of the Influence Area Delimitation (Chapter V):

a) Due to its extension and nature, the project does not generate direct and indirect adverse environmental effects that negatively alter the functionality and charge capacity of the ecosystem present within the area of influence.

c) The majority of the negative impacts identified on the flora and fauna are susceptible of being diminished, also with the possibility of allowing activities associated to the reservoir works with potential of fish breeding utilization, triggering a benefit which is not only ecological but also social.

d) The effects on the employment, local economy, services, public safety and health, even though they are focused on the labor population, also have consequences on the regional scope of the municipalities of San Juan Texhuacan, Mixtla de Altamirano and Zongolica – Veracruz.

In this regard, the location area will be constructed on a zone partially modified by activities developed by the inhabitants of the region, transforming the natural vegetation into cultural vegetation, specially with irrigation cultivations that increase their productive instability. The group of works corresponding to the Proyecto Hidroeléctrico Veracruz to be constructed within the municipalities of Zongolica mainly, it is not comparable to other great hydroelectric projects of the country, but it still is a regional and local important project that deserves that its construction is careful with the surroundings it intends to utilize.

Considering the analysis of the preceding forecast, a follow-up and assessment of the critical impacts affecting the environmental factors with greater value program shall be executed.

#### Monitoring program

In response to the need to control the changes expected to be generated due to the project's preparation, construction and operation activities on the physical, biotic and socio-economic factors, parallel to the execution of the Environmental Handling Plan, specific monitoring programs must be implemented for the hierarchically arranged environmental factors, in compliance with the relevant Mexican environmental regulations and the maximum permissible limits thereby.

### **VII.2.1 General Program of Environmental Surveillance**

- **Purposes**

To establish the general environmental surveillance guidelines to be supervised by the corporation Electricidad de Golfo, S. de R.L. de C.V and the competent authorities, such as the Procuraduría Federal de Protección al Ambiente, or the Secretaría de Salud y Trabajo y Previsión Social in strict observance of the rulings issued in respect to the project, and of the Laws, Rules and Mexican Official Standards applicable in respect to environmental, hygiene and safety matters.

- **Variables and Measures**

In accordance with the environmental conditions established by the environmental authorities through their ruling, the ones proposed in this document in respect to the Environmental Diagnosis, the expected scenarios, the Environmental Handling Plan and

in compliance with the Mexican Official Standards applicable both in the construction and operation stage.

- **Measuring procedures and techniques**

The ones admissible in accordance with the Mexican Official Standards applicable both in the construction and operation stage of the Proyecto Hidroeléctrico Veracruz.

Integration of an environmental surveillance committee, which keeps constant supervision on the compliance with the conditions established by the competent authority

- **Logistic and infrastructure**

In respect to what is established for the supervision of the work between Electricidad de Golfo, S. de R.L. de C.V and the competent authorities, such as the Procuraduría Federal de Protección al Ambiente, or the Secretaría de Salud y Trabajo y Previsión Social, and when it requires the citizen participation.

- **Sampling calendar**

In compliance with what is established by Electricidad de Golfo, S. de R.L. de C.V and the competent authorities, and the frequency of monitoring that due to the sample nature, kind and variable is determined within the time scheduling of the project's works and/or activities.

- **Person responsible for the sampling**

The person responsible will be specialized personnel of the environmental handling area of Electricidad de Golfo, S. de R.L.

- **Action procedures when the permissible values are exceeded**

For the interpretation and use of the monitoring results, the parameters established in the Laws, Regulations and Mexican Official Standards applicable in respect to environmental and hygiene and safety matters will be taken into account.

Effectuate a review on the preventive measures to determine the cause-effect of the variation in the expected values and put in place the necessary modifications in the mitigation measures.

## **VII.2.2 Fauna and flora with protection status monitoring program**

- **Purposes**

Overview the compliance with the Environmental Handling Plan in respect to the region's flora and fauna considered in any status of the NOM-059-SEMARNAT-1994, as well as the ecologic associations related to the exchange of materials and power among the

terrestrial-aquatic environments, in order to adopt the adequate actions to hinder and decrease unbalances in the water flow that cause problems with the stability of the premises and the correct development of the hydroelectric project.

- **Variables and Measures**

In accordance with the NOM-059-SEMARNAT-1994, priority will be given to the identification and protection of the species considered as threatened, or endangered. The number of findings of vegetal and animal specimens (hurt or death, in this last case) will be recorded. Lectures to the personnel will be scheduled in the site preparation stage, on the identification and importance of vegetal or animal species considered of protection, and the record and acting mechanism.

- **Measuring procedures and techniques**

Findings record and history on the relevant action formats

Personnel training, through illustrative cards

Directory of contacts in respect to ecologic investigation (flora and fauna) upon the eventuality of an encounter.

- **Logistic and infrastructure**

For the monitoring of fauna and flora with the protection status, the information contained in the ETJ, this MIA, and local and regional investigation researches will be considered. Likewise, before initiating the activities the personnel, contractors and sub-contracts training shall be reinforced.

- **Sampling calendar**

The sampling calendar will be established based on the project's activities, and the Environmental Handling Plan proposed

- **Person responsible for the sampling**

The persons responsible for the monitoring comprises the supervision of Electricidad de Golfo, S. de R.L. de C.V, contractors and sub-contractors.

Integration of an environmental surveillance committee, that keeps a constant supervision on the compliance with the conditions established by the competent authority

- **Action procedures when the permissible values are exceeded**

A directory of investigation devoted to the capture, protection and ecologic conservation (flora and fauna) within the State of Veracruz shall be provided for.

In case of accidental debris or affectation to the vegetation, it shall be informed and recorded in the formats in order to initiate restoration and/or compensation actions.

### **VII.3 Conclusions**

Based on the project's integral evaluation, it is acknowledged that its implementation is recommendable in respect to the cost-benefit it represents. The foregoing is based on the fact that the area on which it is intended to be developed has been impacted by antique activities; while currently the main deterioration activity is due to the lack of economic development options. Evidently, the generation of electric power utilizing the natural kinetic of an hydric course as important as the Apatlahuaya river, represents an advance in favor of the development of the human populations that will use the service, from the immediate ones to the medium and long terms, and from the direct to the indirect ones.

For the scenario with project, the quality of the environmental system indicates that the components and variables that will present a major impact are vegetation, land use and water; while in the socio-economic component the impacts will be beneficial with the project, improving the regional socio-economic condition due to the importance in the rendering of the hydroelectric service. The scenario with project proposes that the mitigation measures contemplated are sufficient to exclude, minimize, rectify and/or compensate the identified and assessed impacts, with which the impacts caused by the project are counteracted and it is avoided that the biological processes suffer any deterioration.

When the project is being operated at its full capacity and the measures identified in this research are being applied, which are proposed for the prevention and mitigation of the environmental impacts to be generated, it can be established that the impact posed modifies the chronic character of the activities that have been performed in the property, because the burnings of the natural vegetation are interrupted, as well as the agribusiness activities and the extraction of materials and wood.

In conclusion, the project will not affect the ecosystem's self-regulation and stabilization capacity, therefore, it is ecologically respectful and environmentally feasible within the framework of a local sustainable development, generating and maintaining a local, regional and national economic distribution, as a result of the hydroelectric functioning by satisfying the expectations posed with the national and state of Veracruz development plans in effect.

The operations do not imply great headings in the alteration of the ecologic balance and/or contributions of emissions or pouring that can exceed the maximum permissible limits and, in all cases, in the different project's actions no relevant residual impacts were identified and the negative impacts identified, in their majority, are totally susceptible of being mitigated, through preventive, mitigation and/or compensation practices.

## VII.4 Bibliography

1. **“AN INTRODUCTORY GUIDE TO EIA”** Wathern, P. 1994. en Wathern, P. Environmental Impact Assessment: theory and practice. Routledge. pp.3-30.
2. **“ATLAS NACIONAL DE MÉXICO”**, Instituto de Geografía, UNAM.1990.
3. **“BROMELIACEAS”** Adolfo Espejo-Serna, Ana Rosa López-Ferrari & Ivón Ramírez-Morillo. Flora de Veracruz, fascículo 136 diciembre de 2005.
4. **“CONABIO SIERRA DE ZONGOLICA”** Especies de aves clave de la AICA C-20
5. **“CURSO BÁSICO DE INGENIERÍA DE PRESAS”** Comisión Nacional del Agua, Subdirección General Técnica, Gerencia del Consultivo Técnico, Ing. Macario Vega Pérez.
6. **“DESARROLLO DE LA ZONA ECOTURISTICA “LA QUINTA”. CONGREGACIÓN DE AMATITLA, ZONGOLICA, VERACRUZ”** Oliva, Héctor et al. 2005. Primer Congreso Internacional de casos exitosos de Desarrollo Sostenible del Trópico. Boca del Río, VER. México.
7. **“DIPLOMADO EN SISTEMA DE CONTROL DE RESIDUOS MUNICIPALES”**, Memorias del Diplomado impartido por la División de Educación Continua de la Facultad de Ingeniería, UNAM.1995.
8. **“ESTADÍSTICAS CLIMATOLÓGICAS BÁSICAS DEL ESTADO DE VERACRUZ” (PERIODO 1961-2003)** Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, Centro de Investigación Nacional del Golfo, sitio experimental Xalapa, Veracruz México, mayo de 2006.
9. **“ESTUDIOS REGIONALES PARA LA PLANEACIÓN”** Información Básica Región VII Las Montañas Gobierno de Veracruz.
10. **“ESTABLECIMIENTO DE PRIORIDADES PARA LA CONSERVACIÓN DE MAMÍFEROS TERRESTRES NEOTROPICALES DE MÉXICO”** Junio- 2008 Mastozoología Neotropical ISSN 0327-9383 *versión impresa* Gabriela García-Marmolejo, Tania Escalante y Juan J. Morrone.
11. **“ENVIRONMENTAL IMPACT ASSESSMENT”** Canter, L. 1996. Mc-Graw-Hill.
12. **“EVALUACIÓN DEL IMPACTO AMBIENTAL”**, Memorias del curso impartido por la División de Educación Continua de la Facultad de Ingeniería, UNAM.
13. **“EVALUACIÓN DE IMPACTO AMBIENTAL”** Gómez Orea, D. 1988. IRYDA. Madrid, España. 704 p.
14. **“FLORA DE VERACRUZ”** 1983 fascículo 31 Sosa, V y A. Gómez Pompa. Lista Florística. Investigadoras: V. Sosa y A. Gómez Pompa. No 82. Instituto de Ecología A.C Xalapa.

15. **"FLORA ÚTIL DEL MUNICIPIO DE ASTACINGA, VERACRUZ. POLIBOTÁNICA"** Navarro, Luz del Carmen y Sergio Avendaño. 2002., Noviembre No 14. IPN. Pp 67-84
16. **"GUÍA DE MAMÍFEROS DE MÉXICO"**, Pulido J.R., Britton M.C., Perdomo A. y Castro A., Universidad Autónoma Metropolitana, 1983.
17. **"GUÍA METODOLÓGICA PARA LA EVALUACIÓN DEL IMPACTO AMBIENTAL"**, V. Conesa Fernández y Vitora, Ediciones Mundi-Prensa, 1997.
18. **"GUÍA METODOLÓGICA PARA LA EVALUACIÓN DE IMPACTO AMBIENTAL"** Conesa, Vicente. 2003. Ediciones Mundi-Prensa. Tercera Edición.
19. **"GUÍA NORTEAMERICANA DE RESPUESTA EN CASO DE EMERGENCIA, 2004"**, Departamento de transportes de Estados Unidos, Administración de Estudios y Programas Especiales; Transporte de Canadá, Seguridad Materiales Peligrosos; Secretaria de Comunicación y Transporte.
20. **"IMPACTO AMBIENTAL"**, Vázquez A., Cesar E., IMTA-UNAM. 1994.
21. **"IMPACTO AMBIENTAL DE JAULAS FLOTANTES: ESTADO ACTUAL DE CONOCIMIENTOS Y CONCLUSIONES PRÁCTICAS"** L. Molina Domínguez y J. M. Vergara Martín BOLETÍN. INSTITUTO ESPAÑOL DE OCEANOGRAFÍA ISSN: 0074-0195 © Instituto Español de Oceanografía, 2005.
22. **"INGENIERÍA AMBIENTAL"**, Gerard Kiely; Editorial Mc. Graw Hill, 1999
23. **"INSTITUTO NACIONAL DE INVESTIGACIONES SOBRE RECURSOS BIÓTICOS INIREB"** Narave, H.V. 1983. Juglandaceae. (31). Xalapa, Veracruz, México.
24. **"INTEGRATED WATERSHED MANAGEMENT"** Heathcote, Isobel 1998. John Wiley & Sons, Inc. Canada. pp 414.
25. **"INTERNATIONAL JOURNAL OF GEOGRAPHICAL INFORMATION SCIENCE"** Bojórquez-Tapia, L.A., S. Díaz Mondragón y E. Escurra, 2001. GIS-based approach for participatory decision making and land suitability assessment. (15) 2: 129 – 151.
26. **"LA CONTAMINACIÓN Y SUS EFECTOS EN LA SALUD Y EL AMBIENTE"**, Julio Flores, Sergio López y Lilia Albert, Centro de Ecología y Desarrollo.
27. **"LA VEGETACIÓN DE MÉXICO"** Rzedowski, J. 1978. Editorial Limusa, México. DF. Pág.- 432
28. **"LEY GENERAL DE EQUILIBRIO ECOLÓGICO Y LA PROTECCIÓN AL AMBIENTE"**, Secretaría de Desarrollo Urbano y Ecología.
29. **"LEY DEL EQUILIBRIO ECOLÓGICO Y PROTECCIÓN AL AMBIENTE DEL ESTADO DE MICHOACÁN"**. Publicado en el Diario Oficial del Estado el 13 de abril del 2000.
30. **"LIBRO DE CONSULTA PARA LA EVALUACIÓN AMBIENTAL"** Banco Mundial. 1991. Vol I. Políticas, procedimientos y problemas intersectoriales. Departamento de Medio Ambiente. Trabajo técnico 139. Washington, D.C.

31. **“LOS TIPOS DE VEGETACIÓN DE MÉXICO Y SU CLASIFICACIÓN”** Miranda, F y Hernández, X. E. 1963. Bol. Soc. Bot. Méx., núm. 28, pp. 28-79.
32. **“MANUAL DE CONSERVACIÓN DEL SUELO Y DEL AGUA”**. Editado por la SARH-CP. Chapingo México, 1977
33. **“MANUAL DE DISEÑO DE OBRAS CIVILES”**, Instituto de Investigaciones Eléctricas, Comisión Federal de Electricidad.
34. **“MANUAL DE EVALUACIÓN DE IMPACTO AMBIENTAL”** Técnico para la elaboración de los estudios de impacto; Larry W. Canter; Segunda Edición Mc Graw Hill
35. **“MANUAL DE RENDIMIENTO DE LOS PRODUCTOS CATERPILLAR”**, CAT, Illinois E.U.A.1980.
36. **“MEDIDA Y CONTROL DE RUIDO”**, Juan Ochoa Pérez y Fernando Bolaños, Colección Productiva, Editorial Marcombo, 1990.
37. **“MODIFICACIONES AL SISTEMA DE CLASIFICACIÓN CLIMÁTICA DE KÖPPEN”**, Enriqueta García, México 1988.
38. **“NORMATIVAS SECRETARIA DE COMUNICACIONES Y TRANSPORTES”** última actualización 21 de noviembre del 2006.
39. **“PLAN PUEBLA-PANAMÁ (2001)”** Presidencia de la República. México,
40. **“PROGRAMA NACIONAL DE ATENCIÓN A REGIONES PRIORITARIAS”** SAGAR, SCT, SEDESOL, et. al. (1999). SAGAR, SCT, SEDESOL, SEMARNAP, Sector Agrario, SEP, SECOFI, SSA. México
41. **“TAXONES DEL BOSQUE MESÓFILO DE MONTAÑA DE LA SIERRA MADRE ORIENTAL INCLUIDOS EN LA NORMA OFICIAL MEXICANA”**. Luna Vega, M. I. 2003. Juglans pyriformis. Herbario FCME, Universidad Nacional Autónoma de México. México. D.F.
42. **“VEGETACIÓN Y FLORA VASCULAR ACUÁTICA DEL ESTADO DE VERACRUZ”** Lot, H. A. 1991. Tesis de Doctorado, Facultad de Ciencias, UNAM. 217pp.
43. **“XII CENSO GENERAL DE POBLACIÓN Y VIVIENDA 2000”**, Instituto Nacional de Estadística, Geografía e Informática.
44. **XIII CENSO GENERAL DE POBLACIÓN Y VIVIENDA 2005”** “Resultados preliminares, Instituto Nacional de Estadística, Geográfica e Informática.