

II. OF THE WORKS OR ACTIVITIES AND, AS THE CASE MAY BE, OF THE PARTIAL DEVELOPMENT PROGRAMS OR PLANS

II.1 *Projects' general information*

II.1.1 Project's nature.

The project consists in a group of works that will allow the impounding, conduction, utilization and discharge of water for the generation of electric power with self-supply purposes. Therefore, the construction of a small dam with an approximate useful capacity of fifty thousand cubic meters is being considered, which will impound the drippings of the Apatlahuaya river.

Therefore, the project is included within article 5 of the regulation of the Environmental Protection Law (*Ley General del Equilibrio Ecológico y la Protección al Ambiente*) in respect to environmental impact, sections:

- A) Hydraulic: a storage dam will be constructed with a capacity of 194,430 m³ at the Maximum Ordinary Water Level in the Dam (Maximum Ordinary Water Level in the Dam (NAMO)).
- K) Electric Industry: Construction of the hydroelectric plant, construction of electric substation and transmission line of simple circuit with a 4.3 km length.
- O) Land Use Changes of Forestall Areas, as well as Jungles and Arid Zones, without the elimination of vegetation both in the reservoir zone and in the location areas of the infrastructure proposed in the project are required.

The environmental impact statement is filed in the regional modality, under Article 11 of the regulation because it is an electricity power generation project that requires the construction of a dam and alters the hydrologic basin due to the storing of the resource.

A 30 m high gravity dam wall will be constructed from the location with top in the elevation 1,371 MASL located in the Apatlahuaya river bed, the elevation of which at the bottom of the river bed is 1,343 MASL; impounding work for the underground conduction with call canal at the elevation of 1350.50 located in the left margin of the river, 65 m upstream from the dam wall.

The conduction to the hydroelectric generation central, will be carried out through a horizontal tunnel excavated with a portal section 3.0 width and 3.0 m high, 2,790 m length and that will work at full section with low pressure; oscillation ditch 30 m high and an area of 60 m², in circular section; immediately after the tunnel, the water will be conducted through a steel tube which will be at external ramp pressure in a range of 2,300 m length, that initiates in the elevation 1347 MASL at the tunnel's exit and will be placed throughout the Tepetzala ravine until the power house the turbine horizontal axis of which is located at the elevation 584 MASL; the power house will include a Pelton turbine with a 42 MW generation capacity and finally, venting to the Zongolica river through an excavated canal in ground and rock.

Close to the power house a substation will be constructed, which will receive the power generated and it will be sent to the CFE Substation which is located in the Zongolica town, theretofore at the same time a simple circuit transmission line and 4.3 km length, will be installed, with which the enlace will be made.

The projects' particular feature is that 2.5 km downstream from the intended reservoir the water goes to a sewer to come out later 2 km east in an air hole and small water fall. Water discharge from the power house will be made into a brook that joints the river, where water originally runs, with a distance between the fall and the river union of 5 km.

Based on the provisions contained in the Sustainable Forestall Development Law (*Sustainable Forestall Development Law (Ley General de Desarrollo Forestal Sustentable)*), the corporation Consultoría Forestal y Servicios Agropecuarios, S.A. de C.V. (COFOSA) represented by Ing. Juan Martín Hernández Arizmendi in his capacity as General Manager, performed the justification research for the forestall land use change in the lands that contain gallery forest, oak-pine forest, pine forest (renewals), and coffee with shadow trees, to use them for non-forestall activities that include the infrastructure proposed for the hydroelectric project. Such research is included in the relevant annex.

II.1.2 Justification and purposes

Purposes

To have a clean and low cost power supply through the construction and operation of a central for the hydroelectric generation with self-supply purposes.

To support, through private investment, the strengthening of the infrastructure for the generation, transformation and transmission of electric power, interconnecting the project's works with the Comision Federal de Electricidad's national distribution network.

Justification

Among the different socio-economic difficulties present both in the country and in the world, there are constant variations in the prices of supplies and materials, this causes that the producers of goods and services suffer the increase in their operation expenses and it echoes in the costs to the final consumers, which leads to the loss of profits and many times of the labor force. Likewise the accessible consumption and cost of electric power is necessary for almost all the productive sectors, situation that has concerned the Federation because of the gradual response capacity of the electric system against the accelerated increase to the demand, for which it has designed the power generation strategy with self-supply purposes, which allows to have another alternative to solve the limitations and support the industrial sector's development with low operation tariffs.

Since the self-supply alternative improves the industry's situation and competitiveness, the production of electric power invariably requires the utilization of supplies for the functioning of generating equipment, mainly using fossil fuel which require important investments in order to control the pollutant emissions, however, alternatives such as the hydroelectric generation exist which avoids in a great extent the problems due to the utilization of materials containing hydrocarbon and consequently reduces the operation costs.

Based on the foregoing, Mexico's physiography has sites that notwithstanding there are not ideal for the installation of huge hydroelectric plants such as the ones already operating within the country, they do allow the construction of mini-centrals with which benefits may be obtained through the water potential energy. This search of "clean" alternatives for the generation of electricity becomes more necessary and important each day, that is why the company Electricidad del Golfo, S. de R.L. de C.V. has devoted itself to project a generation central in a small scale, in order to take advantage of the natural resources without affecting great surfaces and without carrying out the relocation of communities, as it may normally happen in a hydroelectric project of great sizes.

This way, the intended performance of the Veracruz Hydroelectric Project will not only enable to obtain benefits for the consumer partners, but will also indirectly support the development of the several industrial and services sectors by complementing the country's electric infrastructure through private investment for its construction, with important savings for Comisión Federal de Electricidad with the energy supply. At the same time, the intended project promotes the utilization of "clean" equipment and technologies that avoid and decrease the generation of emissions into the atmosphere, in addition to being of permanent usefulness, only requiring maintenance and substitution of components activities to continue with its service.

It is important to mention that the project is well accepted by the State of Veracruz's government, as well as by the municipal authorities where it is intended to locate the works. To this effect, the necessary communications and meetings have been held in order to inform the works' characteristics, as well as the supports which Electricidad del Golfo is offering to maintain adequate cohabitation and balance among the works and the communities established there.

On the other hand, the necessary steps have been taken to handle the requirements of Comisión Federal de Electricidad on the trajectory and interconnection conditions for the transmission line and the relevant authorizations before this agency are being handled to carry out the works under the specifications required by the project.

The Veracruz Hydroelectric Project is visualized as a work that has goodness and characteristics that adjust to the regulations governing in the country, because when carrying out the planning processes, the necessary procedures are performed in order to face the conditions marked to that effect by the three governmental levels and before the owners of the properties with which the purchase and sale and easement transactions of the lands that will be necessary for the installation of the works, maintaining therewith a commitment and compliance policy.

II.1.3 Investment required

The estimated investment for the full performance of the works is of \$24,591,137.00 (Twenty Four Million Five Hundred Ninety One Thousand One Hundred Thirty Seven US Dollars) equal to a total of \$322,716,868.19 (Three Hundred Twenty Two Million Seven Hundred Sixteen Thousand Eight Hundred Sixty Eight Pesos, Mexican Currency), in accordance with the exchange rate of \$13.1233 Mexican Currency (Thirteen Pesos with One Thousand Two Hundred Thirty Three Ten-Thousandths, Mexican Currency) per one US dollar, dated October 22nd, 2008. The required investment is divided as follows:

TABLE II.1 CIVIL WORK BUDGETS

CONCEPT	AMOUNT (US Dollars)
Impounding Work	\$2,827,646
Intake Works	\$103,052
Conduction Work	\$17,398,118
Power House	\$3,494,499
Drain Off Canal	\$304,944
Substation	\$390,378
Edificiations for Engevix and Elec. del Golfo	\$72,500
TOTAL	\$24,591,137

While for the application of the mitigation measures, the budget breakdown in the following table is required:

TABLE II.2 MITIGATION MEASURES BUDGET

CONCEPT	QUANTITY	UNIT	UNITARY AMOUNT	AMOUNT INCLUDED WITHIN THE EXECUTIVE PROJECT	AMOUNT NOT INCLUDED WITHIN THE EXECUTIVE PROJECT
Acquisition 19-liter bottles of water of a known trademark for human consumption.	6200	Bottle	\$19.00	\$117,800.00	
Soil decontamination and remediation	27	m ³	\$5,000.00	\$110,000.00	\$25,000.00
Compensation payment regardless of the CUTF or in case trees are planted (at a ratio of 1,100 trees of native species per affected hectare)	16313	Tree	\$8.33		\$135,887.29
Impermeable area of 500 m ² the handling of fuels, minor maintenance, waste and lavatories.	6	Platform	\$5,000.00	\$30,000.00	
Portable austere lavatories	246	Sanitary	\$1,000.00	\$246,000.00	
Recollection of solid waste of municipal kind and final disposal	104	Trip	\$400.00	\$41,600.00	
Habilitation of temporary danger waste storehouse in accordance with the law in effect	1	Lot	\$6,000.00	\$6,000.00	
Recollection by the company authorized by SEMARNAT, of used lubricants and oils, tows and the relevant containers.	5	Trip	\$4,000.00	\$20,000.00	

CONCEPT	QUANTITY	UNIT	UNITARY AMOUNT	AMOUNT INCLUDED WITHIN THE EXECUTIVE PROJECT	AMOUNT NOT INCLUDED WITHIN THE EXECUTIVE PROJECT
Caution signals.	6	Lot	\$8,000.00	\$48,000.00	
Explosimeter.	2	Piece	\$50,000.00		\$100,000.00
Fire extinguishers.	20	Piece	\$700.00	\$14,000.00	
Oxygen meter.	2	Piece	\$15,000.00		\$30,000.00
Supply of water from the river to the towns of Palulca and Aticpac, Municipality of Texhuacán	1	Project	\$160,000.00		\$160,000.00
Construction of washing places for the Xala community, Municipality of Mixtla de Altamirano	1	Project	\$90,000.00		\$90,000.00
Adaptation of water system for the community of Xochitla	1	Project	\$220,000.00		\$220,000.00
Training regarding mitigation measures.	1	Course	\$3,000.00	\$3,000.00	
Training for the attention of emergencies	1	Course	\$3,000.00	\$3,000.00	
Training for the use of explosives and applicable security measures.	1	Course	\$3,000.00	\$3,000.00	
Supervision of control measures and mitigation of environmental impact.	24	Month	\$10,000.00	\$240,000.00	
TOTAL MEXICAN CURRENCY				\$722,400.00	\$800,252.00
TOTAL US DOLLAR				\$ 55,060.97	\$ 60,994.81

II.2 Projects' particular characteristics

II.2.1 Description of works and activities

II.2.1.1 Works and activities located outside the projects' jurisdiction

The project contemplates the following works outside the main projects' jurisdiction:

To carry water from the river to the towns of Palulca and Aticpac, Municipality of Texhuacán: These towns are closer to the impounding work site, both communities have less than 100 inhabitants, therefore, the necessary supply is of around of 20 m³/day.

It is planned to make an elevated storage in the side of the Soyayo hill, which may supply water by gravity to the communities. Water will be pumped from the impounding work receptacle to the storage tank taking advantage of the electric power that will be installed in the work in permanent form for the operation of the gates. From the tank pipelines will go

down to the towns carrying water by gravity, to be used by the people in hydrants distributed in several zones of the town.

Washing places for the community of Xala, Municipality of Mixtla de Altamirano. This town is closer to the municipal head, but it has no access road, which makes any construction action difficult, especially during the rain season. The town has public washing places the water supply of which is obtained from a water spring located above the town, and which conducts the water, by gravity, to a storage tank where it supplies the washing places.

Currently, both the washing places, and the tank, are in very bad condition, that is why the municipality requests the reposition thereof.

Water System for the community of Xochitla which is far away from the municipal head but has an access road thereto. It already has a water system which is pumped from the river to a storage tank where it is distributed to the town but this pumping system does not function adequately, therefore support will be provided for the diagnosis and solution so the system may operate adequately.

For the municipalities of Texhuacán and Mixtla the construction of a bridge above the bailer, so in the future, with the development of roads, it is possible to cross the river in a vehicle between the municipalities, because they currently do it through a pedestrian bridge near to the bottom of the river.

II.2.1.2 Works and activities located within the project's jurisdiction

The project will be developed in three different fronts separated not only by construction specialties, but for the distance which separates the three locations required sites.

The locations are the following ones:

- Concrete dam wall, intake works and excavation of tunnel by the entrance.
- Excavation of tunnel by the exit, oscillation louver, concrete cap in the tunnel's mouth and beginning of the pressure tube.
- Placing of the pressure tube, power house, substation elevator and drain off canal.

These fronts are linked among them, as a separate front there is the transmission line to the electric substation.

The general description of the projects' components is mentioned herein below:

Dam and Intake Works

In the construction of this portion of the work, works will be performed in a canyon with hill sides with very stiff slope.

The dam location in the bottom of the river will be made in the low water season in order to be able to deviate the small river flow (around 0.5 m³/s) through one of the bays of the sand

trap gates, while working in the other bay, and once this one is concluded the river consumption is passed to this one and works are performed in the other one.

Notwithstanding there is no hydrometric station installed, with the National Water Commission (National Water Commission (Comisión Nacional del Agua)) permit, and which transmits flow report every 15 minutes it will be avoided to work in the low parts during the rainy season.

Conduction Tunnel

Generally, the tunnel covers the following work's aspects:

Transportation and shifting

Excavation

Temporary Support

Excavated material left over

Definitive support and coating

Explosives and substances to be used

Pressure Tube

For the pressure tube in the project about 1,150 ton of steel pipelines with a 1.22 m diameter will be installed, being the heavier tube stretches of about 5 ton, the pipelines will be superficially installed on stools, therefore there will be no deep excavations risk which might cause landslides.

Power House and Substation

The power house requires no deep excavations because a Pelton type turbine will be used.

The Pelton type turbine is a turbo motor machine, of transversal flow, of partial admission and of action. Consists in a wheel (rotor) provided with blades in its periphery, which are specially made to transform the energy of a water spurt that influences the blades.

The Pelton turbines are designed to work with high charge levels, adequate for the installation of electro-mechanic equipment intended for the project.

Transmission Line

La transmission line will be of one circuit and will have a 4.3 km length.

The preparation of the site will consist in opening the forestall gap for which it previously required to obtain the authorization for the land use change in forestall stretches. Subsequently, the topographic survey and location of the structure outline will be carried out.

The relevant excavations will be carried out to contain the towers foundation and the stuffing and tamping will also be performed.

The construction of the electro-mechanic work will comprise the mounting of steel support structures for support, the dressing of structures, and the laying of the conducting cable and the connection to substations.

To be able to operate the line, tests will be carried out to verify their adequate functioning or, as the case may be, to identify possible failures and to repair them.

During the operation of the Transmission Line it will be necessary to provide maintenance throughout the right-of-way width in order to avoid possible service interruptions, the maintenance consists in en la pruning the vegetation that is above the security levels with the air cable.

II.2.1.3 Description of works and provisional and associated activities

- *Construction of access roads.*

The construction of access roads to the different work sites is not necessary, however it is necessary to construct local accesses such as:

The one that will reach the dam wall's lower portion, which afterwards will be flooded with the reservoir, it will be an earthwork road of 6 m width and a 460 m length.

Access to the power house will be of permanent form, through an earthwork road in terreplein of 5.5 meters width and 175 m length approximately, for which a surface of 968 m² is required. The road will have excavated gutters and conformation of the road with the material thereof or with the power house excavation product to provide a transversal slope.

- *Storehouses, warehouses and workshops.*

The project does not consider the habilitation of workshops for the preventive or corrective maintenance of machinery or equipment, corrective repairs shall be performed outside the works site in established workshops.

The preventive maintenance of oil or filters change and minor failures that do not require to dismount the unit shall be performed in the site, gathering to that effect the machinery in the camping zone, these areas shall be impermeable, whether with argil seals or through geo-membranes, to avoid the soil pollution due to fuels and lubricants spilling .

In case of a spilling it shall be confined, pick up the product and place it in tambours for its subsequent disposal.

The residual product and polluted material shall be deemed as hazardous waste and shall consequently be disposed of in premises approved for hazardous waste.

The soil affected with leakages or spilling, as well as the material polluted by the cleaning works, shall require treatment and/or disposal in accordance with the provisions contained in the soil Restoration Standard (Norma de Restauración de Suelos) and in the Regulation on Hazardous Waste (Reglamento de Residuos Peligrosos) of the

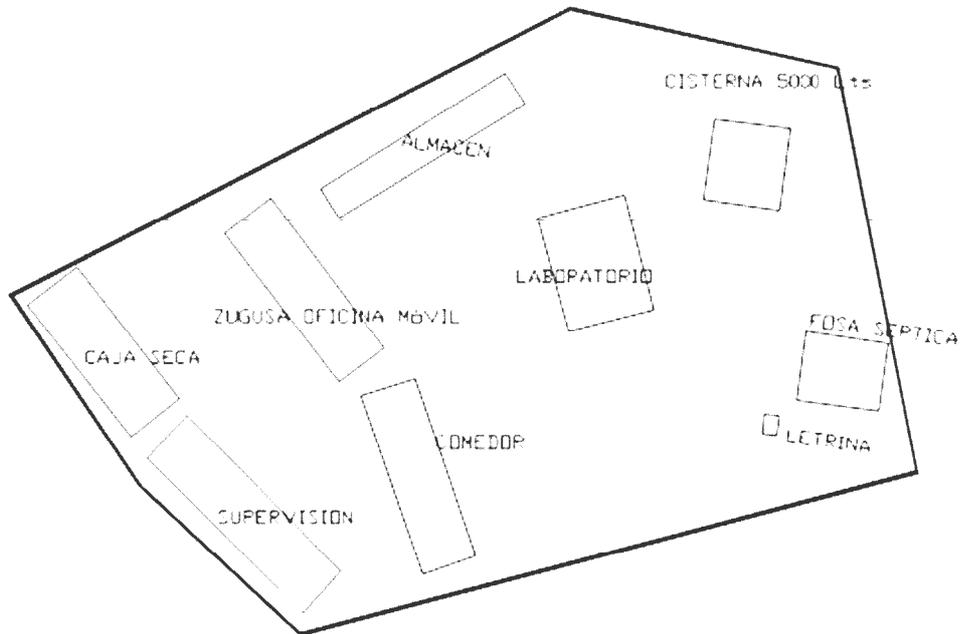
Environmental Protection Law (Ley General del Equilibrio Ecológico y la Protección al Ambiente).

For the operating stage in the hydroelectric central there will be a storehouse to safe keep the auxiliary equipment and spare parts necessary for the works maintenance. This storehouse will be preferably installed al one side of the power house building and shall have an approximate size of 10x15 m. For the construction thereof metallic profiles will be used for the structure and for the closing galvanized plate or of the most common trademarks that have a coating of outdoor resistant painting.

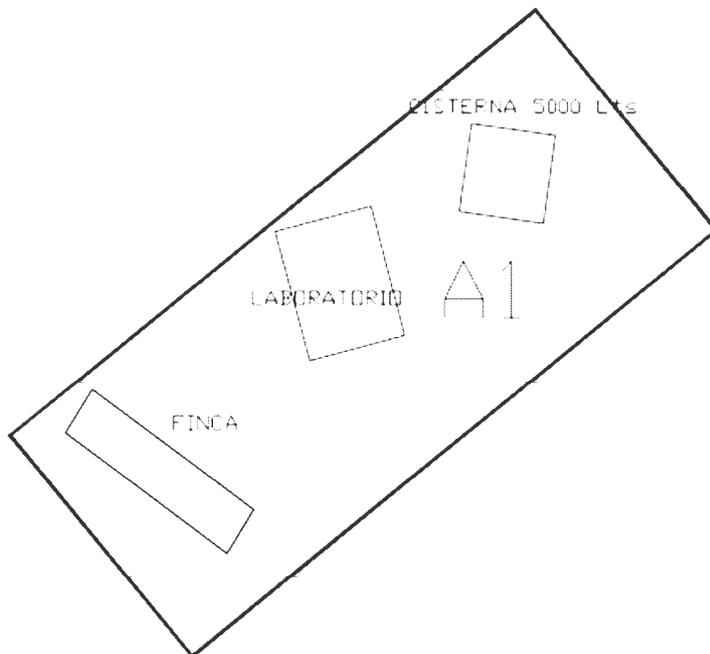
- *Camps, bedrooms, dinning rooms*

Stay only for the outside personnel, the majority of the people will be retained from the zone, therefore, at the end of each journal they will abandon the site. The average of people staying there, in case they are not lodged in Zongolica, shall be around 50 persons distributed in the different camps, obviously there will be more in the dam wall and tunnel areas fronts than in the power house. Camps are regularly used as offices.

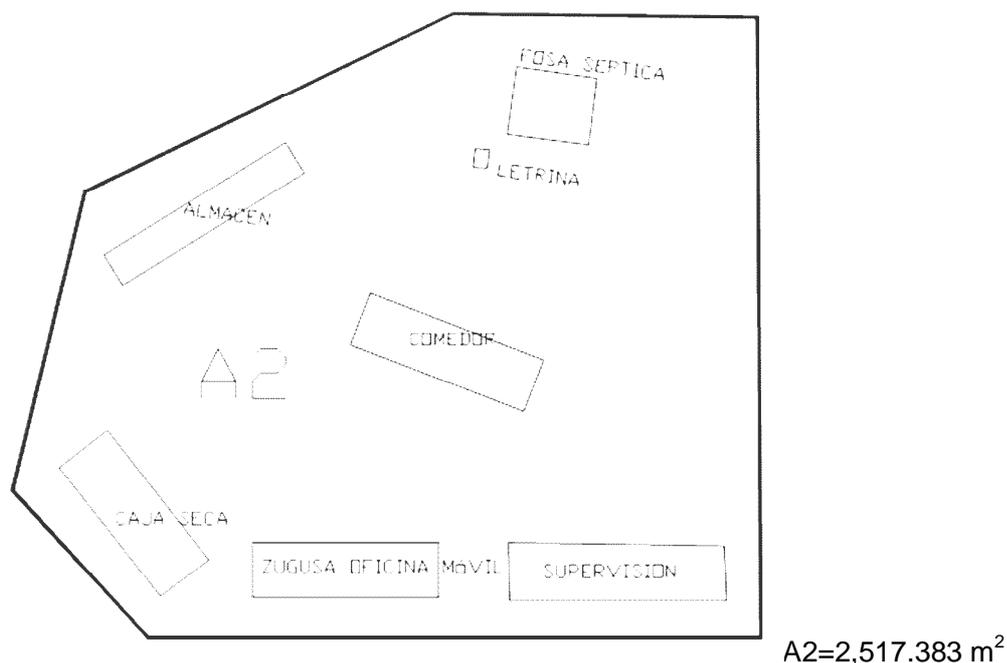
**DIAGRAM II.1 CAMP IN THE COMMUNITY OF PALULCA,
(TUNNEL ENTRANCE), SURFACE 2,200 M²**



**DIAGRAM II.2 CAMP OF THE COMMUNITY PUENTE DE PORRES
(POWER HOUSE), SURFACE 3,464.499 M²**



A1= 947.116 m²



- *Sanitary premises.*

At the beginning of works it is intended to place portable lavatories in a proportion of one lavatory for every 20 employees. A minimum of two will be considered for each work front and there shall be located in easy access places for the personnel involved in the work. The leasing company shall be responsible for the cleaning thereof at least once per week, and shall conduct the waste to the place granted by the competent authority at the time of its registration and operation license.

Subsequently 2 x 2 x 2 excavations will be carried out, with waterproofing, with core wall and cement flattening, concrete cap or tile with PVC ventilation tube and drainages in order to place the latrines or lavatories in the camps zone.

In operation, it is intended to install a pre-manufactured septic tank with specifications in accordance with the NOM-006-CNA-1997 and minimum capacity of 1,500 liters.

- *Material banks*

No material Banks will be exploited by the petitioner. With the excavation of the tunnel an important portion of the stony material necessary for the construction will be obtained.

The aggregates are acquired with the region's transportation men and/or material men.

- *Sites for the disposal of waste.*

The location of sites for the placement of material derived from the excavation may be observed in the maps PHV-05 “Veracruz, impounding zone, DDV affectations” and in the map PVH-06 “DVD affectations conduction zone DDV” included in the relevant annex.

- *Premises for the generation, transformation and conduction of power*

In order to cover with enough safety the electric feeding for the plant’s own and auxiliary services, in addition to the generating unit, there will be an emergency diesel plant and a 13.8 kV line that will be connected to the distribution lines that feed the town in the site.

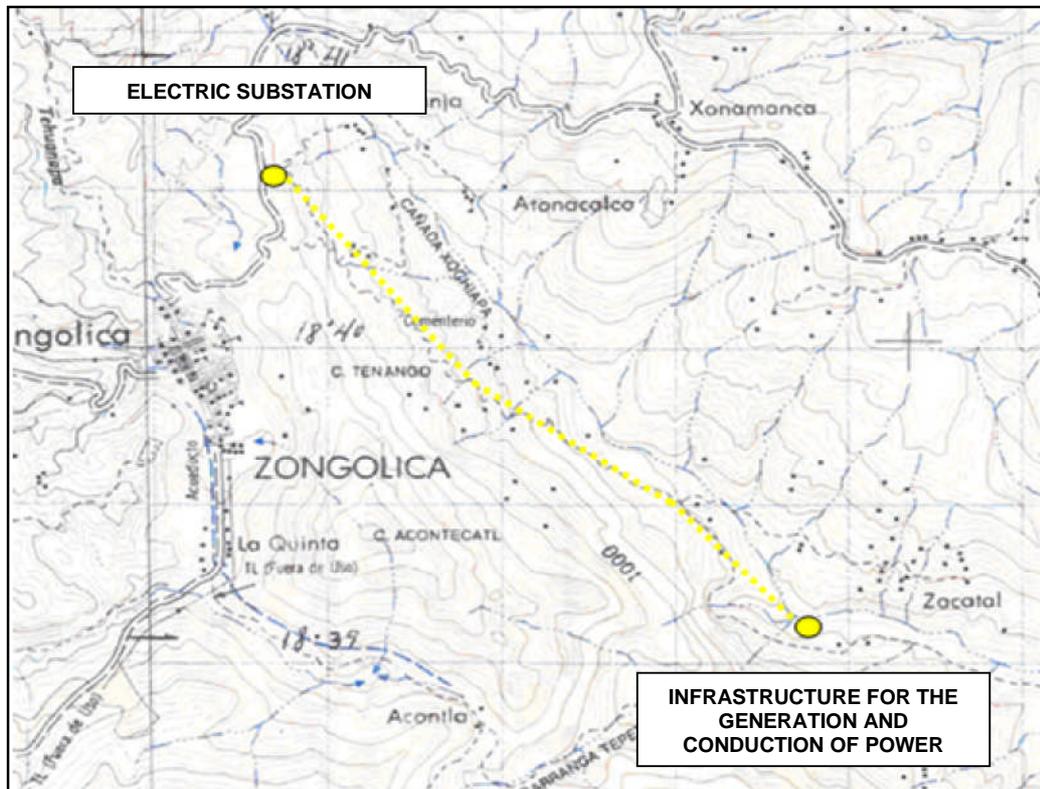
TABLE II.3 LOCATIONS TO PLACE MATERIAL

LOCATION	OWNER'S NAME	COORDINATES	EXPLOITATION	AFFECTED AREA (m ²)
IMPOUNDING ZONE				
1	Constantino Lara	N 2,060,066 E 711,179	Agriculture	10,000.00
CONDUCTION ZONE				
1	José Martínez	N 2,061,918 E 713,098	Agriculture and Wood	12,283.67

The distribution line shall extend up to the power house in poles that will be similar to the existing ones and in the last of them an oil transformer outdoor station type will be installed, with a capacity equal to the one of those of the auxiliary services of each plant and that will be protected with fusible at the side of 13.8 KV and its output in 480 Volts, it will have a thermo-magnetic switch, to which force cables will be connected until reaching the auxiliary services panel through an electro-magnetic switch that will be controlled from the monitoring hall to carry out the transfer of feed sources as required whether manual by the automatic operator through the PLC for auxiliary services control.

In order to protect the transformer of 13.8/480 kV 3 lightning rod with a nominal tension of 12 KV will be installed.

DIAGRAM II.3 LOCATION OF THE INFRASTRUCTURE FOR THE GENERATION, TRANSFORMATION AND CONDUCTION OF POWER



II.2.2 Project's location

The works that conform the hydroelectric project are located in the central southwest zone of the state of Veracruz, in the so called Sierra Negra de Zongolica that is part of the natural Grandes Montañas region, between the coordinates UTM X=710,750 to 714,700; Y=2'059,780 a 2'063,480 and between the elevations 1370 meters above the sea level (MASL) in the reservoir tail of the Apatlahuaya river and 580 MASL in the discharge zone of the Power House drain off to the Zongolica river. The elevations of the Sierra at the southwest increase towards the Sierra Mazateca, in the state of Oaxaca, and to the east descend to the Sotavento plains, in the state of Veracruz.

The works are located in three municipalities, the municipality of Mixtla de Altamirano, Texhuacán and Zongolica, part of the reservoir being located in the municipality of Mixtla; another part of the reservoir, the dam wall, tunnel intake works, tunnel and oscillation ditch in Texhuacán and pressure tube, power house and substation in the municipality de Zongolica.

The local sewer network includes the Apatlahuaya river, that will supply the hydroelectric plant, the Zongolica river where the turbine water will be discharged and the Moyotepec, Coyolapa and Altotonga rivers, all of them tributary of the Tonto river, important affluent of

the Papaloapan river, regulated by the Miguel Alemán dam before its discharge into the Papaloapan.

State Veracruz de Ignacio de la Llave

Municipality The project is located in three municipalities, San Juan Texhuacán, Mixtla de Altamirano and Zongolica.

Towns The referred towns closer to the project's site are Xochitla of the municipality of Mixtla and Zongolica of the same name's municipality.

DIAGRAM II.4 GEOGRAPHIC LOCATION OF THE RESEARCH AREA IN THE STATE OF VERACRUZ



DIAGRAM II.5 LOCATION OF THE ZONGOLICA, MIXTLA DE ALTAMIRANO AND TEXHUACAN MUNICIPALITIES IN THE GRANDES MONTAÑAS REGION

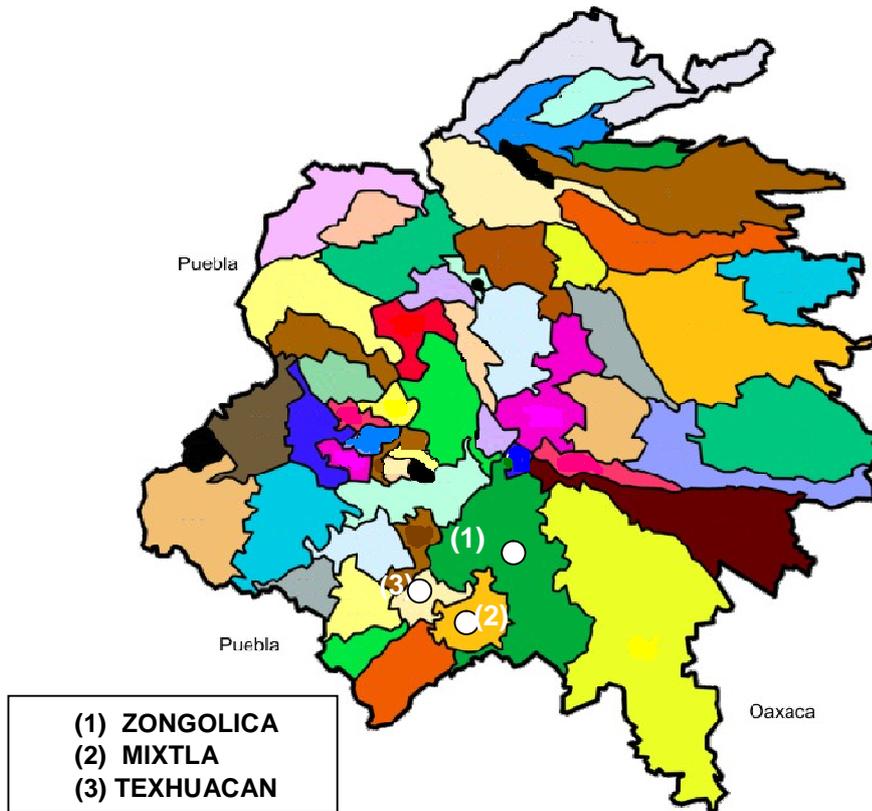


DIAGRAM II.6 PROJECT'S LOCATION SKETCH

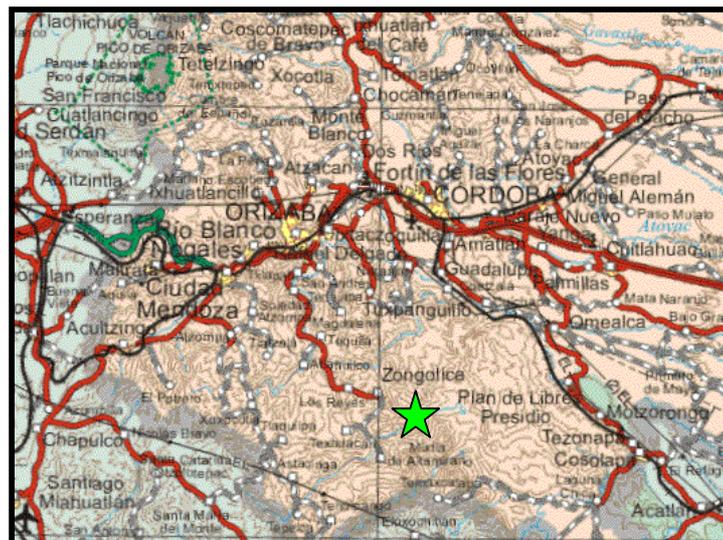
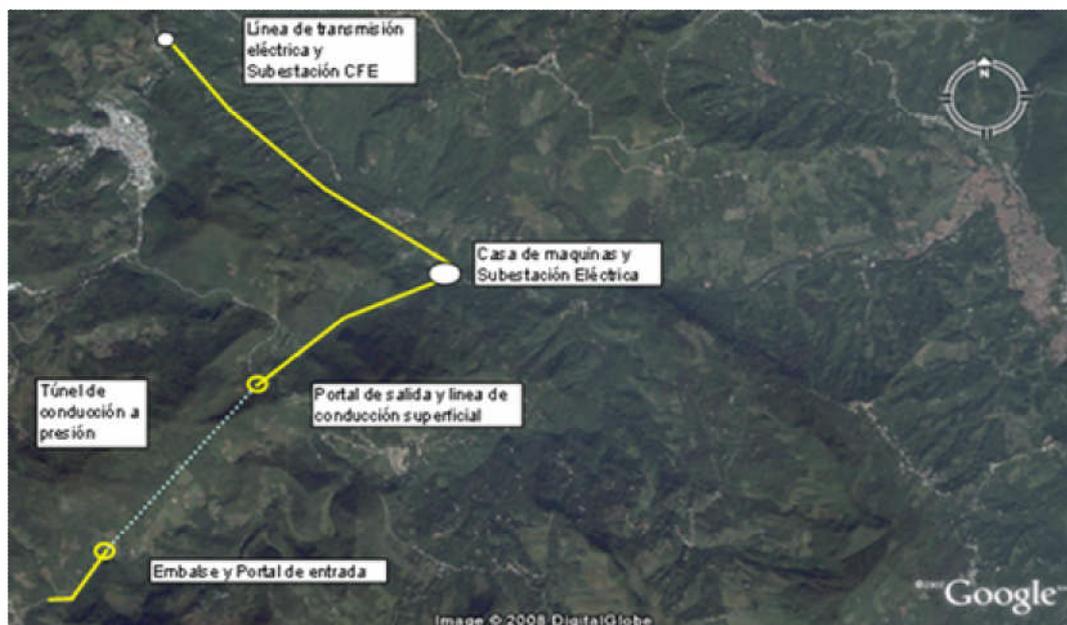


DIAGRAM II.7 PROJECT'S LOCATION



II.2.2.1 Total surface required

For the installation of the project, the necessary procedures will be performed for the acquisition of properties, payment of easements and federal zones that in the aggregate will be a total area of 243,758 m² (24.38 Ha). From this surface it is important to mention that even though this aggregate amount will be included, the area to be occupied will be much smaller, but it has been considered in order to cover the purchase of the lands, the superficial strip that conforms the tunnel trajectory, as well as the protection strips, right-of-way and of the respective requirements for the forestall land use change. Consequently, the surfaces will be occupied as follows:

Construction surface: 25,285.42 m² (2.53 Ha), corresponding to 10.37% of the project's total surface.

TABLE II.4 CONSTRUCTION SURFACE

WORK	SURFACE (m ²)
Power house (41x50 m)	2,050
Substation (30x40m)	1,200
Access to power house (175x5m)	962.5
Definitive storehouse (10x15m)	150
Conduction tube (2160x5m)	10,800
Transmission Line (64m ² x20 towers)	1,280
Portal tunnel	7,672.92
Dam wall	1,170
TOTAL	25,285.42

The project's total area has a wooded surface of 14.83 Ha, from which, the effective surface to be dismantled and its percentage in respect to the wooded area is the following one: 88,849.50 m², (8.88 Ha), which represents 59.91% of the wooded surface and 36.45% of the total surface provided for the project.

TABLE II.5 EFFECTIVE SURFACE TO BE DISMOUNTED FROM THE WOODED AREA

WORK	SURFACE (m²)
Power house	2,050
Substation	1,200
Access to power house	962.50
Conduction tube	10,050
Transmission Line	49,800
Reservoir (elevation 1368)	23,617
Dam wall	1,170
TOTAL	88,849.50

Surface to be occupied by the works and support services such as camps, machinery courtyards, throw sites, etcetera: 22,283.67m² (2.23 Ha) corresponding to 9.14% of the project's total surface.

TABLE II.6 SURFACE TO BE OCCUPIED BY WORKS AND SUPPORT SERVICES

WORK	SURFACE (m²)
Left over throw sites	16,619.17
Camps	5,664.50
TOTAL	22,283.67

Surface corresponding to free or green areas. This is the result from subtracting from the project's total surface from the construction surface, the reservoir occupation and works and support services: 172,571.91m² (17.26 Ha). Upon the works completion, the left over throw and camp sites 22,283.67 m² (2.23 Ha) will remain as free areas, therefore, a total of 194,855.58 m² (19.48 Ha) of free areas corresponding to 79.94% of the project's total surface.

Wooded surfaces, nor wooded surfaces and without vegetation: Wooded 14.83 Ha; No wooded 5.53 Ha; Without Vegetation 4.02 Ha.

Surface required for access roads and other associated works (included in the construction surface table): 962.5 m².

The following table shows the breakdown of the project's permanent and temporary affectation surfaces. The percentage equal to the surfaces in respect to the project's total surface is 20.06% for permanent surfaces and 79.94% for temporary surfaces.

TABLE II.7 PROJECT'S PERMANENT SURFACE

NAME	SURFACE (Ha)
Reservoir	2.36
Dam wall	0.12
Tunnel (portal)	0.77
Conduction Tube	1.08
Transmission Line (20 towers of 64 m ² each)	0.13
Power House and Substation	0.34
Access to power house	0.09
TOTAL	4.89

TABLE II.8 PROJECT'S TEMPORARY SURFACE

NAME	SURFACE (Ha)
Reservoir and dam wall (free surface after Maximum Ordinary Water Level in the Dam (NAMO))	0.78
Tunnel (superficial- portal strip)	1.05
Conduction Tube (Right-of-way–permanent occupation surface)	3.24
Transmission Line (Right-of-way– permanent occupation surface)	8.90
Left over throw zones	1.66
Camps	0.57
Power house and substation (property surface– permanent occupation surface)	3.29
TOTAL	19.49

Based on the foregoing and considering the right-of-way provisions for the conduction tube, covering of the reservoir area at the Maximum Extraordinary Water Level (NAME) as well as several premises of the hydroelectric central, it is intended to carry out the land use change in forestall lands (Gallery Forest, Oak-Pine Forest and Pine Forest Renewal) in a surface equal to 4.29 Ha and in Coffee with shadow trees in a surface of 10.54 Ha, therefore the land use change in forestall land is required in a total surface of 14.83 Ha.

TABLE II.9 DISTRIBUTION OF THE TOTAL SURFACE BY KIND OF LAND USE

VEGETATION	Volume (m3 VTA)	Surface (Ha)
Gallery Forest	197.839	1.39
Oak-Pine Forest	122.683	2.6
Pine Forest (Renewal)	---	0.3
Coffee with shadow trees	457.481	10.54
Subtotal for land use change	778.002	14.83
Agriculture	1.092	4.1
Pasture land	---	1.43
Water corps and surfaces without vegetation	---	4.02
TOTAL	779.094	24.38

II.2.2.2 Access ways to the area where the works or activities will be developed

Access to the project's zone is carried out from Orizaba to Zongolica through the federal highway 150 and from Zongolica there are three Access roads to the works, one to arrive to the reservoir, dam wall and tunnel entrance portal, a different one for the tunnel exit portal and beginning of the pressure tube and one more for the terminal portion of the pressure tube, power house and substation.

To arrive to the dam wall and reservoir initially you have to transit the paved highway that goes from Zongolica to Texhuacán, after 6.2 km turning to the deviation of paved road to Mixtla de Altamirano; after 3.4 kilometers turn to the deviation through a earthwork road capable of being transited in vehicle to the community of Palulca and Aticpac, finally arriving after 1.5 kilometers to the left margin of the Apatlahuaya river in the outlet zone until the dam wall axis; from this point it is possible to continue in vehicle by the tunnel's outline zone until the communities of Palulca and Aticpac, located in the southeast hill side of El Soyayo Hill; in Aticpac the vehicle is abandoned and continue by foot through an earthwork road parallel to the tunnel outline, walking until the community of Equimititla and from there until Ocotitla where the exit portal tunnel and beginning of the pressure tube are located. There is also Access to this last zone in vehicle taking in Zongolica the paved road that goes to Las Quintas colonia and from there the deviation through an earthwork road of 3.4 km until the tunnel entrance that arrives to the community of Ocotitla.

Access to the power house is through a paved road located north from Zongolica and that goes to Xonamanca and the community of Nepopoalco; after 3.2 km from Zongolica through a paved road, you take the deviation to the community of El Zacatal on a 7.2 km earthwork road until the power house that is located between the community of San Jerónimo and Puente Porres on the margins of Zongolica river.

II.2.2.3 Description of required services

The infrastructure of goods and services required for the development of the project in its different stages is as follows:

- Terrains where the project will be located

For the project occupation there will be a net surface of 24.38 hectares, from which, the effective and permanent utilization of 2.53 Ha will be carried out to include the proposed infrastructure, therefore, the agreements and contracts for the purchase and sale and easement have been executed in order to guarantee each of the properties.

- Water

Water supply for the construction of the project shall be through direct pumping from the river to storage tanks in the site. It will also be transported in pipe with a capacity of 6,000 liters in order to irrigate roads.

- Portable Latrines

It is intended to lease portable lavatories at a rate of one unit per each 20 employees. A minimum of two will be considered for each work front and shall be located in easy access places for the personnel involved in the work. The leasing company will be responsible for their cleaning at least once per week, and will conduct the waste to the site granted by the competent authority at the time of its registration and operating license.

- Fuels

In accordance with the number of equipments considered, the fuel daily supply is proposed through pipes, which will be loaded in the Zongolica service station, there will be no fuel or lubricants storage in the work site.

II.3 Description of works and activities

- **Activities within the hydrographic basin**

The relief form in the Zongolica Sierra, is constituted by mountains with hill side slopes between 30° and 60°, forming intra-mountain valleys, the elevations of which range between 600 and 1600 MASL. In the project zone the higher part is the one pertaining to the Soyayo hill, which reaches 2040 MASL in the peak and in the southeast hill side of which the conduction tunnel will be located.

Morphologically, the zone presents an abrupt relief, with sharp mountain peaks and hill sides with predominant slopes between 35° and 60°, forming small intra-mountain valleys; the stratification shows a soft fold, and may form anticlines such as the one of the Soyayo hill where the tunnel outline passes.

There are no populations to be relocated due to the work, only some isolated houses will be affected, which have already been acquired.

- **Reservoir**

TABLE II.10 DESIGN DATA

CONCEPT	UNIT	AMOUNT
Total capacity (Maximum Extraordinary Water Level (NAME))	m ³	262,076
Conservation capacity (Maximum Ordinary Water Level in the Dam (NAMO))	m ³	194,430
Silt capacity	m ³	7,670
Top elevation	m	1371.00
Maximum Extraordinary Water Level (NAME)	m	1,370.50
Maximum Ordinary Water Level in the Dam (NAMO)	m	1,368.00
Minimum Ordinary Water Level (NAMINO)	m	1,356.50
Intake works elevation threshold	m	1,350.50
Sand trap elevation threshold	m	1,345.50
Riverbed's bottom elevation	m	1,343.00
Spillway design consumption	m ³ /s	250
Intake work design consumption	m ³ /s	11
Sand trap design consumption	m ³ /s	20
Top 's height from the placement	m	30.00
Free dyke	m	0.50
Turbine design consumption	m ³ /s	7
Net fall of the turbine design	m	710
Installed power	MW	42
Annual media generation	Gwh	94

TABLE II.11 AREAS AND CAPACITIES CURVES.

ELEVATION	AREAS (m ²)	VOLUME (m ³)
1,340	0	0
1,345	124.83	86.02
1,350	1,386.69	3070.17
1,355	5,777.47	20,669.99
1,360	10,664.68	60,840.80
1,365	17,848.24	133,284.36

1,370	29,123.3	246,936.03
-------	----------	------------

- **Contention structures.**

The dam wall will be made out of concrete of gravity section with an approximate volume of 12,000 m³ and it will have a maximum height from the location to the top of 30 m.

The top will have a bridge to allow the communication between both margins and in the lower part it will be equipped with a sand trap gate that will allow eliminating the silt accumulated in the lower portion of the riverbed.

A removal of altered material in the river bed is estimated with a thickness of 2.00 m.

In addition to the sand trap gates, the dam wall will have an elevation of 1350 MASL with a group of ducts that will measure 8" and 10" respectively, these will cross the dam wall on its left section to allow the exit of the ecologic consumption. This installation will have hydraulic actors to effectuate the closing of each conduit in accordance with the consumption recorded in the hydrometric station, which will be located upstream from the dam site that will allow knowing the level in order to keep the discharge's control. This way, during operation, when consumptions lower than 1m³ are recorded, the remote control opening of the conduits will be carried out for the water exit; with consumptions above the cubic meter, the discharge will be supported by opening the sand trap gates. The documental annex shows the data on the estimation of the dam's ecologic consumption.

- **Surface to be occupied by the dam wall and main structures**

The approximate surface to be occupied by the dam wall is of 1,170 m²

Affectations conduction zone 2160x20 DD: 43,200 m²

The project will comprise a total of 24.38 Ha, distributes as mentioned herein below.

TABLE II.12 SURFACE REQUIRED FOR THE PROPOSED INFRASTRUCTURE

NAME	SURFACE (Ha)
Reservoir	3.14
Tunnel superficial drip (including Portal)	1.82
Dam wall	0.12
Conduction tube	4.32
Transmission line easement	9.03
Power house and substation	3.63
Access to power house	0.09
Left over throw zones	1.66
Camps, offices, etc.	0.57

NAME	SURFACE (Ha)
TOTAL	24.38

- **Deviation works**

The dam's in the bottom of the river will be made in the low water season to be able to deviate the river caudal (about 0.5 m³/s) through one of the sand trap gates bays, while working on the other bay, once this is completed the river consumption will be passed thereto and it will be worked in the other.

- **Intake works**

It will be located in the left slope of the dam's receptacle, at a 1350.5 m level, and will consist in a little access gap to the tunnel's entrance portal, where the water direction works will be carried out into the tunnel with a concrete structure that at the end will have a transition to change from a rectangular section into the conduction tunnel section.

It will have a grid that will impede the passing of materials that might damage the turbine and the grid will be removable to allow access to the tunnel with mechanic equipment in order to unblock it. It will have no flow control gates, because the control will be at the exit of the conduction tunnel.

Elevation threshold	1,350.50 m
Elevation of the Minimum Ordinary Water Level (NAMINO)	1,358.50 m
Design consumption	11 m ³ /s

- **Excess works (Spillway)**

The spillway exceeding will be integrated to the dam wall body, occupying two sections at the centre thereof with the division formed with the structure of the sand trap valves. Each section will have a 15 meters width for a peak length of 30 meters and a height between the base and the dam wall's top of 3 meters for a design consumption of 250 m³/s.

In the bottom of the river bed a sand trap structure will be built, equipped with two sliding gates that, in the overflows season, will allow eliminating the silt withheld in the dam.

In a low level of the Minimum Ordinary Water Level (NAMINO), the intake pipelines will be placed, regulated with valves that will allow sending ecologic consumption to the river. This consumption will be canalized so it drips within the spill way body and it causes no erosion.

Top elevation	1,371.0 m
Maximum Extraordinary Water Level (NAME) elevation	1,370.5 m
Maximum Ordinary Water Level in the Dam (NAMO) elevation	1,368.0 m
Sand trap elevation threshold	1,345.0 m
Peak length	30.0 m

Design consumption

250.0 m³/s

The spillway discharge canal shall be the one corresponding to the dam wall, spillway section, and talus 0.75:1. As final structure a deflecting tray is proposed.

The work will not encourage the relocation or mobilization of inhabitants since the places where works are intended to be done there are no human settlements.

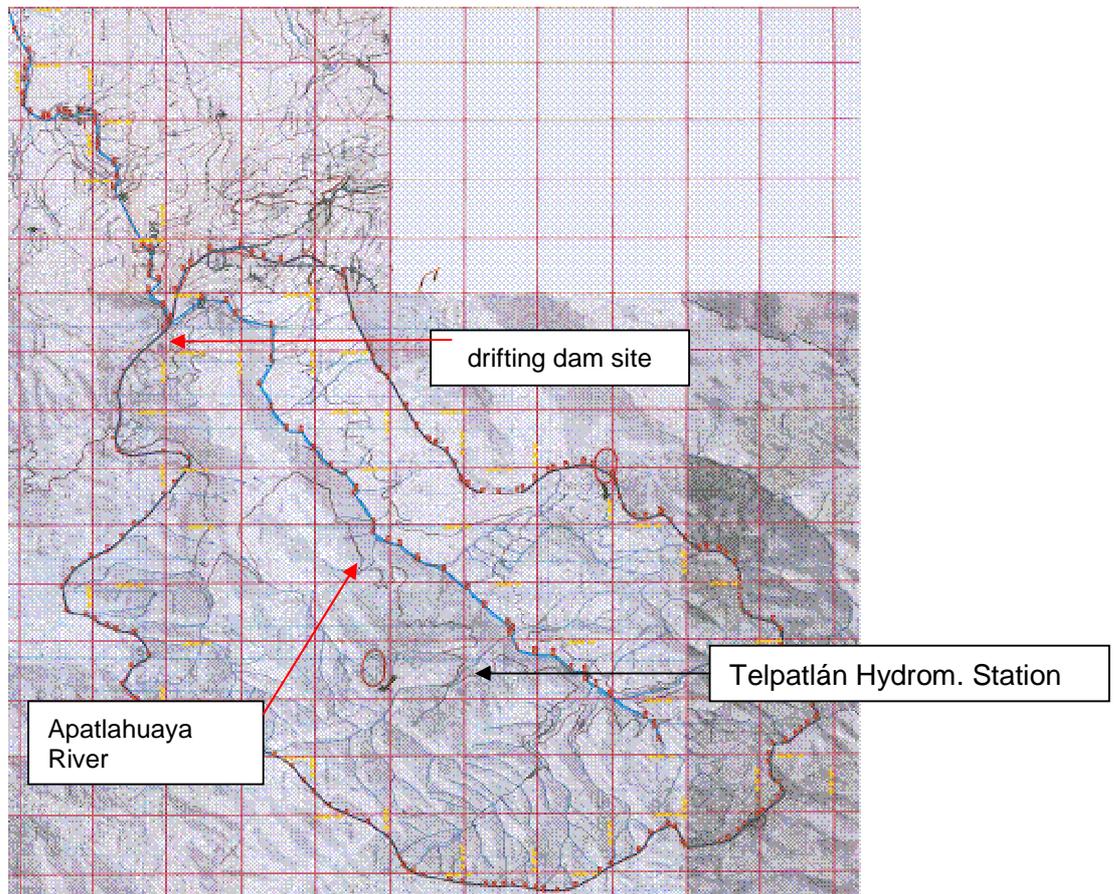
- **Water inputs to the drifting dam**

Up to the drifting dam site, the Apatlahuaya River drains an area of 200 km² located in the superior limits of the Tonto river basin, and represents about 2.5% thereof.

Annual medium dripping = 3.418 m³/s

Minimum consumption in the drifting dam site = 0.58 m³/s

DIAGRAM II.8 DRAINED SAND UP TO THE PROJECT'S DERIVATION DAM.



- **Length and bank slope**

The reservoir length from the dam wall, for the elevation 1360 is of 450 meters. In respect to the slope there is 0.07 at the left margin and 1.0 at the right margin.

- **Systems for the circulation throughout the river bed and for the handling of sediments**

The sand trap gates located in the base of the dam wall will be opened periodically (see map Zongolica II sand trap), allowing the exit and dragging of the sediments with the river water as it currently happens. This action will be preferably carried out in the rain season when the caudal is higher, since the water charge is more effective in the dragging and there is a higher dilution of particles.

- **Tunnel**

The conduction tunnel's length will be of 2,790 m and "Portal" section with a surface of 9 m² with a transversal section of 3.0 m width and 3.0 m height, which represents a total approximate excavation volume of 22,403.7 m³.

In the water dripping direction, in the first half it will be horizontal and in the second one it will have a slope of 0.0025%.

A gap will be excavated in the exit to locate the tunnel's portal.

Lastly, the entrance mouth to the pressure tube will be installed, subsequently straining the hold up cap thereof and installing the butterfly valve.

- **Oscillation ditch**

At the exit a gap will be excavated to place the tunnel portal and approximately 50 m upstream the oscillation ditch will be excavated from the conduction that will be circular with a 9 m diameter and terminated section of 60 m² and a 30 m depth that will serve as an oscillation ditch to absorb the transitory effects occurred during the time when the turbine is closed.

- **Forced pipeline**

The pipeline will be located in the bottom of the Tepetzala ravine that crosses the trajectory from the tunnel exit to the power house.

It has a 2.3 km development and a 800 m total fall, therefore the medium slope thereof is greater than 30%, which makes this work to have a great difficult degree.

It will be constructed with carbon steel tubes with a diameter of 1.22 m, variable thickness in accordance with the work pressure in each stripe and, it will be placed near to the bottom of the Tepetzala ravine on the right slope and it will have the steel and concrete supporting stools and the concrete hold-ups necessary to guarantee its stability, during its development it will have several expansion joints to absorb the temperature changes.

At the end it will connect with the sphere shaped valve of the Power House.

- **Power House**

The power house will be located in the right margin of the Zongolica (Coxole) river and annex thereto the elevating substation will be located on the left side of the power house.

The Power House will be placed in a surface of 2,050 m² in a rectangular terrain of 41 x 50 m, the surface occupied by the power house shall be of 550 m². It will be formed by a concrete structure with grooved insulating plate roof and it will be built in the terrain's natural rock and hermetically sealed up to the protection level against flooding fixed in accordance with the region's hydrology.

A pelton turbine and a generator with a 42 MW capacity will be installed in the power house. It will have its discharge directly into the river, through a very short length drain off canal.

The pressure tube will enter the power house being connected to a needle valve with a 1.20m diameter and there from it will be connected to the Pelton wheel by a short pipeline strip. Also an sphere shaped valve will be taken to the entrance for the turbine flow control.

The building's superior nave will be equipped with a traveling crane with capacity enough to move heavy equipment for repair and maintenance.

The project's data for the generating unit and for the Power House are:

Maximum Ordinary Water Level in the Dam (NAMO)	1368.00 m
Water Design level in the Dam	1360.25 m
Minimum Ordinary Water Level (NAMINO)	1358.50 m
Water Level in the Turbine Venting (Q = 7.0 m ³ /sec.)	590.00 m
Turbine's Nominal Power at Design Charge	42.410 MW
Turbine Maximum Consumption	7.00 m ³ /s
Turbine design consumption	7.00 m ³ /s

- **Substation**

The substation will be located very close to the Power House and will be constructed above the platform to be conformed with material derived from the excavations, where all the concrete elements will be strained for the metallic structures foundation and where the protection equipment will be mounted, as well as the main transformer, insulators, lighting arrester, switches, knives and ground network. All the substation will be fenced with cyclonic type wire netting.

a) Number of transformers.

- A three-phase power transformer, with oil insulating, of two gullies to be mounted outdoors that shall comply with the standards NOM-J-169, NOM I-271, ANSI-C-57

- o Current winging type transformers, outdoor service, mounting on support column

Amount of current transformers : 6

Amount of potential transformers: 4

b) Number of phases: 3

c) Capacity

Continuous capacity and class of cooling at 55° C.

OA	46 440 kVA
FA	48 880 kVA

d) Transformation ratio. 200: 5/5/5/5 A

e) Number of feeders: 4

f) Total surface 1,200 m², in a rectangular land of 30 x 40 m.

g) Control room's surface and characteristics.

The surface is considered within the excitation floor as well as in the control room in the power house, where an approximate area of 26m² is assigned.

Automatic control system: Automaton programmable logic, computer equipment with specialized software in control post and local supervision.

Measure and protection panels: Control panel with generator group, Common system panel, Line panel 115 kV, Synchronization and commutation equipment, Alarms, system of signals of events and acoustic warning, Active and reactive power measuring equipment.

Continuous current system: 125 VDC and 48 VDC system Rectifier Charger (*Cargador de Rectificador*) of solid status with automatic regulator, Batteries Ni-Cd 150 Ah and 85 Ah, Control panel and indicators system.

h) Design characteristics of the perimeter wall: cyclone type wire netting.

i) Lightning arrester and Ground system.

Station type Lightning arrester of zinc oxide, designation tension 96 KV, for a 115 KV, system, outdoor service, that shall comply the attached specifications, the main characteristics of which are the following ones:

Quantity: 6

Lightning arrester nominal tension: 96 KV – rcm.

Protection level equal to the impulse wave front: 230 – 307 KV Peak.

Protection level transitory tensions of switch maneuver, wave of 3000 A.- 182 – 189 KV Peak.

Maximum discharge tension to impulse wave current of the 8x20 μ s- type

3 KA	196 KV Peak.
5 KA	179 – 249 KV Peak.
10 KA	192 – 269 KV Peak.
15 KA	230 KV Peak.
20 KA	216 – 288 KV Peak.
40 KA	279 – KV Peak.

Leakage distance from phase to ground. – 3.5 cm/KV to neutral.

High tension of short duration, shall support without damage an impulse current of (4 to 8) x (10 to 20) with a 100 KVA value and two discharges.

Isolating test tension of the lightning arresters:

- Full wave impulse test 1.2 x 50 μ s.- 450 KV Peak.
- Applied potential 60 Hz., dry 1 min. .- 225 KV.
- Applied potential 60 Hz., humid 10 sec. .- 190 KV.

With each lightning arrester an insulating base must be provided for the installation of a discharge counter.

With each lightning arrester a discharge counter must be provided for.

The foundation height shall be defined in accordance with the substation.

The porcelain shall be of a dark brown color.

The kind of terminal connectors must be provided as required by the substation's final design.

The connector for the ground connection must be able to receive a copper cable of 500 KCM.

- **Electric Transmission Line.**

The construction of a transmission line will be necessary in order to send the power to the Substation located in the community of Zongolica, therefore a transmission line for the project has been considered, with the following characteristics:

- a) Transmission lines capacity (voltage): 115 KV
- b) Number of circuits, one circuit, one conductor per phase
- c) Line's length 4 kilometers
- d) Right-of-way's width 22 meters

The line's trajectory shall initiate in the project's substation and will have a trajectory with northwest direction until its interconnection with the Zongolica substation in the town with the same name.

For its installation a number of 20 support structures (towers) is estimated, which will occupy a surface of 64 m² each one considering for this the foundation cubes that will conform the base of each structure.

The characteristics of the materials to be installed in the transmission line are described herein below:

- a) Conducting cable: aluminium with steel core Type 477 KCM, ACSR
- b) Guard cable : 1 Type 7#8 AAS of galvanized steel; 1 OPGW type (optic fiber)
- c) Insulators: tempered glass Type U70 BS, U70 BL

Simple suspension chains 115 KV, steel aluminium alloy.

Simple tying chains 115 KV, steel aluminium alloy

d) Support structures: Types TAS2P, TAR2P30, for the conformation of structures in the towers extra-galvanized steel will be used

e) Approximate number of structures: 20 towers

f) Foundation: isolated foundation shoes

g) Grounds system: With 5/ sticks 8 and Cooperweld N° 2 cable

h) Cathodic protection

Anodic and cathodic cables of double polyethylene backing of high molecular weight type HMWPE.

Copper cable 500 KCM

Copperweld sticks and Caldwell soldering in unions

In accordance with the resistivity results present in the land of each of the stretches, the cathodic protection will be applied, considering the network and requested depth.

i) Vegetation handling within the right of way.

During the Transmission Line's operation it will be necessary to provide maintenance throughout the right-of-way in order to avoid possible service interruptions, the maintenance consists in pruning the vegetation that exceeds the security limits height with the air cable.

II.3.1 General work program

TABLE II.13 GENERAL WORK PROGRAM

CONCEPT	MONTHS																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Site preparation																									
Gap opening and excavations	■	■	■	■																					
Construction																									
Dam and intake works											■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Tunnel		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Entrance and exit portals		■	■	■																					
25% tunnel perforation					■	■	■	■																	
Hurled concrete and equipment					■	■	■																		
Perforation 100%											■	■	■	■	■	■	■								
Hurled concrete and equipment											■	■	■	■	■	■									
Oscillation tower											■	■	■	■											
concrete cape pipeline beginning																				■	■				
Installation of valves and access door																					■	■			
Pressure tube											■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power house and substation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Transmission Line				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Towers Shoes				■	■	■	■																		
Stuffing and tamping									■	■	■														
Mounting of steel structures for support											■	■	■	■	■										

CONCEPT	MONTHS																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Dressing of the steel structures																								
Laying of conducting cable																								
Operation																								
Tests and starting up																								

II.3.2 Selection of site or trajectory

II.3.2.1 Field research

The field researches performed for the executive project are the following ones:

- Topographic

The outline and leveling of the location areas of the project structures was carried out, as well as the pressure conduction line's and the electric line transmission's outline. The topography was performed through total and lineal measurement state stations.

- Hydrologic

The research "Assessment of Ecological Consumptions the Drifting Dam of the Veracruz Project" was carried out which includes the hydrology of the zone and the estimation of the annual medium ecologic volume discharged in the drifting dam. Such research is included in the relevant annex.

With the estimations of the ecologic consumptions performed in such research, it is demonstrated that the proposed operation policy for the discharge of ecologic consumptions in the drifting dam leads to:

- At all times there is a consumption that drips downstream from the dam.
- The monthly ecologic consumption varies from 10% to 36% from the medium monthly consumption of entry to the drifting dam.
- The annual medium ecological consumption represents between 20% and 29% from the medium annual consumption of entry to the dam.

It being that:

Annual Medium Ecologic Consumption = 0.503 m³/s

Annual Ecologic Volume = 15.850 m³/s

Annual Medium Ecologic Consumption / Annual Ecologic Volume = 20.6%

- Geologic

The research “Geologic Superficial Exploration in the Zones where the Proyecto Hidroeléctrico Veracruz Works, in the State of Veracruz will be Placed” was prepared by the company Geotecnia, S.C. Such research is included in the relevant annex.

- Geophysical

The research “Geophysical Exploration in the Zones where the Proyecto Hidroeléctrico Veracruz Works, in the State of Veracruz will be Placed” was prepared by the company Geotecnia, S.C. Such research is included in the relevant annex.

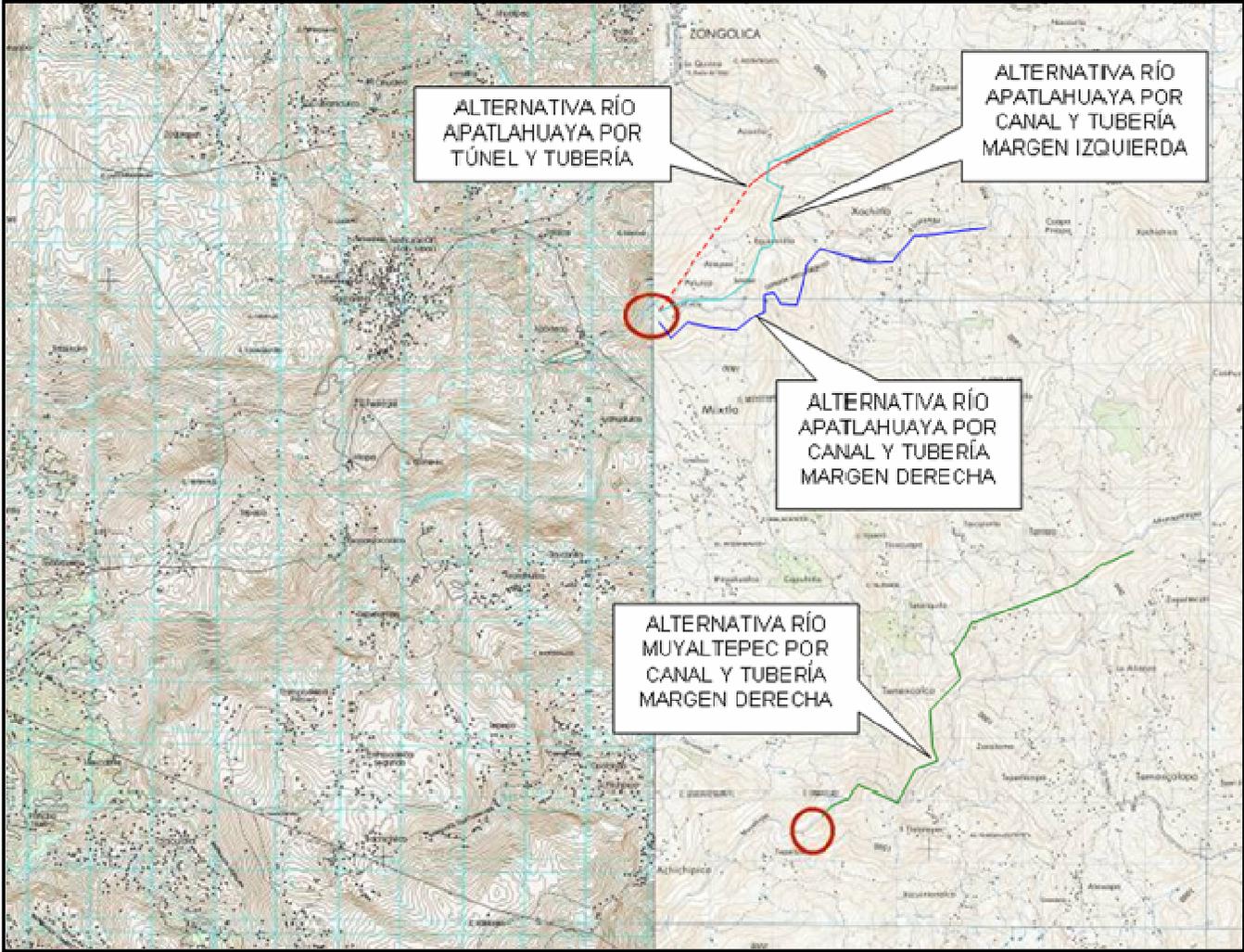
- Justification Technical Research for the forestall land use change

Based on the provisions contained in the Sustainable Forestall Development Law (Sustainable Forestall Development Law (Ley General de Desarrollo Forestal Sustentable), the corporation Consultoría Forestal y Servicios Agropecuarios, S.A. de C.V. (COFOSA) represented by Ing. Juan Martín Hernández Arizmendi in his capacity as General Manager, carried out the justification technical research for the forestall land use change in the lands that contain gallery forest, oak-pine forest, pine forest (renewals), and coffee with shadow trees, to use the to non forestall activities that will contain the proposed infrastructure for the hydroelectric project. Such research is included in the relevant annex.

II.3.2.2 Alternative sites or trajectories

Prior to making the decision to choose the alternative which is the subject matter of this research, the corporation CONSTRUCCIONES ZUGUSA, S.A. DE C.V. analyzed several alternatives until 5 different particular alternatives were determined, which at the same time have different particular alternatives, all of them located in the central part of the State of Veracruz, in the Zongolica Sierra, it is a mountain zone located in the limits with the Tehuacán Valley, Puebla and with the Mazateca Sierra of Oaxaca. Each of them is mentioned herein below:

DIAGRAM II.9 ALTERNATIVE TRAJECTORIES



- Hydroelectric Project Denominated Tenexcalco, in the Zongolica Sierra, in the State of Veracruz

The exploitation of the Moyotepec River waters (Muyaltepec, Moyoatempa) is proposed, drifting them to a 1,200 MASL approximately height, conducting them by the rivers left margin, approximately 6.0 kms, and subsequently return the to the original river bed at an elevation of 500 MASL, obtaining an approximate 700 meters fall. The project's preliminary conception includes the following structures:

- An impounding structure (drifting dam)
- An intake work structure (included in the dam)
- A conduction of approximately 6 kms (canal and pipelines)
- Pressure tube (approx 700 meters fall)
- Power house
- Discharge structure
- Transmission line

The municipality is irrigated by the Altotolco, Moyoatempa, Santiago rivers, all of them tributary del Río Tonto, important affluent del Río Papaloapan and less dragging rivers such as Ayejapa and Coscole.

The research area is mainly conformed by small isolated communities, where they speak *náhuatl*, ground communication among them is rudimentary, there are earthwork roads to the municipal heads, and small gaps that are being opened with the federal government's help under heading 33. This read program is quite delayed and its development is very slow. It is normal to go from one place to another by foot or in the best scenario, by horse.

- Comisión Federal de Electricidad is performing the work of electrifying the zone, taking it lines up to the towns that have no vehicular access. Hydroelectric Project denominated Apatlahuaya, in the Zongolica Sierra, in the State of Veracruz

The exploitation of the Apatlahuaya river is proposed, drifting them at an approximate height of 1,350 MASL, conducting them, and subsequently returning them to the original river bed at an elevation of 550 MASL, obtaining an approximate 800 meters fall. The preliminary project's conception includes the following structures:

- An impounding structure (drifting dam)
- An intake work structure (included in the dam)
- A conduction (canal, tunnel or pipeline)
- Pressure tube (approx. 800 meters fall)
- Power house
- Discharge structure (included in the power house)
- Substation in power house
- Transmission line
- Interconnection

The river basin area under research for the Apatlahuaya river is of 20,000 has. And forms form of the Tonto river basin, which itself is main affluent of the Papaloapan river.

Access to the zone is through the paved highway from the Orizaba City and arriving through the Zongolica Municipal Head, the area subject to the research is mainly conformed by small communities, the communication among them is by roads, the area's highway network is conformed by asphalt paving highways between the most important towns/cities, Texhuacan and Comalapa, but mainly through earthwork roads.

When the Apatlahuaya river runs at the approximate 1,250 elevation, it disappears in the calcareous formation denominated sewer, the topography nearby is the one of a closed basin. Therefore, in order to drift and exploit its caudal, it is obligated to go out with tunnel from such basin, for which it is proposes to build the impounding structure between the elevations 1,400 and 1,350.

The form to conduct the water may be through a combination of three different forms, tunnel, canal or pipelines. Each of them has advantages and disadvantages on the other ones, the application thereof depends on the particular conditions of each site.

Conclusions

- In the impound site a 1.0 m³/sec. dripping was observed.
- The area from the basin to the impound site is of about twenty thousand hectares.
- The CFE substation is relatively close.

In this alternative only the trajectories with pipeline conduction were reviewed and with the construction of a tunnel.

- Hydroelectric Project denominated Apatlahuaya 2, in the Zongolica Sierra, in the State of Veracruz.

The exploitation of the Apatlahuaya river water is proposed, drifting them at an approximate 1,350 MASL height, conducting them, and subsequently returning them to the original river bed at an elevation of 550 MASL, obtaining an approximate 800 meters fall. Several alternatives will be analyzed to attain the above mentioned.

The preliminary conception of the project includes the following structures:

- An impounding structure (drifting dam)
- An intake work structure (included in the dam)
- A conduction (canal, tunnel or pipeline)
- Pressure tube (approx. 800 meters fall)
- Power house
- Discharge structure (included in the power house)
- Substation in power house
- Transmission line
- Interconnection

The basin area researched for the Apatlahuaya river is of 20,000 has. And forms part of the Tonto river basin, which itself is main affluent of the Papaloapan river.

Access to the zone is through a paved highway beginning from the City of Orizaba and arriving to the Zongolica Municipal Head, the research area is mainly conformed by small communities, the communication among them is by roads, the highway network of the area is conformed by asphalt paving highways between the most important cities, Texhuacan and Comalapa, but mainly by earthwork roads.

Conclusions

- In the impound site a significant dripping was observed notwithstanding it was the low water season.
- It was not noticed that this dripping had an exploitation for agricultural uses by the neighbors.
- The basin area to the impound site is of about twenty thousand hectares.
- CFE substation is relatively close.

In this alternative only the trajectories with conduction with pipelines were reviewed and with the construction of a tunnel without coating and by canals.

- Hydroelectric project denominated Apatlahuaya 3, in the Zongolica Sierra, in the State of Veracruz

The exploitation of the Apatlahuaya river water is proposed, drifting them at an approximate 1,350 MASL height, conducting them, and subsequently returning them to the original river bed at an elevation of 550 MASL, obtaining an approximately 800 meters fall.

- The preliminary conception of the project includes the following structures:
 - An impounding structure drifting dam with capacity to store minimum 50,000 m³
 - Sand trap structure, included in the dam
 - An intake work structure included in the dam
 - A conduction tunnel working as canal.
 - Pressure tube (approx. 800 meters fall)
 - Power house
 - Discharge structure (included in the power house)
 - Substation in power house
 - Transmission line
 - Interconnection

Upon selecting the outline consisting in drifting the consumption in the elevation 1,360 MASL approximately, water is conducted through a tunnel up to a point situated in the Ixcuintecatl foot hill in front of a possible location of the power house, and this two points are connected through the pressure tube.

The load work is of about 800 meters, this means an approximate pressure of 80 kg/cm² in the pipeline's lower part, which is translated into great efforts, which are supported with considerable densities in the pipeline and this means weight and cost.

Different diameters for the pipeline are analyzed, two of them are selected and the pipeline's thickness is determined for each 100 meters increase in the loading.

The conduction through the tunnel shall be as canal and with the adequate slope for the flow to be proposed.

For a diameter of 1.40 in the pipeline a balance between the tunnel and the pipeline prices may exist, and the outline shall be for the simpler to negotiate.

When the diameter is increased and consequently the densities, the tunnel price may be more convenient than the pressure tube one.

II.3.2.3 *Legal status of the project sites and its boundary lines*

TABLE II.14 SURFACE AFFECTED BY THE RESERVOIR

NAME	HECTARES	SURFACE (m²)
Adalberto Fermín Cano Lara	05-18-40	1,004.91
Delfino Lara Acatzihua	5-51-25	1,548.28
José Del Carmen Lara Hernández	5-41-50	1,060.96
Isidro Lara Cano	5-38-75	1,467.53
Isidro Lara Cano	5-47-31	1,124.22
Melecio Lara Hernández	6-38-00	2,192.52
Rosa Lara Cano	5-28-95	865.98
Adelaido Lara Dolores	05-03-00	1,062.78
Melecio Lara Hernández	21-86-00	8,460.16
Fidel, Honorio y Adelaida Tlaxcalteca Amayo	41-60-00	13,844.00
TOTAL		32,631.35

TABLE II.15 SURFACE AFFECTED BY THE PROPOSED INFRASTRUCTURE

No.	NAME	D. HORZ.	FROM KM	TO KM	SURFACE (m2)
CONDUCTION TUBE					
1	Tomas Hernández Aurióles	150.000	0+000	0+150	3,000.00
2	Carmen Nopaltecatl Martínez	130.000	0+150	0+280	2,600.00
3	María Rosario Martínez Tiel	40.000	0+280	0+320	800.00
4	Joaquín Hernández Lara	200.000	0+320	0+520	4,000.00
5	Juan Zepahua Chimalhua	120.000	0+520	0+640	2,400.00
6	Crispín Tepole Xalamihua	180.000	0+640	0+820	3,600.00
7	Joaquín Hernández Lara	630.000	0+820	1+450	12,600.00
8	Rufino Martínez Núñez	320.000	1+450	1+770	6,400.00
9	Joaquín Hernández Lara	50.000	1+770	1+820	1,000.00
10	Leonor Martínez Sánchez	340.000	1+820	2+160	6,800.00
	TOTAL				43,200.00
TUNNEL					
1	José Carmen Lara Hernández	30.00	0+000	0+030	180.00
2	Delfino Lara Acatzihua	30.00	0+030	0+060	180.00
3	Alberto Fermín Lara Cano	30.00	0+060	0+090	180.00
4	Humberto Hernández Lara	50.00	0+090	0+140	300.00
5	Ezequiel Lara Hernández	50.00	0+140	0+190	300.00
6	Sidonio Lara Hernández	100.00	0+190	0+290	600.00
7	Hilario Lara Luna	150.00	0+290	0+440	900.00
8	Eduardo Cano Lara	50.00	0+440	0+490	300.00
9	Ezequiel Lara Hernández	150.00	0+490	0+640	900.00
10	Virgilio Gálvez Lara	200.00	0+640	0+840	1,200.00
11	Francisco Javier Hernández Quechulpa	200.00	0+840	1+040	1,200.00
12	Isidro Lara Cano	300.00	1+040	1+340	1,800.00
13	Anselmo Gálvez Muñoz	500.00	1+340	1+840	3,000.00
14	Luis Zopiyactle Núñez	100.00	1+840	1+940	600.00
15	Gaudencio Gálvez Muñoz	200.00	1+940	2+140	1,200.00
16	Jorge Luis Gálvez Hernández	200.00	2+140	2+340	1,200.00
17	Antonio Martínez Martín	450.00	2+340	2+790	2,940.00
	TOTAL				18,180.00
TRANSMISSION LINE EASEMENT					
1	Erasmó Delgado Guerra	421.038	0	421.038	9,262.836
	Camino	8	421.038	429.038	
2	Erasmó Delgado Guerra	654.613	429.038	1083.651	14,401.486
3	José Domínguez Mellado	355.000	1083.651	1438.651	7,810.000
4	Estela Domínguez Mellado	157.000	1438.651	1595.651	3,454.000
5	Juan Domínguez Contreras	533.940	1595.651	2129.591	11,746.680
6	Javier Domínguez Contreras	86.280	2129.591	2215.871	1,898.160

No.	NAME	D. HORZ.	FROM KM	TO KM	SURFACE (m2)
7	Tobías Pérez	69.043	2215.871	2284.914	1,518.946
8	Magdaleno Pérez Maldonado	154.036	2284.914	2438.950	3,388.792
9	Modesto Pérez Maldonado	61239	2438.950	2500.189	1,347.258
10	Guadalupe Pérez	64.562	2500.189	2564.751	1,420.364
11	Cipriano Domínguez Pérez	140.415	2556.751	2705.166	3,089.130
12	Adolfo Flores Sosa	261.584	2705.166	2966.75	5,754.848
13	Alejandro Alfaro González	308.635	2966.750	3275.385	6,789.970
	Camino	7.000	3275.385	3282.385	
14	Ramón Alfaro Guerra	25.130	3282.385	3307.515	552.860
15	Abundio Zavaleta Lara	500.206	3307.515	3807.721	11,004.532
16	Ma. Del Carmen Alfaro Hernández	269.387	3807.721	4077.108	5,926.514
17	Alberto Vargas Hernández	42.918	4077.108	4120.026	944.196
	TOTAL				90,310.572
POWER HOUSE AND SUBSTATION					
1	Héctor Domingo Mellado				968.36
2	Serafín Pilar Domínguez Alfaro				36,184.00
	TOTAL				37,152.36
PROPERTIES LEFT OVER DEPOSIT					
1	Constantino Lara Tzanahua				10,000.00
2	Jesús Martínez Martín				12,283.67
	TOTAL				22,283.67

II.3.2.4 Current land use in the project site and its boundary lines

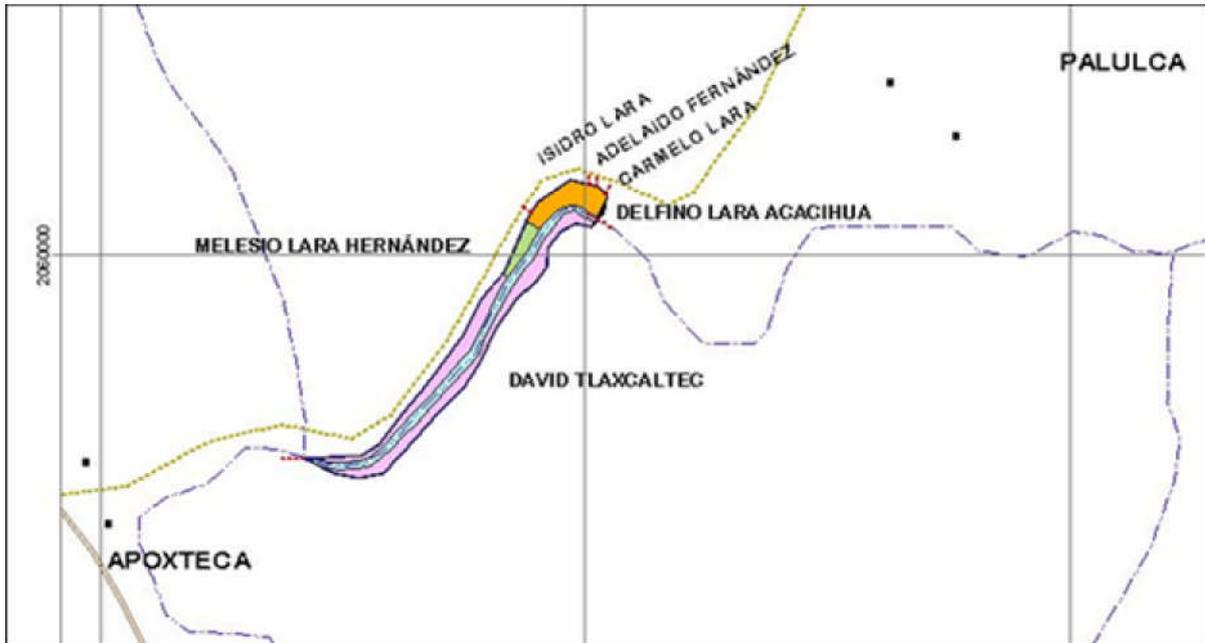
In the municipality of Zongolica the land use is distributed in 60% agriculture, 10% housing, 2% public offices, 1% public spaces, and 27% in hills. In Mixtla de Altamirano, land is used 75% in agriculture, 10% in commerce, 10% in housing, 5% in commerce, 5% in offices and public spaces and 5% is rustic and non productive.

The following figures include the land uses currently present in the project site and a brief description thereof.

As shown in illustration II.10, the land use present throughout the Apatlahuaya river intended to be flooded to create the reservoir is forestall with Oak-Pine forest and the riparian in both river margins.

To the northwest from the river margin, the project in the lands is located in a reforestation pine zone and more towards north there are lands where corn is cultivated in the Soyayo hill sides.

DIAGRAM II.10 CURRENT LAND USES IN THE PROJECT SITE, RESERVOIR, DAM WALL PALULCA, INTAKE WORKS AND ENTRANCE PORTAL OF THE CONDUCTION TUNNEL



Particularly the site's vegetation mainly maintained is riparian which is located in both margins of the river after the Oak-Pine one in the right margin located southeast from the image.

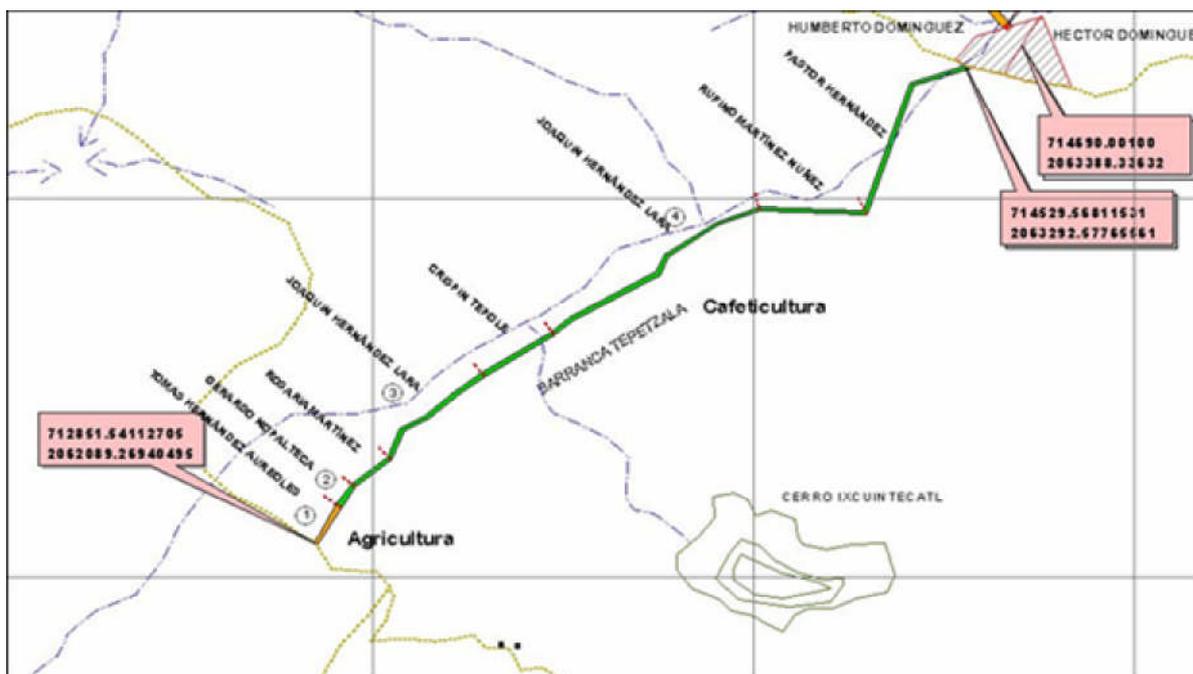
The deforestation is remarkable and is observed in the hill sides of both El Soyayo and Apoxteca.

It is important to mention that in the area at the side of the Apoxteca hill the municipal authorities are carrying out the opening of a road that will communicate to the Mixtla town, where the banding of material is applied to the side of the road, causing the material to roll down hill and demolishes the vegetation located therein.

In the tunnel's exit portal first mesophyll mountain vegetation exists afterwards the superficial pipelines will begin crossing an already existing road that communicates with the town of Xochitla, the pipeline will descend by the Tepetzala ravine until arriving at a place where it will be connected with the power house, this superficial pipeline will find on its way the following land uses, as indicated in figure II.11.

- agriculture (cultivation of corn, banana, sugar cane, etc.)
- Coffee growing (coffee plantation), the major portion of the superficial pipeline's outline crosses lands that are used for this activity.

DIAGRAM II.11 TUNNEL'S EXIT PORTAL AND SUPERFICIAL CONDUCTION LINE UP TO THE POWER HOUSE SITE



In the lands for the electric transmission line from the power house until arriving to the electric substation will mainly cross lands that present the following use, in accordance with illustration II.12.

- Agriculture (cultivation of corn, banana, sugar cane etc.)
- Coffee growing (coffee plantation)
- Pasture land (cattle breeding)

Land use in the boundary lines where the project will be carried out.

The land use change will be carried out in accordance with the Sustainable Forestall Development Law (Ley General de Desarrollo Forestal Sustentable), since the removal of vegetation in forestall lands is required, to use them for the activities intended in the project which is the subject matter of the research.

- 1) Industrial. Not applicable
- 2) Housing. Irregular, rural human settlements
- 3) Agricultural. Manual seasonal agriculture for its commercialization, mainly coffee, banana, followed by annual sugar cane.
- 4) Cattle. Extensive and self-consumption cattle.
- 5) Forestall or silviculture. Timber-yielding Vegetation Pine- Oak

DIAGRAM II.12 ELECTRIC TRANSMISSION LINE FROM THE POWER HOUSE TO THE ELECTRIC SUBSTATION



SIMBOLOGÍA

- CORRIENTE PERMANENTE E INTERMITENTE
- CORRIENTE QUE DESAPARECE
- CAMINO DE TERRACERÍA EXISTENTE
- CAMINO PAVIMENTADO
- VIVIENDA
- POBLADO
- PRINCIPALES ELAVACIONES
- PI LINEA DE TRANSMISIÓN
- PRESA A CONSTRUIR
- ÁREA DE MAQUINAS

VEGETACIÓN

- Agricultura
- Cafecultura
- Potrero
- Guamil
- Pino (reforestación)
- Encino-pino
- Vegetación riverañá

II.3.2.5 Area's urbanization

The project is located in a rural zone.

II.3.2.6 Natural protected area

The sites where the construction of the proposed infrastructure for this project are used, are not within, nor limiting with any kind of natural protected area.

II.3.2.7 Other priority attention areas

Approximately 12 km to the south from the research site, is the location of the Priority Terrestrial Region (*Región Terrestre Prioritaria*): North Oaxaca Mixe Sierras RTP-130, which involves the entities of Oaxaca, Puebla, Veracruz and the extreme coordinates are the following ones:

North Latitude: 16° 11' 42" a 18° 33' 22"

West Longitude: 95° 06' 44" a 97° 08' 24"



Important biotic aspects of the RTP-130 Sierras del Norte – Mixe:

Functional ecological integrity: Both in flora as in fauna, however, the dry zone probably has a high integrity and in the humid zone the integrity is low.

Function as biological corridor: It could be considered as a corridor between the Chinantla and the Chimalapas in the high part.

Extraordinary natural phenomenon: The perennial leaves high jungles are the ones that, in structure, present the greatest basal area among all the ones sampled in the country. On the other hand, it is considered a Pleistocene Tertiary refuge. Spectacular limestone outcropping and wind in La Ventosa.

Presence of endemism: Both in flora and in fauna. Several levels may be distinguished: low in the humid zone, high in the dry zone for plants, mammals and birds and very high in reptile fauna and plants in La Ventosa jungle.

Specific Richness: Region with high richness of plants, mammals and birds species.

Function as origin and natural diversification centre: Mainly for butterflies and salamanders. Diversification centre of *Lepanthes* sp. (Orchidaceae).

II.3.3 Site preparation and construction.

II.3.3.1 Site preparation

It will be necessary to proceed to the felling of trees, off-rooting, hatchet-blow to fell trees and general cleaning within the areas where the infrastructure corresponding to the dam will be placed, in the tunnel's entrance and exit portals, in the pressure tube length and in the power house and the substation, as well as in all the transmission line's right-of-way. The hatchet-blow to fell trees will be carried out until eliminating the organic material and vegetal earth.

The felling of trees will be carried out to remove the damaged trees indicated in the inventory of the technical justification research, logs and roots will be removed.

In order to carry out the felling of trees process, power saws will be used for the demolition of trees previously marked. It is foreseen that each property carries out this activity separately, due to the contracting of the resulting products that may be sold or utilized.

– Kinds of vegetation to be affected and surface.

A land use change in forestall lands (Gallery Forest, Oak-Pine Forest and Pine Forest Renewal) will be carried out in a surface equal to 4.29 Ha and in Coffee with shadow trees in a surface of 10.54 Ha, therefore, a forestall land use change is required in a total surface of 14.83 Ha.

TABLE II.16 DISTRIBUTION OF THE TOTAL SURFACE BY KIND OF LAND USE

VEGETATION	Volume (m3 VTA)	Surface (Ha)
Gallery Forest	197.839	1.39
Oak-Pine Forest	122.683	2.6
Pine Forest (Renewal)	---	0.3
Coffee with shadow trees	457.481	10.54
Subtotal for land use change	778.002	14.83
Agriculture	1.092	4.1
Pasture land	---	1.43
Water corps and surfaces without vegetation	---	4.02
TOTAL	779.094	24.38

For the process power saws and hooks for a feasible approach are required. For the extraction of wood, it will be allowed to the inhabitants of the locations established therein. For wood extraction, it will be allowed to the inhabitants of the towns to carry out the utilization, since it is not the corporation's intent to make use of the product derived from the clearing of felling trees. It is necessary to mention that in order to demolish the trees quantified in the Technical Justification Research for the Forestall Land Use Change the trees shall be previously marked with the hammer with the technical responsible monogram.

TABLE II.17 IN FIELD REGISTRATION OF ARBOREAL VEGETATION COMMITTED IN THE PROJECT

WORK	SPECIES	ASSESSMENT TOTAL VOLUME
DAM (5.05 HA)	<i>Aguacatillo (Persea schiedeana)</i>	2.541
	<i>Poplar (Platanus lindiana)</i>	158.748
	<i>Ceiba (Bombax ellipticum)</i>	3.620
	<i>Dragon (Croton draco)</i>	0.677
	<i>Oak (Quercus castanea)</i>	29.001
	<i>Ash (Fraxinus uhdei)</i>	23.449
	<i>Jonote (Heliocarpus appendiculatus)</i>	0.624
	<i>Liquidambar (Liquidambar macrophylla)</i>	0.740
	<i>Walnut (Juglans pyriformis)*</i>	12.599
	<i>Palo Negro (Garrya laurifolia)</i>	33.045
	<i>Pine (Pinus Oaxacana)</i>	24.720
	<i>Quilite</i>	3.593
	<i>Ramoncillo (trophis racemosa)</i>	14.692
	<i>Timbre (Inga spuria)</i>	11.909
	<i>Yaco (Tilia mexicana)**</i>	0.564
CONDUCTION LINE (2.53 ha)	<i>Avocado (Persea americana)</i>	1.545
	<i>Aguacatillo (Phoebe mexicana)</i>	4.998
	<i>Aile (Alnus arguta)</i>	0.308
	<i>Annona (Anona squamosa)</i>	0.437
	<i>Calabur (Ardicia compressa)</i>	6.616
	<i>Red Cedar (Cedrela mexicana)</i>	32.885
	<i>Ceiba (Ceiba aesculifolia)</i>	6.581
	<i>Chinene (Persea schiedeana)</i>	17.586
	<i>Oak (Quercus castanea)</i>	0.261
	<i>White fraxinella (Fraxinus uhdei)</i>	2.066
	<i>Ash (Fraxinus uhdei)</i>	2.173
	<i>Acacia (Leucaena esculenta)</i>	0.894
	<i>Jinicuil (Inga jinicuil)</i>	0.584
	<i>Jonote (Heliocarpus appendiculatus)</i>	20.351
	<i>Jonuxpepe</i>	0.167
	<i>Macuil (Tabebuia pentaphylla)</i>	7.762
	<i>Mango (Mangifera indica)</i>	12.313
	<i>Orange (Citrus duramtium)</i>	0.513
	<i>Walnut (Juglans pyriformis)*</i>	16.942
	<i>Rose apple (Syzygium jambos)</i>	0.167
	<i>Pototoca</i>	0.167
	<i>Tatil (Comocladia palmeri)</i>	0.102
	<i>Tepehuaje (Lysiloma acapulcensis)</i>	0.753

WORK	SPECIES	ASSESSMENT TOTAL VOLUME
	<i>Teponaxtle</i>	0.162
	<i>Tescohuite</i>	2.048
	<i>Xochilcogual</i>	58.283
	Yaco (<i>Tilia mexicana</i>)**	1.888
	<i>Yolosochit</i>	2.965
	<i>Yonosochit</i>	0.335
	White sapodilla (<i>Casimiroa edulis</i>)	0.261
POWER HOUSE SUBSTATION (3.18 HA)	Red cedar (<i>Cedrela mexicana</i>)	2.130
	Chinene (<i>Persea schiedeana</i>)	0.753
	<i>Jinicuil</i> (<i>Inga jinicuil</i>)	11.359
	Mango (<i>Mangifera indica</i>)	0.804
	<i>Xochilcogual</i>	10.386
TRANSMISSION LINE (9.51 HA)	Red cedar (<i>Cedrela mexicana</i>)	22.698
	Chinene (<i>Persea schiedeana</i>)	17.214
	Ash (<i>Fraxinus uhdei</i>)	1.092
	<i>Jinicuil</i> (<i>Inga jinicuil</i>)	126.771
	<i>Jonote</i> (<i>Heliocarpus appendiculatus</i>)	7.421
	Mango (<i>Mangifera indica</i>)	11.351
	Manzanilla olive (<i>Hipomanne Mancinella</i>)	4.149
	Walnut (<i>Juglans pyriformis</i>)*	11.099
	Ocozote-Liquidambar (<i>Liquidambar macrophylla</i>)	3.020
	Obo (<i>Spondias mombin</i> l.)	4.594
	Palo Mulato (<i>Bursera simaruba</i>)	5.218
	Primerose (<i>Tabebuia donnell-smithii</i>)	3.694
	<i>Xochilcogual</i>	12.707
TOTAL		779.094

Note: Species included in the NOM-059-SEMARNAT-2001 * Threatened; ** Endangered

It will also be necessary to carry out the removal or rocks throughout the outline, as well as excavations, leveling and stuffing to achieve the levels set forth in the project.

The product derived from the excavation containing argillaceous materials and/or vegetal earth, may be used to carry out recharges in the adjacent erosion zones.

Excavations shall only be carried out in the project section and no ledge nor scattered materials will be left in the cuts talus.

– **Description of the preparation of site activities for each of the infrastructure proposed.**

Particularly the site preparation in each of the proposed structures shall be made as follows:

Dam wall, spillway and intake works.

The dam wall, the spillway, as well as the intake works will be constructed in an integral form, therefore, therein below is a description of the site preparation activities:

On the left margin a construction road will be developed that arrives to the depth of the river bed and that will have a ramification at the location from the intake works. Its length will be of 430 m, the majority of which will remain inside the dam's receptacle and the products derived from the excavation will be carried to the left over r bank indicated in the maps.

Upon the completion of the construction road, the dam wall's placement excavation will begin, both in the depth of the river bed and in the hill sides, to uncover the healthy rock where the concrete dam wall will be placed. In this stage the necessary foundation treatments will be carried out, as injections and denticles.

The excavation of the intake works will be initiated simultaneously to form the entrance to the tunnel and excavate the transition itself between the tunnel and the intake. This structure shall also remain within the dam receptacle.

Impounding Works

The dam wall slopes will be dismantled and cleaned and the depth of the river in the dam wall zone, as well as the beginning portal of the conduction tunnel. The hill sides will be cleaned until finding the healthy material (rock) and the dam wall foundation treatment will be made in the depth and slopes. All the excavation material will be deposited in the established left over r bank.

Conduction tunnel

The tunnel will have the "Portal" Section of 3 m width times 3 m height, with 9 m² of surface and a 2,790 m length, which represents an excavation volume of 22,403.7 theoretical m³.

The tunnel will be excavated in the two fronts, which represents a volume of 11,201.85 m³ per front, measured in site. Explosives in the minimum amount necessary will be used to have a good rock fragmentation that will be used as gross aggregate in the concretes necessary in the work.

Pressure Tube

The outline and cleaning of the zone through which the pressure tube trajectory is located. Its placement shall be leveled on girders anchored to the natural terrain, or on a provisional structure based on rafters and canals, throughout the rail deviation pulleys de forma horizontal y vertical as the case may be, will be placed parallel, with which the cable will be guided in parallel manner in respect to the rail.

This rail shall be contiguous to the conduction line, so it does not interfere with the excavation process and the formation of supports and hold-ups, which at the same time allows to open more work fronts without interference among them.

As of the analysis of the procedures within the project the excavation volumes for the supports and hold-ups, were classified in accordance with the conditions present in the

terrain, therefore, Hand made excavations, Machine made excavations and Excavations with the use of explosives are contemplated, the last one of them in the rocky zones.

Power House

The construction of a protection cofferdam will be necessary so in case of a river swelling it does not affect the works. The necessary excavation will be made with heavy machines in the common material and with the use of explosives in the rock, using the modern techniques of protection and control in the utilization thereof. The product derived from the excavation will be used to form the elevating substation platform.

As commencement of the activities it is required to make the access road and the necessary cuts to make the platforms where the power house and the substation will be made.

Once the platforms are made, the excavations will be carried out, which during the process will have the necessary scooping pumping.

Elevating Substation

The excavations are made first to level the terrain and immediately after, with the material derived from the excavation of the power house a rigorously tight platform is made in accordance with the specifications.

Once the platform is constructed, the local excavations will be carried out to strain the foundation cubes of the metallic structures and control cabin.

Transmission Line

A strip of land or forestall gap will be opened, where the Transmission Line will be set and the center of which coincide with the topographic outline and the width thereof shall be the same width as the right of way; the purpose of this is to allow the construction maneuvers during the development of the works, as well as the compliance with the regulations applicable to this kind of installations. The vegetal waste derived from this activity, will be chopped and disseminated within the right-of-way for their integration to the soil as organic material.

- **Handling, transportation and disposal form of the felled trees material.**
- The dismantled material derived from the forestall products will be raised in furrow in order to be chopped, in the smallest length possible (50 cm) and incorporated to the land, which shall be placed and disseminated in a perpendicular manner in the slope to contribute to the retention thereof and so the same are rapidly incorporated to the soil.

In the case of unhealthy or plagued trees, the same shall be fumigated immediately after being demolished, before this, the sickness or plague to which the same are subject shall be identified in order to be able to select the chemical product to be used in the healing process. Once the same are healed the same shall be handled as the rest of the trees.

TABLE II.18 OUTLINE, LEVELING, CLEANING AND EXCAVATION IN THE PROJECT'S AREA

WORK	CONCEPT	UNIT	QUANTITY
Dam wall	Outline, leveling and cleaning of the area	m ²	1,170
	Excavations	m ³	413
Intake works	Outline, leveling and cleaning of the area	m ²	2,050
	Excavations	m ³	1,009
Spill way	Outline, leveling and cleaning of the area	m ²	150
	Excavations	m ³	1,450
Sand trap	Excavations	m ³	640
Tunnel	Outline, leveling and cleaning of the area	m ²	7,673
	Excavations	m ³	22,403.7
Pressure Tube	Outline, leveling and cleaning of the area	m ²	10,050
Power House	Outline, leveling and cleaning of the area	m ²	3,013
	Excavations in the open in common material	m ³	7,320
	Excavations in the open in rock	m ³	4,880
Substation	Outline, leveling and cleaning of the area	m ²	1,200
	Excavations in the open in common material	m ³	3,780
	Excavations in the open in rock	m ³	2,520
	Compacted stuffing 90 % proctor	m ³	400
Drain Off Canal	Outline, leveling and cleaning of the area	m ²	3,000
	Excavations in the open in common material	m ³	1,536
	Excavations in the open in rock	m ³	1,024
Transmission Line	Outline, leveling and cleaning of the area	m ²	49,800

The inhabitants of the towns established therein will be allowed to carry out the utilization, because the company does not intend to make use of the product derived from the clearing of trees. It is important to indicate that, regardless of the use given to the wood derived from the exploitation, notwithstanding its length, nor the diameters it has, in order to leave the property in automotive vehicles, the official documentation for the transportation of forestall products will be required.

The material derived from the felling of trees may be used as soil improvement.

- **Sites established for the disposal of materials.**

The location of sites for the placement of material derived from excavations may be observed in the maps PHV-05 “Veracruz, Impounding zone, affectations due to DDV” and in the map PVH-06 “Conduction zone affectations due to DDV” included in the relevant annex.

TABLE II.19 SITES FOR THE PLACEMENT OF MATERIAL DERIVED FROM HATCHET-BLOW AND EXCAVATION

SITE	OWNER'S NAME	COORDINATES	EXPLOITATION	AFFECTED AREA (m ²)
IMPOUNDING ZONE				
1	Constantino Lara	N 2,060,066 E 711,179	Agriculture	10,000.00
CONDUCTION ZONE				
1	José Martínez	N 2,061,918 E 713,098	Agriculture and wood	12,283.67

– **Description of the methods to be used to guarantee the talus stability.**

Mainly, in order to attain the talus stability, the laying angles of the materials involved shall be respected. The talus shall be recovered with native vegetation so the roots are attached to the ground and avoid its erosion. Additionally, bushes or trees that help to tie the vegetal coverage in variable points shall be planted, so their roots, which are deep, serve as support for the talus preventing its shifting.

– **Kind, volume and supply source of the material required for the terrain leveling.**

No material banks will be exploited by the petitioner. With the excavation of the tunnel an important portion of the rocky material needed for the construction will be obtained.

The aggregate material required are acquired with the region's transporters and/or material men.

– **Handling from, transportation and place of final disposal of remaining material.**

The material will be transported to the sites indicated for the material supposition by dump trucks.

II.3.3.2 Construction

This section describes the construction procedure of each of the civil works to be performed.

Dam wall, spillway and intake works.

The dam wall, the spillway, as well as the intake works will be constructed in an integral form, therefore, herein below is as description of the construction procedure thereof:

Upon the completion of the construction road, the dam wall's placement excavation will begin, both in the depth of the river bed and in the hill sides, to uncover the healthy rock where the

concrete dam wall will be placed. In this stage the necessary foundation treatments will be carried out, as injections and denticles.

The excavation of the intake works will be initiated simultaneous to form the entrance to the tunnel and excavate the transition itself between the tunnel and the intake. This structure shall also remain within the dam receptacle.

Upon the conclusion of the excavations described, the placement of concrete will be initiated in order to take this work components, dam wall, intake and spillway following a sequence as height is being reached with the concrete.

The concrete will be produced in a dosing central with the resistance required in each of the work stages and will be transported to the placement site in revolving truck and will be placed with the Tower Crane and transportation band. The rock derived from the excavation of the conduction tunnel will be processed to be used as gross aggregate for the concrete and the sand will be brought from commercial Banks operating in the Orizaba zone.

Upon termination of the concrete structure the protection grid of the intake works will be installed, the sand trap gate and its elevating mechanisms, and lastly, in the dam wall top the gate's operation cabin will be constructed.

Also in the existing line of 13.8kV, a transformer to feed in 440V the gate mechanism and the dam wall lighting will be placed.

Impounding Work

Upon dismounting and cleaning the surface to be occupied, a gravity dam wall out of concrete will be built, and which will be 30 m height and will have an approximate volume of 12,000 m³, the gross aggregate (gravel) for the concrete will be processed using the excavation material from the tunnel that is very good quality limestone and ideal to manufacture concrete. Sand will be brought from the Orizaba zone, purchasing it to the suppliers established in the zone.

The concrete will be manufactured in a platform at the top height in the dam wall's left embedding and will be placed by means of transportation bands. The steel reinforcement, the metallic centering and the auxiliary elements, including the sand trap gates will be placed with a Tower Crane installed in the left hill side.

Conduction Tunnel

The tunnel will have a "Portal" section of 3 m width times 3 m height with a 9 m² surface and a length of 2,790 m, which represents an excavation volume of theoretical 22,403.7 m³.

The tunnel will be excavated through the two fronts, which represents a volume of 11,201.85 m³ per front, measured in site. Explosives in the minimum amount necessary to have a good fragmentation of rock will be used. Such fragmentation will be used as gross aggregate in the concretes necessary in the work.

An important portion of the excavated volume by the entrance portal will be processed to be utilized as gross aggregate in the dam wall's concrete, the volume extracted in the exit portal will be deposited in the leftover bank indicated in the maps.

Within the tunnel, safety elements will be installed, such as forced ventilation and gas detectors, in addition to the illumination necessary determined by the established hygiene and safety rules. The electric power will be taken from CFS'S existing lines which pass by the two excavation fronts of the tunnel.

Extraction of the material derived from the excavation will be made with the equipment adequate to the tunnel size, carrying the material up to the tunnel's mouth and from there the dump trucks will be loaded, which will deposit it in the left over bank or in the aggregate processing plant.

During the excavation process the walls and ceiling where it results necessary will be protected because the geologic researches indicate that the rock is of a very good quality, with Hurlled Concrete that will serve as the tunnel's definitive support.

That floor will have a simple concrete template of 0.15 m thickness and in the walls and ceiling there will be a Hurlled Concrete protection where required for the structure's stability.

In the tunnel exit zone a louver with 9 m diameter and 30 m depth will be excavated, which will serve as oscillation ditch to absorb the transitory effects occurring while closing the turbine. Therefore, a ditch will be perforated from the surface up to the tunnel ceiling and subsequently the louver termination will be carried out at the 60 m² necessary, leaving the material through the ditch and loading it into trucks from the tunnel, to deposit the material in the left over banks.

Lastly, the pressure tube's entrance horn will be installed, subsequently straining the hold up cap thereof and installing the butterfly valve.

After the louver, very close to the tunnel's exit, the entrance horn of the pressure tube that will be submerged in a concrete cap of approximately 10 m long, will be installed. At the end of the horn, still within the tunnel a butterfly valve with a diameter of 1.20 m will be placed. There will also be a stanch door that will allow access to the tunnel for unblocking works.

Both the tunnel entrance and the louver platform, will have gates and will be fenced to avoid vandalism and accidents to the community inhabitants.

As of the existing earthwork road, access roads to the tunnel portal will be constructed, and the platform where the louver will be excavated. The excavation product will be placed in the same left over bank as the tunnel material.

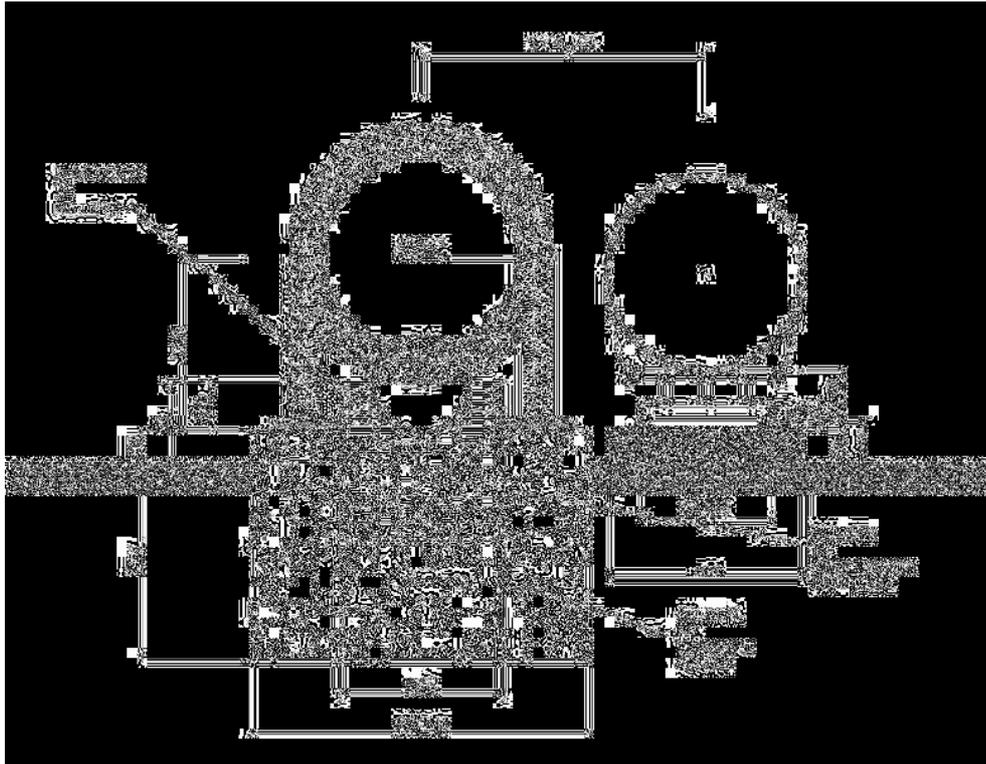
Pressure Tube

The tubes will be taken to the work site by the adequate transportation, the unloading and fitting will be carried out with the help of and hydraulic crane and the necessary tools and personnel will be used for the installation.

Placement

Placement of the pressure tube requires experienced personnel in this subject, therefore, the Contractor's selection is very important.

The constructing proposal basically consists in developing the outline where the pipeline will be placed from the tunnel's exit up to the power house's platform, based on rails on steel profile structures, supported in wooden girders.



The traction force will be the basis of 10 ton spindles in platforms every 500 meters up to the power house.



Initially, the placement of the tubes from the bottom to the top is contemplated, therefore the tubes must be descended to initiate their placement, however, the possibility of placing the pipelines by the two ends continues being analyzed.

Rails

It will be initiated with the placement of the rails for which it is required to first outline and clean the zone where the rail will be deposited, the placement thereof will be leveled on girders anchored to the natural terrain, or above a provisional structure based on rafters and canals, parallel throughout the rail, deviation pulleys of horizontal and vertical form, as the case may be, will be placed, with which the cable will be leaded parallel to the rail.

This rail will be contiguous to the conduction line, so it does not interfere with the excavation process and forming of supports and hold-ups, which at the same time allows to open more work fronts without interference among them.

Excavation

As of the analysis of the proceedings within the project the excavation volumes for the supports and hold-ups were classified, in accordance with the conditions present in the land, therefore hand excavations, excavations with machinery and excavations with the use of explosives are contemplated, the last one in the rocky zones.

Mounting

The mounting shall be carried out as follows:

A spindle will be placed in the higher part of the road at the tunnel's exit on a platform formed precisely for this activity. This equipment will be fixed to a concrete tile through anchors.

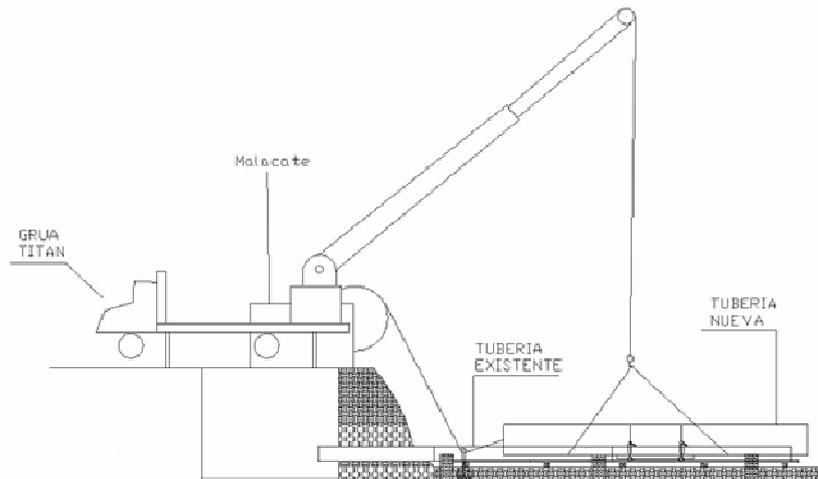
With the use of a titan crane the new tubes from the storing courtyard will be taken and carried to the launching and will be launched above the spindle to deposit them in the mounting cart.

Once on it, in the cart ends two chain differentials of 3 ton each will be placed to fix the cart to the pipeline.

Two ears will be placed to the tubes in which the spindle cables will be fixed.

Once the above mentioned is effectuated, the crane is removed so the spindle carries out the pipeline descent.

Throughout the pipeline distance traveled on the rails, the deviation pulleys must be placed to keep the cable parallel to the rails, these pulleys will be mounted on concrete basis or on the rails structure, depending on the curve's angle.



Previously the excavation works for the hold-ups and stools foundation will be carried out, these will be carried out through mechanical means in the most accessible parts and manually in the difficult access parts.

The stools will be constructed before mounting the pipeline.

The hold-ups will be placed in two portions, the stage first as support to place the tube and the second stage after mounting the pipeline, because it must remain inserted in the concrete.

The concrete will be in site manufactured, the materials will be set closer to each structure by using the cart and the spindles.

Mounting of the pipeline will be carried out placing a flag crane downstream from the mounting cart, in the zone where the mounting will be initiated.

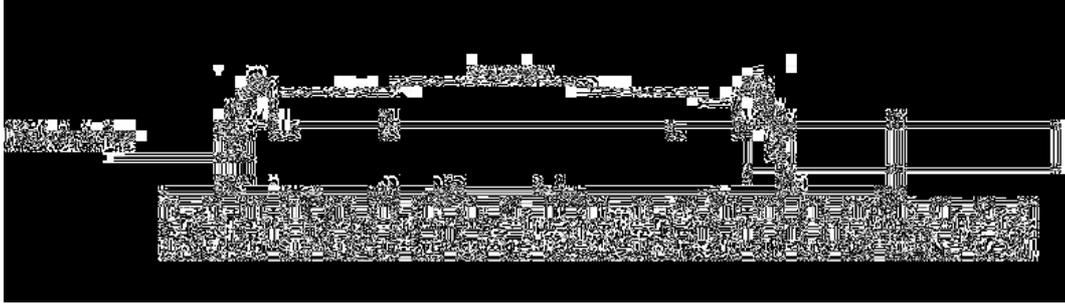
The crane is attached to the rail and the cart is positioned with the pipeline 1 meter from the middle of the clear.

The cart is tighten to the rail, and the second flag crane is placed upstream from the mounting cart and it is also attached to the rail.

5/8" x 3" long plate guides will be placed in the tube-to-tube joints to rest one of the ends of the pipeline that is being mounted.

The cranes are manipulated to hook the 5 ton single blocks to the ears previously soldered to the pipeline in the upper part, and it begins to be heaved at the same time.

Once the pipeline has been lifted from the cart, the flag cranes are rotated and the spindle begins to descend so the pipeline arrives to its position. Once it is placed in its position the rounding begins to be conformed, aligned, pointed and minted, to be able to release the spindle and the flag cranes.



The spindles basements will remain the site for the pipeline maintenance works during the operation.

Power House

A very precise coordination among the civil work, the provision of electro-mechanic equipment and the mounting thereof is required. As commencement of the activities it is required to make the access road and the necessary cuts to make the platforms where the Power House and the substation will be made.

Once the platforms have been made, the excavations will be carried out, which during the process will have the necessary scooping pumping, the foundation concrete will be strained, as well as the necessary injection treatments will be carried out, for which 3" diameter performers and grout injection pumps will be used, the structure's base tile will be placed and subsequently, the bases for the placement of the Pelton turbine will be carried out, the construction of the perimeter walls will continue.

The columns and joists will be constructed to place the rails of the traveling crane that is the first equipment to be mounted. Once the crane is installed, the superstructure and ceiling of the power house will be constructed so the latter is protected from dust and humidity.

The turbine will be placed and the second strains will be made to fix it on its final position, in order to subsequently strain the generator's floor and initiate the mounting thereof in a clean environment.

For the generator and the control equipment mounting, it is necessary that the power house is completed and protected against rain and dust, because the equipment may be damaged in the absence of this precaution.

Once the generator has been mounted, the connections with the mechanic and auxiliary electric equipment and the connection of the needle valve to the pressure tube will be carried out, to initiate the equipment tests and starting up .

As an important part of the electric connections, the connection of the generator to the substation's power transformer will be carried out, which will increase the voltage from 13.8kV to 115kV.

For the substation a leveled platform is required, where the excavations and the straining of the foundation cubes for all the mechanic and electric equipment which are components thereof will be carried out.

Afterwards, the electro-mechanic mounting will be made, including the communication equipment with CFE and the tests necessary for its acceptance by this entity.

The substation will be linked to the transmission line with a 115kV voltage.

Elevating Substation

Once the platform has been constructed, the local excavations are carried out to strain the foundation cubes of the metal structures and control cabin. The metal structures that form the substation body are mounted in the foundation cubes and subsequently, all the electro-mechanic equipment is mounted in order to make the connection of the transmission line in the exit portal.

Transmission Line

For the construction of the transmission line it will be proceeded as follows:

Once the project area is clean and dismantled, the location of structures and verification of the field profile where the acknowledgement boundary stones and stakes with the number and kind of structure to be placed is carried out, in addition to corroborating the profile's more outstanding points.

The opening of holes to form the location sections in the foundation of the support structures will begin and the same will be located and dimensioned in accordance with the project's specifications.

A layer of compacted concrete with a minimum 10 cm thickness to level the structure will be placed in the foundations' location.

The steel structures will be mounted and the concrete foundation will be placed. During the straining the grounds system will be installed by introducing Copperweld bars into the ground and laying the Copperweld wire at a 50 cm depth between the foundation shoes which will be connected to each of the structure legs.

Once the leveling of each of the towers has been reviewed and approved, the stuffing and compacting with the material derived from the excavation will be carried out and the structures upper body will be mounted.

Next, the dressing of the towers will be carried out, which consist in the placement of chains, iron fittings, insulators and, as well as the laying, placement and stretching of the guard cable.

As final activities the placement of accessories and iron fittings in order to fasten the insulator chains will be carried out and the laying and stretching of the conducting cable with its relevant joints, bridges and pinnacles in the towers which so require will be performed.

II.3.4 Operation and maintenance

II.3.4.1 Operation program

The activities in respect to the operation and maintenance of the project will include: generation of electric power, preventive maintenance, corrective maintenance and replacement of equipment.

The general proceeding for the operation of the hydroelectric central is presented, in which the activities commonly developed for the production and delivery to the power network may be observed.

The production of electricity will be governed by the operating policies both of the dam as of the emission of energy flow to the distribution network, this means that the company is subject to the authorizations by the Comisión Federal de Electricidad to transmit the electricity in accordance with a delivery protocol, for which the prior programming in order to enter to the system and the relevant notices or orders in order for the flow to enter into the network is carried out. On the other hand, the discharge volume and the dam's water levels are subject to the indications issued by the *National Water Commission* (National Water Commission (Comisión Nacional del Agua)) and other authorities based on their utilization program and on the dam's receptacle own operation, therefore, the use to be given to the resource in the hydroelectric plant will have a strict handling control.

It is important to mention that in the hydroelectric central discharge exit there will be a Parshal measurer, through which a continuous recording of the water flow to be turbinated will be kept, as well as the record measurers required by CFE to know the amount of power generated by the central.

In accordance with the foregoing, a regular operation situation of the plant is performed in the following manner:

The availability of the resource will be verified on a daily basis, so in accordance with its program, the central operation periods are planned. Communication with the Centro Nacional de Control de Energía CENACE of CFE is established in order to set the entrance periods into the distribution network and obtain the relevant orders. The preparation of the electro-mechanic equipment continues for the beginning of the central synchronization with the network and the turbine work commences to reach the required speed and maintain the charge power in order to be released to the system. Once the power has been reached and the equipment has been synchronized a signal through the control system is sent to the substation switches to make the relevant connection and thus make the transmission of electricity flow up to the interconnection with the distribution network.

As the generation of electric power is being carried out the process of water entry and discharge will work as follows:

The water flow from the dam enters to the conduction tunnel through the spillway and it will be directed to the exit portal section where the conduction tube is located, here, with the terrain's natural slope, water will descend by gravity generating a greater pressure in the duct, this way providing the drive power until reaching the connection point with the power house, that is why when opening the butterfly valve, the flow enters the snail pipeline

increasing its speed due to the decrease in the pipeline's diameter, with which at this point a pressure spurt circulates which generated motion when pushing the vanes of the turbine-generator set, subsequently passing through the aspiration elbow until reaching the back pressure tank, where the turbulence is broken and the speed with which water is expelled to reach here the minimum speed regime. Once the water is discharged in the back pressure tank and its drain off canal, the water will be disposed to the river bed for its down stream distance traveled as it currently happens.

When motion is produced in the turbine-generator set the production of electric power will begin, this activity is monitored through the control systems automatically or manually, supervised by the central's personnel that is gathered in the control room and in the platform where the electro-mechanic equipment are distributed and placed. This way the process that transforms the water potential power into mechanic power first and thereafter into electric power.

It will have the satellite communication service to cover the telephone and Internet services which are necessary mainly for the operations carried out before CFE in the power network as well as for the remote surveillance of the systems operating the hydroelectric central. The installation of the communication system only requires the mounting of a parabolic antenna and the supplementary equipment for the signal decoding and backups, cables within the power house building and, as the case may be, the peripherals required for its connection to the computer system to be installed in the control room.

For the protection of the central's equipment and personnel the detection and extinction systems as well as the personnel protection equipment required for the control of fire attempts will be installed. The detection system will have two alarm services and automatic stop by sending a signal to the control group through the sensors with capacity for the detection of temperature increase and smoke. The system will be supplemented with a battery of CO₂ tanks that may be activated manually or automatically for fire control and extinction in case any fire is present in the generator body.

II.3.4.2 Predictive and preventive maintenance program.

Detailed description of the maintenance activities in the hydroelectric central Veracruz.

ROUTINE MAINTENANCE PROGRAM TURBINE AND REGULATION SYSTEM (010PMRTUR)

- 1 Exterior cleaning of oil-hydraulic unit
- 2 Review and reposition of oil levels
- 3 Cleaning and review of exterior control oil filters
- 4 Cleaning and review of internal control oil filters
- 5 Review to the oil-hydraulic tank
- 6 Review de hoses and connections
- 7 Review of opening and closing times of the sphere shaped valve
- 8 Record opening readings of the waterspouts servomotor
- 9 Review and cleaning of sphere shaped valve
- 10 Review and drying of the tank's silica
- 11 Interior cleaning of the Speed Regulator Cabinet and connection boxes

- 12 Cleaning and lubrication of manual valves rods
 - 13 Review and cleaning of the switch limit detectors of the water spouts
 - 14 Measuring of current and vibrations in motor-pumps 1 and 2
 - 15 Review and cleaning of the inner tube and the packing of the turbine's burlap press
- Measuring of entrance and exit times to reload the pumps oil pressure.
Review and lubrication of the waterspouts joint direction mechanism

ROUTINE MAINTENANCE PROGRAM LUBRICATION AND BEARING SYSTEM (021PMRSLCH)

- 1 Verification of free rotation of lubrication rings
- 2 Verification of lubrication and bearing abnormal noises
- 3 Detection of leakages in caps and axial seals
- 4 Recording of vibrations and temperatures to LA and LOA bolsters
- 5 Verify the operative conditions of the vibrations, analyzer, detectors and thermo-pairs
- 6 Calibration of field measuring instruments and remote unit
- 7 Visual inspection to the exceeding speed detector

ROUTINE MAINTENANCE PROGRAM LUBRICATION SYSTEM (022PMRLUB)

- 1 Exterior cleaning of the lubrication unit
- 2 Cleaning of the oil cooler lubrication and carry out hydrostatic test.
- 3 Review of lubrication levels
- 4 Verification and recording of flows and lubricating oil pressures
- 5 Measuring of current and detection of CA motor noises
- 6 Review and cleaning lubrication filters
- 7 Review the oil's dirtiness degree (oil filtration)
- 8 Humidity detection (hot plate) in lubricating oil
- 9 Actual functioning test of the direct current pump
- 10 Review and cleaning of lubrication tank and bearing carter and oil cleaning with press filter
- 11 Review of the main lubricating pump coupling
- 12 Review and cleaning cooler water filter

ROUTINE MAINTENANCE PROGRAM COOLING SYSTEM (023PMRENF)

- Functioning test, current measuring and detection of noises in motor-pumps
- 2 Cleaning of the filter self-cleaning system
 - 3 Cleaning manual filters
 - 4 Cleaning and lubrication of valves rod.
 - 5 Review and cleaning of valves check
 - 6 Cleaning of cooling unit.

ROUTINE MAINTENANCE PROGRAM OF THE BRAKE AND SERVICE AIR SYSTEM (024PMRFYAS)

Review and/or change of the lubrication filter

Review and/or replacement of the lubrication level

Cleaning of air filters

Review, cleaning of separator tank and change of filters.

Cleaning of electric module

Recording of temperature, pressure, service hours, amperage parameters and review abnormal noises.

Review of tension and bands condition

Review and cleaning air cooler.

Pistons review and maintenance. Starting up of brake shoes

Cleaning of the brake modules and compressor

ROUTINE MAINTENANCE PROGRAM SCADA SYSTEM (030PMRSCADA)

Inspection with thermo-vision equipment to detect hot spots

Review and cleaning of ventilators and Cabinet filters and CPU

Review that there is no water condensation within the control cabinets

Review of signal system lamps and change the damaged ones.

Review and cleaning of electronic cards and CPU, as well as data base backup.

ROUTINE MAINTENANCE PROGRAM CCM 480 V (051PMRCCM)

Inspection with thermo-vision equipment to detect hot spots
Review the correct functioning of locks
Cleaning cabinet and verification of wraps
Review the connections tighten, observing the possible discoloration due to loose connections
Review the status of contactors contact, relees etc.
Greasing of controls and action devises
Review of the conductors insulating
Signal lights of the control panel test and change the damaged ones.
Review of a complete functioning cycle (local and remote control, temporizers, signal system)

ROUTINE MAINTENANCE PROGRAM LIGHTED TRANSFORMER PANEL OF 480/220 V (053PMRTALU)

Inspection with thermo-vision equipment to detect hot spots
Review the correct functioning of locks
Cleaning of Cabinet and verification of seal wraps
Review of connections tighten, observing the possible discoloration due to loose connections
Review the status of the contactors contact, relees etc.
Review of controls and action devises. Greasing if necessary
Review the conductors' insulation
Review of a complete functioning cycle (local and remote control , temporizations, signals)

ROUTINE MAINTENANCE PROGRAM DIRECT CURRENT SYSTEM FOR PROTECTION AND CONTROL (060PMRSCD)

Review ventilators and cleaning of the Cabinet filters
Review that there is no water condensation within the control squares.
Review and cleaning, with compressed air, the electronic cards.
Cleaning of the batteries gate and air extractor
Review the level of the batteries liquid
Cleaning module, lubrication and change of damaged plaques.
Review and repair, is required, of the emergency lighting
Winder cleaning
Review the signal lights and change damaged bulbs
Inspection with thermo-vision equipment to detect hot spots

ROUTINE MAINTENANCE PROGRAM ELECTRIC SUBSTATION OF 115 KV (070PMRSE)

Oil leakage detection in the main Transformer, TC'S AND TP'S
Review of dielectric oil levels in Main Transformer, TC'S Y TP'S
Inspection of auxiliary equipment, transformers, lightning arrester and knives
Inspection of silica gel dryer.
Cleaning the 115 KV support insulators
Inspection of ground placing connectors.

Perform cleaning in the substation's interior and exterior
Review of the ground networks
Cleaning the connections Cabinet of the Main Transformer
Review / repair the substation lighting
Scooping and cleaning of transformer tank
Review the free rotation of ventilators and if necessary change bearings.
Inspection with thermo-vision equipment to detect hot spots
14 Carry out cleaning in the measuring cabin

ROUTINE MAINTENANCE PROGRAM EMERGENCY GENERATOR (090PMRGEM)

Verify the oil level in carter, water in radiator and level in the fuel deposits
Verify the indicator of air filter obstruction and cleaning of air filter
3 Verify the Battery's electrolyte level, density and charge.
4 Cleaning with air and/or change of air filter.
5 Start-up and empty test
6 Start-up and charge test
7 Carry out equipment general cleaning
8 carry out hot plate test to the lubrication oil
9 Review and/or lubricating oil change and filters

ROUTINE MAINTENANCE PROGRAM TRAVELING CRANE (102PMRGV)

1 Review of Control of Control .
2 Functioning test in Emptiness of Bridge and Transversal Cart.
3 Review and test of main and auxiliary hook load.
4 Review and lubrication of drums and heaving cable of main and auxiliary hook.
5 Review the charge limiter.
6 Review and lubrication of motor-reducing bolsters.
7 Review balata gums.
8 Review and adjustment of speed micro.
9 Review and cleaning of electric equipment, and race adjustments.
10 Review and cleaning of electronic unit.

ROUTINE MAINTENANCE PROGRAM AIR CONDITIONING AND VENTILATION (104PMRAIRE)

Cleaning of condensers of all the air conditioning of the power house, camp and cabins.
2 Current parameters and equipment pressure intake.
3 Inspection of electric components
4 Review de stretching of Bands in Ventilators
5 Change of bearings to the ventilators in the control room.
6 Adapt bearings to ventilator motor.
7 Review drainages in air conditioning and uncover if necessary

ROUTINE MAINTENANCE PROGRAM SERVICE WATER SYSTEM (106PMRSAS)

- Cleaning and/or change of the water system service filters of the central
- 2 Cleaning of 750 liters earth-ware jar. Power House.
- 3 Cleaning and/or change of the camp's water service systems filters
- Cleaning of earth-ware jar and cistern of the camp's water service system
- 5 Carry out cleaning and painting of Balsa
- 6 Review the status of the balsa and accessories
- 7 Review and cleaning of Moto-pump starter
- 8 Inspection and/or change of damaged cable sections from the pump to the starter.

ROUTINE MAINTENANCE PROGRAM OF STRUCTURES, DUCTS AND CABLE RECORDINGS (107PMRESTRUDUC)

- Cleaning of stairs (Irvin grids) of the power house
- Cleaning and sealing of Medium Tension poly-ducts from power house to substation.
- Cleaning of power and control trays of the power house.
- Internal and external cleaning of power house structures
- Cleaning of the internal ditch of the power house
- Cleaning the power house' storehouse
- Cleaning de la bodega del camp

ROUTINE MAINTENANCE PROGRAM ROADS AND ACCESS TO THE CENTRAL SYSTEMS (108PMRCYA)

- Cleaning of the trail from the Valves House to the substation.
- Cleaning the tank of the forced pipeline tank.
- Rehabilitation of gutters and maintenance to the access road, from camp to Power House.
- Cleaning camp's exterior and footways
- Rehabilitation of the access road gutters from camp to Power House.
- Cleaning of areas around the camp.

ROUTINE MAINTENANCE PROGRAM SEPTIC TANK (109PMRFS)

- Review the tank's interior and the earth-ware jar.
- Tie and paint metallic covers
- Withdraw solid waste from the septic tank. Using a special equipment.
- Carry out exterior cleaning.

ROUTINE MAINTENANCE PROGRAM FIRE SYSTEM (110PMRCI)

- Review and cleaning of detectors.
- Inspection of CO2 Cylinder weight
- Inspection of Action Mechanisms
- Inspection of CO2 pipelines.
- Functioning test to the CO2 generator system insulating the cylinders.
- Inspection and replacement of signal lights.

ROUTINE MAINTENANCE PROGRAM INDUSTRIAL SAFETY(115PMRSDH)

- Cleaning of status signals of the detector
- Cleaning the smoke detector
- Cleaning of alarm central box
- Cleaning the alarm sirens
- Cleaning the manual pulsator
- Cleaning the re-arming thermal detector
- Cleaning the infrared detector
- Functioning test to the fire detector system

ROUTINE MAINTENANCE PROGRAM COMMUNICATION SYSTEM (120PMRSCM)

- Review Motorola MC2000 consoles. Control room.
- Verify the correct functioning of Vanguard. Control room.
- Review and recording of tension, with load, of the Control room's UPS and of the camp repeater
- Carry out voice enlace with Zongolica.
- Carry out voice enlace with the Subarea.
- Verify data enlace with Zongolica.
- Review and maintenance to portable radios, base and vehicular.

II.3.5 Abandonment of the site

Due to the importance represented by this kind of works and the service offered, the abandonment of the site is not considered.

Once the infrastructure reaches its useful life the necessary adaptations and updating will be carried out, in order to continue providing the service for which it was projected.

Considering the duration of the concessions granted by CONAGUA, the project's useful life will have a minimum of 20 years of operation, since the dam's characteristics provide the opportunity to continuously unblock it and the core equipment may be substituted, modernized or rehabilitated, increasing the useful life time frame.

II.4 Personnel and supplies requirement

II.4.1 Personnel

During the project's construction and starting up, personnel will be hired for the different stages of the same project and it is estimated in about 232 workers for the maximum simultaneous activity in the different fronts, it being understood that the number will be variable as of the beginning of the work, in which persons will be incorporated in accordance with the needs and shall be decreasing as the relevant stages thereof are completed.

Specialized, qualified and not qualified personnel will be required in temporary form and will be distributed in accordance with the following table:

TABLE II.20 PERSONNEL BY CATEGORY:

Civil Work	Electro-mechanic work	Transmission line	Administration	Supervision
Work Director				
<ul style="list-style-type: none"> - Dam wall civil work chief - Tunnel Superintendence -Superintendence forced pipeline - Civil work chief power house and substation -Qualified Personnel - Non qualified personnel 	<ul style="list-style-type: none"> - Electro-mechanic work chief - Electric engineer -Mechanic engineer - Electro-mechanic mounting specialists - Control systems specialists -Qualified Laborers -Non qualified Laborers 	<ul style="list-style-type: none"> - civil work chief -Electric engineer - line technicians -Topographer -Qualified Laborers -Non qualified Laborers 	<ul style="list-style-type: none"> - administrative chief -Accountant -Support personnel 	<ul style="list-style-type: none"> -Civil work Supervisor -Electro-mechanic mounting Supervisor -Supervisor tunnel -Supervisor pressure tube -Transmission line Supervisor

Herein below is a table containing the number of workers per work area.

TABLE II.21 NUMBER OF WORKERS PER AREA:

Work area and personnel	Number of persons to the employed	8 hour shifts
Work direction		
General superintendent	1	1
Civil Work		
Dam wall civil work chief	1	1
Tunnel superintendent	2	2
Forced pipeline superintendent	1	1
Power house and substation civil work chief	1	1
Qualified personnel	54	2
Non qualified personnel	97	2
Electro-mechanic Work		
Electro-mechanic Work chief	1	1
Electric Engineer	1	1
Mechanic Engineer	2	1
Specialist in Electro-mechanic mounting	6	1
Specialists in control systems	2	1
Qualified Laborers	25	1
Non-qualified Laborers	45	1
Transmission Line		
Civil work chief	1	1
Electric Engineer	1	1
Line technicians	2	1
Topographer	1	1
Qualified Laborers	5	1
Non qualified Laborers	9	1
Administration		
Administrative chief	1	1
Accountant	1	1
Support personnel	3	1
Supervision		
Civil work Supervisor	1	1
Tunnel Supervisor	1	1
Electro-mechanic mounting supervisor	1	1
Pressure tube supervisor	1	1
Transmission Line supervision	1	1

The personnel required for the operation and maintenance of the Hydroelectric central Veracruz amounts a total of (9) employees, comprised of (1) Superintendent, (4) operation and maintenance technicians and (4) technical assistants, the main activities of which are the following ones:

Position's denomination: **Superintendent**

Generic function:

Administrate the human, material and financial resources used for the electric power generation process in the Veracruz central, having a close coordination with the *National Water Commission* (National Water Commission (Comisión Nacional del Agua)) and with the regional control area of Comisión Federal de Electricidad, in compliance with the authorized generation and maintenance programs for the equipment and premises.

Position functions:

General:

Preparing the budget for the investment and exploiting expenses of the work centre; as well as to overview and control the exercise thereof.

Evaluate the performance and merits of the personnel under his supervision in accordance with the procedures established to promote productivity.

Participate in the evaluation and selection of personnel recently incorporated to the work centre.

Coordinate and participate in the timely preparation of technical-administrative reports of the work centre.

Coordinate the preparation and compliance with the annual, routine and predictive maintenance programs of the generating unit and the premises in general.

Promote, disclose and verify the compliance with the official normative, regulations, proceedings and agreements in effect in connection with administration, training, productivity, environmental control, industrial safety, civil protection and quality, as well as the preparation of the relevant programs.

Coordinate the application and updating of technical and administrative manuals and procedures.

Coordinate and participate in the preparation of the work centre's basic administration organization.

Coordinate and/or prepare the personnel vacation program, supervising the application thereof.

Coordinate and/or timely request before the control are the formalities of the licenses for the programmed maintenance to the generating unit, the substation and the premises in general.

Formulate for their timely procedures, the requirements, contracting of works applications and of third parties' services, in accordance with the regulations in effect.

Analyze and validate the central's financial statements.

Establish an adequate coordination with the regional control area and the Veracruz distribution zone of Comisión Federal de Electricidad and with the national water

commission representatives, to Schedule licenses of the generating unit, for the execution of scheduled and emergency works required.

Provide training to the personnel ascribed to the central.

Plan and organize activities in order to prevent accidents of the personnel under his supervision.

Analyze the hydrometric reports of the dam's basin gathered by and for the National Water Commission (*Comisión Nacional del Agua*).

Position identification: **operation-maintenance technician**

Reports to: **Central's Superintendent**

Generic function: operate and maintain with safety and efficiency the central's equipment to attain continuity in the generation of electric power in accordance with the programming established with the CNA and the regional control area of the CENACE.

Position functions:

Keep in optimal conditions the work premises, equipment and corresponding to his area, timely reporting to the central's superintendent the physical and functional losses thereof.

Adequately use take care of the communication means installed in his work centre.

Adequately interpret, apply and keep the procedures, work instructions, manuals, maps, diagrams and technical literature necessary for the correct performance of his work.

Plan, organize and execute with quality and efficiency the maintenance work entrusted by the central's superintendent and adequately prepare the reports and records in accordance with the maintenance procedures established.

Drive the work vehicles available in the central, under the authorization and supervision of the central's superintendent.

Use the machinery and tools necessary for the good performance of his duties.

Timely request the materials, spare parts, equipment and tools necessary for the works to be performed, reporting when their existence is null or insufficient.

Personally corroborate that the equipment or systems are perfectly shut down or their mechanic and electric operation is blocked, before beginning the maintenance works and upon their conclusion, request to the central's superintendent the approval thereof, to proceed to remove the relevant license.

Carry out the maneuvers necessary to ensure that the generation unit and the substation, as well as the auxiliary equipments and systems efficiently operate, both in regular operation and emergency situations, in coordination with the personal under their direction, strictly observing the established procedures and regulations in effect.

Truly and timely inform, in coordination with the central's superintendent, to the control area and to the distribution control centre of the Veracruz zone, the events that have affected or may affect the availability or reliability of the generation. Provide the information requested as well as to observe such control area's instructions in accordance with the internal regulation for the operation of the national electric system.

Keep the access doors to the premises closed.

Specific:

Keep the premises and electro-mechanic equipment in optimal physical and operative status, so they are available at the time when required, with efficiency, with resources rationality criteria and taking all the safety measures applicable to each event, under the coordination of the central's superintendent, to which he will directly report.

Carry out the daily routine inspections, at least 2 in regular operation conditions, in premises and equipment of the power house correcting or normalizing what is required and does not require the unit's stoppage.

Efficiently operate the equipment directly involved in the generation of electric power (generator, turbine, speed regulator, excitation system, field and machinery switches), in the scattered maneuvers, synchronization and unit stoppage in manual or automatic form, taking all the necessary safety measures.

Effectuate reviews to the central's equipment in each shift change as routine and due to special conditions (unit shots or abnormal equipment operation), including in addition to the ones mentioned in the preceding paragraph, the review of bearings, (performing oil reposition if necessary), bearings, valves, filters cleaning and change in the cooling water system and purge thereof, control panel, radio frequency VHF, substation and equipment, etc.

Position identification: Technical Assistant

Reports to: operation-maintenance technician

Generic function: surveillance, revision, maintenance and take care of premises and equipment, supporting and under the coordination of the operation-maintenance technician, keeping order and cleanness in his work areas.

Position's functions and activities:

General:

Keep in optimal conditions the work premises, equipment and tools corresponding to his responsibility scope, timely reporting to his immediate boss the physical and functional losses thereof.

Participate in the timely preparation of routine and extraordinary reports of his area, to the central's superintendence.

Adequately use and take care of the communication means installed in his work centre.

Adequately interpret, apply keep the procedures, work instructions, manuals, plans, diagrams and technical literature necessary for the correct performance of his work.

Observe, promote and overview the compliance with rules, regulations, manuals, plans, programs, procedures and agreements in effect, applicable in connection with industrial safety, occupational health, civil protection and disciplinary policies or of acknowledgement of the safety attitudes established in the work centre.

Execute the maintenance works assigned by his immediate boss, reviewing the placement of safety cards in the equipment involved and report at the end of the work, for the removal of the order, verifying together with the operation-maintenance technician, the equipment's correct functioning.

Drive the vehicles assigned to the work centre when the activities related to his work so require, under the authorization of his immediate boss.

Use all kind of tools and equipment necessary for the correct performance of his duties.

Timely request all the materials, spare parts, equipment and tools necessary for the works to be performed, reporting when the existence thereof is null or insufficient.

Keep in good condition all diagrams, instructions, books and technical literature related to his duties.

Execute maneuvers which are required to comply his specialty works.

Inform to his immediate boss when noticing abnormalities of the central's equipment detected during the execution of works.

Support the operation-maintenance technician in the performance of the central equipment alignment works.

Use the oxyacetylene equipment, for cutting of plaque and heating works.

Use soldering equipment of electric arch to mark with dots several metallic pieces.

Report and document the work performed, using the formats established in the department.

Specific:

Keep the premises and electro-mechanic equipment in optimal physical and operative condition, so they are available at the time when requested, with resources rationality criteria and taking all the safety measures required for each event, under the coordination of the central's operation-maintenance technician, to whom he will directly report.

Carry out the daily routine inspections, at least two in regular operation conditions, in premises and equipment of the power house, correcting or normalizing what is required (reposition of oil levels, adjustment of stuffing boxes, cleaning of several filters, etc.) under the coordination of the central's operation-maintenance technician.

Execution of the routine, major and minor maintenance to the turbo-generating units, with efficiency, resources rationality criteria and taking the safety measures necessary, under the coordination of the central's operation-maintenance technician.

Execution of maintenance and/or rehabilitations in the equipment and hydraulic premises (gates, needles, grids, pressure tube, valves of the forced conduction, etc.).

Support in cleaning maneuvers or works in the hydraulic works, provided that the major priority activities allow it.

Safe driving of the work vehicles when requested.

In case any situation is detected, which indicates the imminent failure of the equipment being operated, directly communicate it to the operation-maintenance technician, directly act if time does not allow the above mentioned, removing them from the service to avoid major damages.

Move to the drifting dam to support in the maneuvers and works that require it, under the coordination of the central's operation-maintenance technician.

Carry out the duties and activities provided for the operation-maintenance technician as training under the responsibility and coordination thereof.

II.4.2 Supplies

TABLE II.22 NATURAL RESOURCES USED

RESOURCE USED	VOLUME, WEIGHT OR QUANTITY USED	OBTAINMENT FORM	USE STAGE *	OBTAINMENT PLACE	EMPLOYMENT FORM
Wood	150 plywood leaves and 300 rafters.	Supplier	Construction		Centering and supporting
Stony materials	11,000 m ³	Excavation and region's transporters and/or material men	Site preparation and construction	Tunnel, excavation in rock and y Supplier	Construction and stuffing material
Hard water	20 m ³ /month	Pumping	Site preparation	Apatlahuaya and Zongolica Rivers	Concretes and irrigation preparation
Hard water	3,000 m ³ /month	Pumping	Construction	Apatlahuaya and Zongolica Rivers	Concretes and irrigation preparation
	7m ³ /s	Gravity	Operation	Reservoir	In the generation turbine

II.4.2.1 Water

The consumption of hard water for the site preparation stage depends on the application of periodical irrigation in the excavation zone and access road to avoid the generation of dusts.

During the construction the utilization of hard water is being considered, mainly for the manufacture of concrete and moistening of earthwork roads. The amount marked in the table refers to the total volume of water required for this stage. Water used will receive prior no treatment because it complies with the quality specifications in the manufacturing of concrete.

The water will be extracted through direct pumping from the river to storage tanks in the site. Water will be transported in pipes with a capacity of 6,000 liters for the irrigation of roads. No treatment will be necessary prior to its utilization.

TABLE II.23 WATER REQUIREMENT FOR THE MANUFACTURE OF CONCRETE

RESISTANCE OF HYDRAULIC CONCRETE	WATER REQUIREMENT (l/m ³ concrete)
f'c=100 kg/cm ²	40.50
f'c=150 kg/cm ²	36.00
f'c=200 kg/cm ²	27.00
f'c=250 kg/cm ²	24.00

$f'c=350 \text{ kg/cm}^2$	18.00
---------------------------	-------

For human consumption, through trucks, drinking water bottles of a known trademark, which guarantee its quality will be taken to the work. At a rate of a daily bottle per each 19 employees, such ration will be adjusted to the actual requirements during the project's construction, but always guaranteeing that enough liquid for the workers consumption exists.

For the operation stage, the consumption was determined considering an impounding consumption of $0.5 \text{ m}^3/\text{s}$

TABLE II.24 VOLUME OF WATER REQUIRED BY STAGES

STAGE	WATER	ORDINARY CONSUMPTION		EXCEPTIONAL OR PERIODIC CONSUMPTION				TOTAL
		VOL. (m ³ /month)	ORIGIN	VOL. (M ³)	ORIGIN	PERIOD	DURATION	
Site preparation	Hard	20	Apatlahuaya and Zongolica Rivers					
Construction	Drinking	2	Supplier					
Construction	Hard	3,000	Apatlahuaya and Zongolica Rivers					
*Operation	Hard	1,296,000	Reservoir					
Maintenance								

* Notwithstanding that water will be used for the functioning of the turbine in the hydroelectric central, it is necessary to precise that its use is not consuming.

Authorization and concession of the National Water Commission (*National Water Commission*) (CONAGUA)

By virtue of the procedures and formalities applicable for the obtainment of the authorizations and licenses concessions, this Environmental Impact Statement to obtain the relevant approval and give sequence to the requirements requested by this authority.

II.4.2.2 Material and substances

Material:

In the construction stage it will require materials to be applied in the manufacture of platforms, impounding dam, conduction tunnel, pressure tube, power house building, and the works that will supplement the hydroelectric central. It is necessary to indicate that also turnery , multi-panel plaques, roof gutters, crystal glass, steel sheets, etc. will be required, which is not reported in the table.

TABLE II.25 MATERIAL TO BE USED BY FOR THE WORKS

Material	Stage	Supply sources	Handling and transportation form	Quantity required
Cement	Construction	Supplier	Sacks 50 kg in platform truck	9500 ton.
Steel reinforcement	Construction	Supplier	Bars on truck with tow platform	560 ton.
Structural steel	Construction	Supplier	Profile sections on tow truck	65 ton
Steel pipeline	Construction	Supplier	Profile sections on tow truck	1,200 ton
Steel netting	Construction	Supplier	Netting Rolls in truck platform	1,950 m ²
Sand-gravel	Site preparation and construction	Supplier	Extraction with frontal loader or dredger and transfer in whirling truck	8,000 m ³
Gravel for the dam wall	Construction	Tunnel excavation	Extraction with frontal loader and transfer in whirling truck	5,000 m ³
Wood for centering	Construction	Supplier	Plywood sheets and rafters in platform truck	150 plywood sheets and 300 rafters.

Substances:

The non hazardous substances that will be used during the construction will be additives for concrete, which have different denominations depending on the manufacturer's trademark, their physical status is liquid and the product's presentation is in 200 liter cans, it is not toxic nor flammable. The total approximate amount required for the preparation of concrete is of 60,500 liters, that will be supplied by the supplier as the work advances. Due to space and economy reasons only the amount of additive to be used in one month will be stored and it will be of about 10 cans.

In the site preparation and construction stages gasoline and diesel will be used as fuel in equipment, machinery and vehicles.

For the construction of the works the use of high concentration explosives will be required in the case of the tunnel and braking explosives kind "ANFO" (mixture of Ammonium Nitrate

with some kind of combustible) for the rest of the excavations in rock. It is planned to consume about 40 ton of explosives.

There will be no storehouses, as the material is being required it will be transported to the work site.

The contractor will be responsible for the use, as the case may be, storage and vigilance of the spit fires, transportation and handling of the explosives used, theretofore it shall have the relevant General or Extraordinary permission granted by the Ministry of the National Defense (*Secretaria de la Defensa Nacional*).

TABLE II.26 EXPLOSIVES

KIND OF EXPLOSIVE	QUANTITY STORED	QUANTITY USED PER DAY (Kg/day)	KIND OF STORAGE	KIND OF TRANSPORTATION	ACTIVITY AND STAGE IN WHICH THEY WILL BE USED
High concentration	NA	109	NA	Truck with wooden box for Explosives Transportation	Tunnel excavation
Anfo	NA	19	NA	Truck with wooden box for Explosives Transportation	Rock excavation

II.4.2.3 Power and fuels

Electric power:

For the site preparation and construction stages electric power will be required for the office activities, lighting and tool handling. The supply will be provided by the 13.8 kV lines that currently reach the three main work sites, that is: dam and intake works; tunnel exit portal, which is also an end of the pressure tube and to the power house and substation, which also covers the other tube pipe line end. The estimated power consumption is of 24000 kWh/month.

Fuels:

In respect to fuel, the main demand will be to feed the machinery and equipment used during the work construction. Fuels used are: diesel, gasoline and lubricating oil. The approximate consumption of lubricating oil is at a rate of 2 to 4 liters for each 250 liters of fuel used.

In accordance with the number of equipment considered, the daily supply of fuel may be carried out through pipes, which will be loaded in the service station of the Zongolica town which is the nearest one and they will proceed to supply the construction equipment, first thing in the morning every day. No fuel will be stored, only the necessary amount for the equipment working in accordance with the utilization program will be kept.

In case the fuels are transported in trucks, specific and duly identified containers must be used for each kind of material. They will be filled up at 75% of their capacity, they will have a cap to avoid spilling and their fastening to the transporting vehicle must be ensured. Special attention shall be given to the appropriate and careful handling of the containers, which must be perfectly identified and the main characteristics of the material being transported in accordance with the applicable law shall be indicated. The driver of the transporting vehicle shall be trained to resolve any eventuality in case of an accident, in addition to having a shipment card indicating the immediate actions to be carried out in case an emergency occurs.

In case of spilling or accident originated in the transportation or storage of fuels and lubricants the emergency plan may be carried out in accordance with the Guideline 128 "Flammable Liquids (No Polar/No Mixable with Water)" in which gasoline, diesel and fuels are included, of the American Guide in Case of Emergency".

TABLE II.27 FUELS AND LUBRICANTS

COMMERCIAL NAME	TECHNICAL NAME	CAS	PHYSICAL ESTADO	CRETIB	KIND OF CONTAINER	STAGE OR PROCESS IN WHICH IT IS USED	QUANTITY OF MONTHLY USE	REPORT QUANTITY	IDLH5 TLV6	FINAL DESTINATION OR USE	USE OF THE LEFT OVER MATERIAL
Gasoline	Conventional 93 octane, Premium gasoline	8006-61-9	L	I	Metallic Tambo of 200 liters	Site preparation, construction	200 liters	NA	500	Fuel equipment and construction machinery	It is stored until it is used
Diesel	Automobile diesel	68334-30-5	L	I (2)	Metallic Tambo of 200 liters and/or pipe	Site preparation, construction	13,440 lts.	10,000 barrels	100	Fuel equipment and construction machinery	It is stored until it is used
					Large can	Operation	17 lts.			Emergency plant	It is stored until it is used
Lubricating oil	Lubricating oil	NA	L	I (1)	Metallic Tambo of 200 liters	Site preparation, construction	300 lts.	NA	NA	Lubricant equipment and construction machinery	It is stored until it is used or is handled as hazardous waste
					Metallic Tambo of 200 liters	Operation, for the rotor's lubrication system in the generator	8.3 lts.			Lubricant	

CAS: Chemical Abstract Service.

CRETIB: Corrosive, Reactive, Explosive, Toxic, Flammable, Biologic-infectious.

IDLH5 Immediately Dangerous of Life or Health.

TLV6 Threshold Limit Value.

II.4.2.4 Machinery and equipment

TABLE II.28 EQUIPMENT AND MACHINERY USED DURING THE SITE PREPARATION AND CONSTRUCTION STAGE

EQUIPMENT	QUANTITY	TIME IN WORK	WORK HOURS /DAY	dB EMITTED	EMISSIONS TO THE ATMOSPHERE (GR/S)				KIND OF FUEL
					Particles	CO	HC	NO	
IMPOUNDING WORK									
Topography equipment	1	12	8	NA	NA				Electricity
Bulldozer	1	2	8	90-96	0.67	1.22	0.69	2.5	Diesel
Compressor	1	12	8	85	NA				Electricity
Perforators	4	12	8	115	NA				Compressed air
Backhoe	1	8	8	84-93	0.67	1.22	0.69	2.5	Diesel
Rock triturator	1	8	8		NA				Electricity
Concrete plane	1	12	8		NA				Electricity
Transportation bands	1	12	8		NA				Electricity
Dump Truck	1	8	8	88	0.67	1.22	0.69	2.5	Diesel
Tower crane	1	12	8	90-96	NA				Electricity
Bar cutter	1	12	8	NA	NA				Manual
INTAKE WORK									
Bulldozer	1	1	8	90-96	0.67	1.22	0.69	2.5	Diesel
Backhoe	1	1	8	84-93	0.67	1.22	0.69	2.5	Diesel
Dump Truck	1	1	8	88	0.67	1.22	0.69	2.5	Diesel
Compressor	1	1	8	85	NA				Electricity
Perforators	4	1	8	115	NA				Compressed air
Concrete plant	1	1	8		NA				Electricity
Tower Crane	1	1	8	90-96	NA				Electricity
Bar cutter	1	1	8	NA	NA				Manual
CONDUCTION TUNNEL									
Bulldozer	2	21	3	90-96	0.67	1.22	0.69	2.5	Diesel
Compressor	4	21	8	85	NA				Electricity
Perforators	8	21	5	115	NA				Compressed air
Frontal loader	4	21	3	86-94	0.67	1.22	0.69	2.5	Diesel
Dump Truck	2	21	3	88	0.67	1.22	0.69	2.5	Diesel
Concrete launcher	2	21	2		NA				Electricity/Air
Ventilator	4	21	8		NA				Electricity
FORCED PIPELINE									
Spindle	4	12	8		NA				Electricity
Compressor	1	12	8	85	NA				Electricity
Breakers	6	12	8	111	NA				Compressed air

EQUIPMENT	QUANTITY	TIME IN WORK	WORK HOURS /DAY	dB EMITTED	EMISSIONS TO THE ATMOSPHERE (GR/S)				KIND OF FUEL
					Particles	CO	HC	NO	
Solders	2	12	4	101	NA				Electricity
Concrete mixer	1	12	6	105	NA				Electricity
POWER HOUSE AND SUBSTATION									
Bulldozer	1	2	8	90-96	0.67	1.22	0.69	2.5	Diesel
Backhoe	2	6	8	84-93	0.67	1.22	0.69	2.5	Diesel
Dump Truck	4	6	4	88	0.67	1.22	0.69	2.5	Diesel
Concrete plant	1	16	4		NA				Electricity
Tower Crane	1	16	8	90-96	NA				Electricity
Compactor	1	6	8	90-100	0.67	1.22	0.69	2.5	Diesel

II.5 Generation, handling and final disposal of solid waste

II.5.1 Generation of waste

Hazardous:

In case of waste considered hazardous, in accordance with NOM-052-SEMARNAT-2005, as example, used oils, oil and fuel containers, paint cans, paint waste, materials impregnated with such waste, among others, shall be handled in the environmentally appropriate manner and through a recollection of hazardous waste company acknowledged by SEMARNAT and SCT.

Therefore, the construction company shall be filed before the SEMARNAT as generator of hazardous waste, shall handle their hazardous waste in accordance with the applicable law in this matter, and shall be recollected through a recollecting company authorized by SEMARNAT.

The hazardous waste that may be generated during the project operation derive from the maintenance actions and shall be reduced to used oils, material impregnated with oil, paints and solvents.

Special Handling Waste:

- Construction waste

During the construction and in accordance with the National Chamber of Construction Industry (Cámara Nacional de la Industria de la Construcción) the waste generated range from 3 to 10% of the volume of material to be used, that will depend on the supervision and quality of the works performed.

Not hazardous Waste:

- Waste derived from the demolition of trees

For the proceeds from pruning and demolition, it is recommended that the pieces or sections of logs and branches have a 120 cm length, to facilitate their handling and moving.

The dismantled material derived from the forestall products will be raised in furrow in order to be chopped, in the smallest length possible (50 cm) and incorporated to the land, which shall be placed and disseminated in a perpendicular manner in the slope to contribute to the retention thereof and so the same are rapidly incorporated to the soil.

In case of sick or plagued trees, these shall be fumigated immediately after they are demolished, prior to this, the disease or plague to which the same are subject must have been indentified in order to be able to select the chemical product to be used in the healing procedure. Once healed there shall be handled as the rest of the trees.

The exploitation will be allowed to the inhabitants of the towns established therein, because the company does not intend to make use of the result of the clearing of trees. It is necessary to indicate that, regardless of the use to be given to the wood derived from the utilization, no matter its length nor diameters it has, in order to leave the property in automotive vehicles, the official documentation for the transportation of forestall products will be required.

The material derived from felling of trees may be used as soil improvers.

- Urban waste

A generation of waste of 0.5 kg/laborer/day equal to 116 kg/day is estimated assuming a maximum concentration of 232 workers for the period of maximum simultaneous activity in the different fronts.

The solid waste generated shall be classified for its reuse and shall be deposited in containers that shall be strategically placed to have easy access thereto. Such containers shall ease the classification of solid waste of the non hazardous, at least into organic, inorganic and sanitary waste.

In respect to the inorganic waste, in order to be reused, it is highly recommended to separate them in reusable sub-products such as glass, plastic, metal, carton and paper, cans free of hazardous substances, in order to reincorporate them into the economic activity.

El temporary storage of the organic waste shall not exceed 5 days because as of this lapse harmful fauna tends to appear and smells begin to be produced. That is why the containers shall have enough capacity to contain waste generated in this lapse. In no case shall the storages loose their temporary feature and become definitive sites.

An efficient recollection and transportation program shall be implemented by the constructor company, which shall be in charge of carrying out its final disposal in the spillway site appointed by the competent authority.

El temporary storage of the organic waste shall not exceed 5 days because as of this lapse harmful fauna tends to appear and smells begin to be produced. That is why the containers shall have enough capacity to contain waste generated in this lapse. In no case shall the storages loose their temporary feature and become definitive sites. Organic waste may be incorporated to the environment through composte which will reduce the transportation cost to the final destination.

During the operation a generation of urban waste consisting in office stationery, food waste and sanitary waste is expected, at a rate of 0.20 kg/employee/day, with a volumetric weight of 80 kg/m³, since there will be a total of 9 employees, the daily generation is of 1.8 Kg/day .

II.5.2 Handling of hazardous and non hazardous waste

As previously mentioned, if hazardous waste are generated it shall be filed before the SEMARNAT as hazardous waste generator and shall proceed to state the kind of generator in accordance with the annual generation volume, there shall be handled as hazardous waste in accordance with the applicable law on that matter, and shall be recollected by a recollection company authorized by SEMARNAT.

In tables II.29 and II.30 the infrastructure for the disposal of the non hazardous waste as well as for the recollection, transportation and handling of hazardous waste, closest to the project site are shown, as it may be seen, the same are located in Córdoba and Orizaba.

II.5.3 Final disposal of hazardous and non hazardous wastes

II.5.3.1 Throw sites

For wastes derived from the excavation:

The location of sited for the placement of material derived from the excavation may be seen in the maps PHV-05 “Veracruz, Impounding zone, affectations due to DDV” and in map PVH-06 “Conduction Zone affectations due to DDV” included in the relevant annex.

TABLE II.29 INFRASTRUCTURE FOR THE RECOLLECTION AND TRANSPORTATION OF HAZARDOUS WASTE CLOSE TO THE PROJECT'S SITE

NO.	AUTHORIZATION NR.	CORPORATE NAME	DOMICILE	TELEPHONE	KIND OF WASTE	CAPACITY (TON/TRIP)	NR. OF VEHICLES	EFFECTIVE
732	30-44-PS-I-23-2005	Comercializadora y Transportadora Santa Inés, S.A. de C.V.	Calle 30 Av. 19 y 21 No. 1913 A, Fraccionamiento Nuevo Córdoba, CP 64550, Córdoba, Veracruz	2717123556	Corrosive, toxic and flammable solid, liquid and sludge, perforation cuts, derived from oil wells, impregnated with fluids base don oil and water, except biologic-infectious and byfenil polyclorated	1,403.00	91	Del 15-ago-05 al 15-Ago-10

Source: SEMARNAT, September 2008

TABLE II.30 INFRASTRUCTURE FOR THE HANDLING OF INDUSTRIAL HAZARDOUS WASTE NEAR THE PROJECT SITE

NO.	CORPORATE NAME	DOMICILE	TELEPHONE	ACTIVITY	WIND OF WASTE	AUTHORIZATION NR.	EFFECTIVE	CAPACITY
59	Cementos Apasco, S.A. de C.V. (Planta Orizaba)	Blvd. Fernando Gutiérrez Barrios No. 84, Ixtaczoquitlán Orizaba Veracruz	(272)10101	Energetic recycling	Recycling of alternate fuel	30-118-PS-VII-07-97 3	From 0/12/97 to 30/12/98	25% substitution of alternate fuel
						30-118-PS-VI-01-98	From 17/12/98 to 17/12/03	30% de substitution of alternate fuel
						30-85-PS-VI-05-2003	From 28/11/03 to 28/11/08	30% de substitution of alternate fuel
77	Ecoltec, S.A. de C.V. (Planta Orizaba)	Blvd. Fernando Gutiérrez Barrios No. 84, Ixtaczoquitlán Ixtaczoquitlán Veracruz	5724 0000	Energetic recycling	Preparation of alternate fuel	30-85-PS-V-04-99	From 04/05/99 to 04/05/04	120,000 ton
						30-85-PS-VI-03-2004	From 06/05/04 to 06/05/09	128,000 ton

Source: SEMARNAT, September 2008

TABLE II.31 SITES FOR THE PLACEMENT OF MATERIAL DERIVED FROM THE EXCAVATION

SITE	OWNER'S NAME	COORDINATES	EXPLOITATION	AFFECTED AREA (m ²)
IMPOUNDING ZONE				
1	Constantino Lara	N 2,060,066 E 711,179	agriculture	10,000.00
CONDUCTION ZONE				
1	José Martínez	N 2,061,918 E 713,098	agriculture and wood	12,283.67

II.5.3.2 Confinement of hazardous waste.

In conformity with what is previously mentioned, in case hazardous wastes are generated, in accordance with NOM-052-SEMARNAT-2005, the same will be handled in the environmentally appropriate manner and a recollecting of hazardous waste company shall be retained, which shall be authorized by SEMARNAT and SCT.

The following tables show the infrastructure for the recollection and transportation of hazardous waste and for its handling, closer to the project site, as it may be seen the same are located in Córdoba and Orizaba.

II.5.3.3 Municipal Garbage Dumps.

In accordance with the information of the Ministry of Social Development and Environment (Secretaria de Desarrollo Social y Medio Ambiente) of Veracruz, in the XVIII Zongolica district, where the project is immersed, only the Municipality of Nogales has a sanitary stuffing operated by private companies, which provides service to 14 adjacent municipalities, but it is far from the project site.

The municipalities located in the Zongolica sierra deposit their waste in the open garbage dumps.

II.5.3.4 Sanitary stuffing.

In the project zone and its surroundings there is no sanitary stuffing. As previously mentioned, in the Municipality of Nogales there is a sanitary stuffing by private companies, which provides service to 14 adjacent municipalities, but it is far from the project site.

II.6 Generation, handling and discharge of liquid waste, sludge and residual water.

II.6.1 Generation

II.6.1.1 Liquid waste

TABLE II.32 LIQUID WASTE

WASTE NAME	CRETIB	MONTHLY VOLUME GENERATED	KIND OF CONTAINER	TEMPORARY STORAGE SITE*	ORIGIN	STAGE
Oil	I	30 l	Metallic tank of 200 liters	Temporary storehouse of dangerous hazardous waste (in camps area)	Maintenance to equipment and construction machinery	Site preparation and construction
		10 l	Metallic tank of 200 liters	Temporary storehouse of dangerous hazardous waste (power house)	Maintenance	Operation

* In accordance with the kind of generator the applicable law shall be complied with.

In the case of generation of hazardous waste in accordance with NOM-052-SEMARNAT-2005, the constructor company shall be filed before the SEMARNAT as generator of hazardous waste and shall take the steps necessary for its categorization as such and in accordance thereto it shall comply with the guidelines stipulated in the General Law for the Integral Handling of Waste (*Ley General para la Gestión Integral de Residuos*) and its regulation.

The hazardous waste shall be recollected through a recollecting company authorized by the SEMARNAT and SCT and through the relevant Delivery-Reception Statements to the recollecting company guarantees the final disposal site where the recollected wastes are taken.

II.6.1.2 Residual water

To avoid that defecation is practiced at open air, in accessible places for the personnel involved, portable lavatories will be placed, at a ratio of one per each 20 employees, considering a minimum of two units. The leasing company will be responsible for their cleaning, and shall conduct the waste to the site granted by the competent authority at the

time of its registration and operating permit. In no case will the pouring of such waste be allowed into the ground, superficial flows and in case this happens it will be imputable to the person resulting liable thereof (leasing or contractor) which shall carry out all the relevant remediation techniques and of the relevant penalty assessed by the authority.

The generation volume will be of approximately 3 liters/worker/day equal to 696 l/day, considering 232 workers for the maximum simultaneous activity in the different fronts that will be disposed of in the portable lavatories or in the latrines constructed within the work program.

While for the operating stage it is contemplated that a total number of 9 workers will work, notwithstanding that not all of them will work on the same days and shifts. Therefore, in the hypothesis that 4 workers coincide, with an amount of 100 l/worker/day and a contribution of 70% there will be a total generation of 280 l/day.

It is not considered that residual water discharges exist since it is contemplated in the project to use pre-manufactured septic tanks.

II.6.1.3 Sludge

Not applicable

II.6.1.4 Handling

No liquid waste treatment system is applicable.

II.6.2 Disposal

II.6.2.1 Characteristics

Since the water generated will only be the one derived from the sanitary services, presumably the quality of such water will be typically domestic with the physical – chemical characteristics shown in the following Table.

TABLE II.33 PHYSICAL – CHEMICAL CHARACTERISTICS OF DOMESTIC RESIDUAL WATER.

CONCEPT	PARAMETER
Total solids (mg/l)	720
Total Dissolved Solids (mg/l)	500
Fixed	300
Volatile	200
In Suspension Solids	220
Fixed	55
Volatile	165
Sedimentable Solids (mg/l)	10
Bio-chemical Oxygen Demand DBO ₅ (mg/l)	220
Chemical Oxygen Demand (mg/l)	500

CONCEPT	PARAMETER
Total Organic Carbon	160
Total Nitrogen (mg/l)	40
Organic Nitrogen (mg/l)	15
NH ₃ -N	25
NO ₂ -N	0
NO ₃ -N	0
Total Phosphorus	8
Organic	3
Inorganic	5
Chlorides (mg/l)	50
Alkalinity (As CaCO ₃)	100
Fat (mg/l)	100
Total Coliforms (NMP/100 ml)	1.00E+08
Faecal Coliforms (NMP/100 ml)	<1.0E+8
Virus, PFU/100 ml	500

II.6.2.2 *Water corps*

Not applicable

II.6.2.3 *Ground and underground*

Due to the project's operation characteristics and the considerations for the handling of water from the sanitary services, it is not intended to use any kind of water injection to the underground, nor depositions will be carried out in natural or on the ground reservoirs.

II.6.2.4 *Drainages*

- Pluvial drainage

Both the power house and the electric substation will have drainages and tubes through a PVC pipeline and culverts with grids for the impounding and derivation of the pluvial dripping into the river bed. This way, during the occurrence of rain the gutters and lowers in the roofs and surfaces of the edifications will immediately derive the drippings into the natural drainages without limiting its disposal. It is important to clarify that this drainage is exclusive for pluvial water and that at no time there will be mixed with the waters with a sanitary origin.

- Process Drainage

As described, the utilization of water for the turbine's movements does not imply any modification to the quality or quantity of water during its disposal through the drain off canal, therefore, no residual water discharges of this kind will be carried out.

- Sanitary Drainage

In addition to the description contained in item II.6.1.2, there will be no drainage networks because portable latrines will be used and the impounding will be immediately located in the area where the sanitary services will be placed.

During the operation there will be only one line to impound the water from the sanitary services and kitchenette of the power house, this will be installed with a PVC tube and it will arrive directly to the installation of the pre-manufactured septic tank, which at the same time will be placed on one side of the central building.

II.7 Generation, handling and control of emissions into the atmosphere

During the construction gas emissions will be produced, and suspended particles caused by the construction equipment and machinery in amounts estimated in accordance with the following table:

TABLE II.34 PARTICLES ISSUED INTO THE ATMOSPHERE BY INTERNAL COMBUSTION MOTORS

Particles (kg/h)	CO (kg/h)	HC (kg/h)	NO (kg/h)
2.4	4.4	2.5	9.0

Note: carbonic gases: CO (carbon monoxide), HC (Carbonic acid), NO: Nitrogen Oxide.

Sources: "EVALUACIÓN DEL IMPACTO AMBIENTAL", Memorias del curso impartido por la División de Educación Continua de la Facultad de Ingeniería, UNAM.
"IMPACTO AMBIENTAL", Vázquez A., César E., IMTA-UNAM.

II.8 Contamination due to noise, vibrations, thermal or luminous radioactivity

The noise levels observed at a 15 m distance from the different construction equipment, vary from 72 to 96 dB(A) for soil moving equipment, from 75 to 88 dB(A) for material handling equipment and from 68 to 87 dB(A) for fixed equipment, the impact equipment may generate noise levels of up to 115 dB(A) (EPA, USA, 1972).

TABLE II.35 NOISE LEVELS GENERATED BY THE CONSTRUCTION EQUIPMENT

EQUIPMENT	NOISE LEVEL IN dB(A) A 15 m
Caterpillar Tractor	77-95
Frontal loader	71-84
Vibratory rollers	73-75
Landscape loader	88-91
Backhoe	93
Dump truck	82-94
Power saws	64
Electric breaking hammers	88-91
Concrete Mixer	80-93
Concrete Pump	70-77
Cranes	75-88
Concrete vibrator	64
Four-wheel drive truck	72

dB(A): Acoustic pressure level, A.

Sources: "Evaluación del Impacto Ambiental", Memorias del curso impartido por la División de Educación Continua de la Facultad de Ingeniería UNAM;

"Impacto Ambiental", Vázquez A., César. E., IMTA-UNAM;

"Medida y Control de Ruido" Ochoa Pérez y Bolaños, Colección Productiva, Editorial Marcombo.

In respect to the maximum exposure per day to which a worker may be exposed to at a constant frequency, the following table includes the maximum exposure times in accordance with the amount of generation decibels.

TABLE II.36 MAXIMUM EXPOSURE PER DAY

EXPOSURE PER DAY	LIMIT dB(A)
Up to 1.5 minutes	120
3 minutes	110
7 minutes	103
15 minutes	97
30 minutes	93
1 hour	90
2 hours	87
4 hours	85
8 hours	85

The equipment provider shall guaranty that the Vertical Axis Pelton Turbine, auxiliary systems and equipment operate within the guaranteed ranges, without producing harmful noises and

being within the ranges established in the standard ISO 1999. The maximum noise level allowed is 85 dB(A) measured at a distance of 1,0 m from the equipment or portion that produces it.

The maximum vibration values in the arrow shall be in accordance with the provisions contained in the standard VDI 2059.

II.9 Safety measures

The Veracruz Project will be developed in three different separated fronts not only by construction specialties, but because of the distance that separates them and that requires to have construction superintendences as well as supervisory personnel in the three required sites.

The sites are as follows:

Concrete dam wall, intake works and excavation of tunnel by the entrance.

Excavation of the tunnel by the exit, oscillation louver, concrete cap in the tunnel mouth and beginning of the pressure tube.

Installation of the pressure tube, power house, elevating substation and drain off canal.

These fronts are linked among them, therefore a good coordination among them is required so the general safety regulations and measures are uniform for all and also so special steps are taken which take into account the special features of each of them.

As a separate front and that does not require a close coordination with the others, because it can be handled independently, we have the transmission line, which has its own safety measures.

General Safety Measures

The constructor shall at all times take into account and put in place the safety systems in the work in order to minimize risks in accordance with the regulations in respect to safety and hygiene, in addition to providing training to the personnel in charge of the construction of the works.

In accordance with what is observed in the site intended for the construction of the works, it is recommended to apply and overview the following importance issues for the attention of preventive measures.

All personnel working in the tunnels zone shall be kept informed on the activities to be developed and the duration thereof.

Both the construction personnel responsible for the work as the supervision personnel shall have full knowledge of the works to be performed on a daily basis and shall verify that a strict control when opening the valves during the connection works from the pressure tube to the power house is observed. Therefore, each person responsible shall inform each of the

persons involved in the contemplated program and immediately notify in case of any modifications thereto.

The signals indicating when it is possible to work in the site and when the same must be evaluated shall be placed in visible places and in a strategic form. For this purpose, a color code that marks the times in which the activities are to be performed shall be preferably established and not involving the workers in a situation of risk. All personnel that has contact with the control systems and workers in general shall be informed on the meaning of each color and the scope of each of them.

If the works are extended during the vespertine time schedules, the utilization of acoustic and luminous alarms shall be invariably in accordance with what is provided for in the preceding paragraphs.

In the soldering activities it shall be overviewed that the personnel always has the insulating protection equipment and that the equipment is not near to water corps or humid zones which may produce a discharge.

For the use of explosives it is recommended to apply in the same manner the above mentioned procedures and to maintain a personnel safety and hygiene brigade to direct the workers during the dislodgments and that verifies that the zone is ready to perform the blowing up. Also, an explosives handling program shall be requested to the construction contractor, as well as the specific safety plans for the site.

Particular safety measures in the different fronts.

Dam and Intake Works

In the construction of this part of the work, works will be performed in a cannon with very stiff walls, therefore, special attention will be given to the signals in the work roads.

For the hill sides cleaning works, the personnel will be provided with safety harnesses and a hard helmet to protect them in case of falling materials.

When placing concrete protecting shoes and clothes shall be used, as well as protecting glasses for the eyes and gloves for the protection of hands.

The cranes works that will supply materials such as reinforcement and structural steel and panels for centering, shall have acoustic signals that notify the personnel that the same are in movement.

The dam location in the bottom of the river will be made in the low water season in order to be able to deviate the small river flow (around 0.5 m³/s) through one of the sand trap gates bays, while working in the other bay, and once this one is concluded the river consumption is passed to this one and works are performed in the other one.

Notwithstanding there is an hydrometric station installed and managed by the petitioner company, with the National Water Commission permit, and which transmits flow report every

15 minutes which can be observed in the office's computer, it will be avoided to work in the low parts during the flood season.

The Reading of the level in the reservoir and the gates operating control in the dam will be carried out through a radio signal.

The issue of data from the hydrometric station will be carried out via satellite.

Conduction Tunnel

Generally, the tunnels are the most risky part of the civil works, therefore, special attention shall be given to the discipline and measures which are necessary to prevent accidents.

The company has adopted as safety manual in tunnels the one published by AMITOS and CFE under the title "Safety when working on the construction of tunnels" ("*Seguridad en el trabajo en la construcción de túneles*") and which covers the following aspects:

- Worker's equipment in tunnels
- Installations
- Transportation and shifting
- Excavation
- Temporary support
- Excavated left over material
- Definitive support and coating
- Toxic substances
- First aids.

Pressure Tube

The pressure tube in the Project is one of the most important parts from the logistic and personnel safety and installations point of view, because about 1,150 t of steel pipelines with a diameter of 1.22 m will be installed, being the heavier tube stretches of about 5 t, therefore, both the machinery and the personnel protection equipment must be in optimal conditions with very frequent reviews.

The pipelines will be superficially installed on stools, therefore there will be no risk of deep excavations which might cause landslides.

Power House and Substation

Because the turbine to be used is a Pelton type, the power house requires no deep excavations and activities having a risk greater than those of the civil work constructions regular risks, therefore, with the application of the general hygiene and safety measures, an adequate safety will be attained in this front.

The communication systems for the operating duties of the generation electric power generating plant will be operated via satellite.

The brake shoes (balata gums) of the rotor in the generator are asbestos or toxic compounds free. Also the brake system has extractors and filter that gather the dust which could be generated with the materials wear and tear.

The lubrication systems have pressure sensors that impede the release of oil in the event a leakage in the system is produced. In general all equipment is linked to the control system that allows the automatic stop in case of failures.

It will have cisterns for water impounding and spilling which might occur in the plant, where treatment for their subsequent release may be provided, therefore, there will be no industrial residual water discharges at any times.

Attention to emergencies

There shall be several first aids medical kits in the following sites: one in the offices and dining room area, another one in each of the three work fronts mentioned and another one in the general storehouse. Each medical kit shall at least contain the following:

- 1 bandage for wounds 10 x 20 cm
- 1 elastic bandage or gauze
- 1 pressure bandage with instructions for its use
- 1 rounded point scissors
- 1 orthopedic neck protector
- 1 Anti-inflammatory
- 1 Desinfectant (benzal)
- 1 Bottle of alcohol
- 1 Bottle of hydrogen peroxide
- Packages of sterile gauzes
- 1 cotton package
- Splint kits (ankle brace, knee protector, thigh brace)
- Antidote for scorpion bite
- Antiviperine
- 1 ointment picrate
- 1 oxygen mask
- Rubber bands for pressure
- Sulfatiazol envelopes
- 1 micropore tape
- 1 tong-holder package
- 1 Bottle sterilized water
- Disposable syringes packages of 3 and 5 cm³

There shall be trained personnel to apply the first aids and a safety and hygiene brigade shall be formed, which shall be supported with the labor safety and health institutions in the zone.

The organization and functioning of the safety personnel and the rescue brigades shall be preferably addressed to the work resident, which shall be trained to handle contingencies and with the knowledge of all the safety procedures in their respective work areas.

Within their activities they shall periodically review the structures and equipment they are working with and that the operative personnel have the protection equipment adequate for their functions.

The individuals in charge shall record the accidents and analyze the causes to avoid the repetition thereof through the corrective measures in accordance with the relevant event.

In order to avoid fire risks it shall be overviewed that no flammable materials are stored at any time outside the areas assigned for their storage as well as the prohibition of energized electric elements and personnel smoking in the fuel area. Fire extinguishers will be installed in strategic points such as offices, general and fuel storehouse, dining room and the cabin of the machinery to be used, in addition to taking into account what is set forth in NOM-002-STPS-1993.

The possible risks during the construction shall be analyzed and training and information shall be provided to the personnel on how to evacuate the site at any given moment, the possible evacuation routes must be indicated, as well as access and procedure to provide attention to personnel who suffered an accident as well as the location of medical kits and fire extinguishers.

It is convenient to provide a vehicle 24 hours per day to the construction personnel, which is adequate for transportation in case of any accident, as well as a radio-communication system to request the necessary support in case any contingency arises.

Sanitary attention

During the construction the permanent control of the disposal of domestic waste shall be kept in order to avoid the proliferation of harmful fauna, as previously explained, the recollection and disposal of the waste in the places indicated by the municipal authority is contemplated. Considering a population of 232 workers with a production of .5 kg of daily waste per person during the work apogee, it will be required to move to the disposal sites 580 kg every 5 days. Based on this the recollection will be programmed with maximum one week periods.

On the other hand, a strict control in the dining activities as well as the maintenance given to the portable lavatories retained will be kept. Therefore, the form in which the waste is disposed of by the personnel will be supervised and the commitments with the company rendering the sanitary services will be established without exceeding their storage capacity.

In respect to the provision of potable water, the same will be acquired per bottles and will be distributed in the work fronts, it will be overviewed that the same are properly covered and protected to avoid their contamination and that the workers use it without risks. The same will be displayed in covered places, away from sites used for store wastes or fuels.

For social security, the personnel shall have the rendering of services before the Instituto Mexicano del Seguro Social (IMSS), and the attention will be provided in accordance with the institutional program both for timely detection of deceases as curative or rehabilitation activities in personnel who suffered any accident. As the case may be, it will be requested to such institution to contemplate within their health fostering programs the follow-up to the

workers involved in the work due to respiratory, audition, stomach and dermatologic diseases, among others.

II.9.1 Signals and preventive measures

The reaction times of the conductor are involved with the determination of visibility distances for safety stop, overdrive and speed in the accesses to intersections. Herein below are the response times to different stimulus shown.

TABLE II.37 CONDUCTOR'S REACTION TIMES

STIMULUS	REACTION TIME IN SECONDS
Light	0.18
Sound	0.14
Tact	0.14

SOURCE: ROADS MANUAL GEOMETRIC PROJECT, SCT

Consequently, it is important to carry out the adequate signal placing, which shall satisfy five fundamental requirements:

- Satisfy an important need.
- Call attention.
- Transmit a clear message.
- Infuse respect to the users.
- Be located in a visible and appropriate place to give time to react.

Placement of protection barriers

They are used to prevent the users on the closing or restriction of a portion of the circulation track, placing them in such form that the reduction is gradual, avoiding that rough changes are produced to the transit trajectory.

DIAGRAM II.13 PROTECTION OF WORKS DEVICES

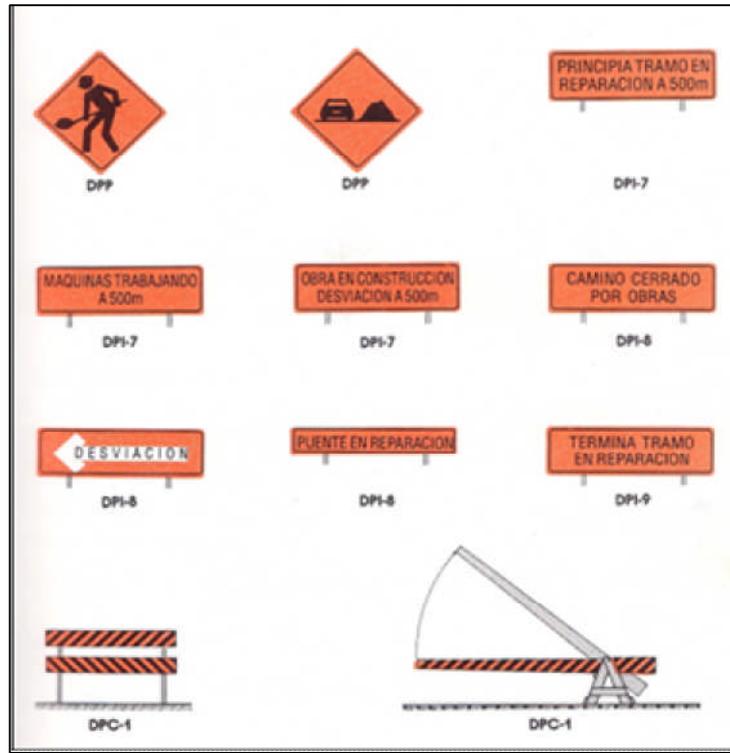


TABLE II.38 DIMENSIONS OF THE PROTECTION BARRIERS.

SIZE OF BOARDS (cm)
20, 30, 40 X 122
20, 30, 40 X 244

The protection barriers are placed in poles in the case of long term works and on portable easels in the case of short term works.

Color and visibility: alternate orange and white colored stripes of 10 cm width are used in the protection barriers, inclined 45° so the same are convergent with the transit direction, that is, descending from right to left. The reflecting feature of the signals is to ensure the visibility even at night, notwithstanding that the ways are well illuminated, preventing a failure in the electric supply.

Cones are used in case the speed, transit volumes and visibility, do not require the use of barriers. Cones are used to lead the transit, divide the opposite circulation tracks and the tracks when two or more are open in the same direction. They are also used to delimit maintenance works and short term service.

Polythene Banners and Polythene Tape

The banners in cord and polythene tape are mainly used to guide the pedestrian through the work zone, and make sure that they are far away from the dangerous places, delimiting their zone of circulation. The banners are made out of plastic and have a triangular form of 30 cm. per side, of orange color. The cord that attaches them is commonly made out of plastic.

II.10 Identification of the possible affection to the environment which are typical to the kind of project

The hydroelectric plants have an important role in the development of the hydric basins, particularly, they favor the economic development and scientific progress because of the hydroelectric production

The intensification of agriculture, locally, through irrigation, may reduce the pressure on the forests, the intact fauna habitats, and the other areas which are not ideal for the agriculture. Likewise, the reservoirs may create the agricultural production in the area, downstream from the reservoir, that, in some cases, might more than compensate the losses suffered in these sectors, as a result of the construction thereof.

The construction of dams favors the regional development,

- Clean power: it does not issue “greenhouse” effect gases, does not provoke acid rain, does not produce toxic emissions.
- Cheap power: the utilization costs are low, and its technology causes that the available hydraulic resources are efficiently exploited.
- It works at an environmental temperature: no refrigeration systems or caldrons are necessary, which consume power and in many cases contaminate.

However, generally, with the construction of dams also activities that may negatively impact the environment are developed, some of which are mentioned herein below, generally, even though it is important to mention that in each case the project’s incidence is set forth.

- Change in the micro-climate conditions due to the appearance of the reservoir and to the elimination of vegetation in the work development sites.
- Change will exist in the natural patterns of water flow and in the sedimentation of the rivers regime.
- The fluvial ecosystems will be fragmented, isolating the biotic communities in the high basins from those that inhabit the medium and low zones, migrations and movements of the species are interrupted and the river is separated from its plains and littorals. Particularly, the project’s location has as special feature that 2.5 km down stream from the intended reservoir water goes to a sewer to subsequently go out 2 km east in an air hole and a small waterfall, so particularly for this project this kind of impact with the

construction of the project will not be present because this barrier is present in a natural form.

- Loss of vegetal coverage that will be flooded by the reservoir and in the lands where the proposed infrastructure will be placed.
- Destruction of the fauna species' habitat.
- Loss of anthropogenic activities in the reservoir zone. In this project corresponding to agricultural activities.
- Changes in the amount of water, the effects derived from changes in the hydrology of the river basin include variation in the phreatic level and the river flow up stream from the reservoir, these have direct environmental impacts and affect the users down stream. In this project the ecologic caudal has been incorporated to guarantee the existing activities down stream with the dam wall.
- Other than in the big dams, in the small reservoir, as the case is in this project, the physical-chemical parameters change such as temperature, pH, dissolved oxygen, total solids dissolved, conductivity, may be much more appreciable due to environmental fluctuations, such as solar radiation, gas exchange (oxygenation), dragging of organic material from the hill sides, sedimentation, among others, even more, considering the retention times exceeding 12 hours. These changes may be evident, at the time of the discharge in the receptor course, with the great benefit of aeration, but with disadvantages on the biota aquatic stability.
- The indicators on erosion processes, hill sides' instability and creation of meanders generated by the intervals in the river speed increase must be taken into account.
- Reservoir sedimentation, sediments are deposited in the bottom of the receptacle, which implies that the dam gradually loses its storage capacity. Likewise, in the rest of the river, down stream, the nourishments may be decreased. To avoid this in the operation of the project it is contemplated to periodically open the sand trap gates which are located in the dam wall's base (see map Zongolica II sand trap), allowing the exit and dragging of the sediments with the river water as it currently happens. This action will be preferably carried out in the rainy season when the caudal is higher, since the water charge is more effective in the dragging and there is a greater dilution of particles.
- Dam walls overflow (due to discharges in the dangerous situations or due to the extreme precipitations). In the dam operation the river bed capacity downstream will not be exceeded, since the site is a olla and in such a case the area would be flooded first and it will gradually be displaced by the sewer. Supposing that the downstream river were a 5x5x1,850 m canal, this would have a capacity to accumulate 46,250 m³
- The projected reservoir is not capable of storing a great amount of water, however, the overflow time would occur in only 14 hours assuming that the reservoir were empty, therefore the existence of downstream flooding due to water discharges of the dams in rain seasons is less probable.

- Removal of people: in the project's particular case there are no populations in the reservoir zone nor in the sites where the construction of infrastructure will be carried out. In connection with the particular cases of some houses that will be affected, the necessary arrangements to have such properties have already been done and the consent of the affected people has already been obtained, it is considered that the project affects a total of 9,800 m², equal to the land where 2 houses are located, particularly in the impounding works.

II. WORKS OR ACTIVITIES AND, AS THE CASE MAY BE, OF THE PROGRAMS OR PARTIAL DEVELOPMENT PLANS	1
II.1 Project's general information	1
II.1.1 Project's nature	1
II.1.2 Justification and purposes	2
II.1.3 Investment required	3
II.2 Project's particular characteristics	5
II.2.1 Description of works and activities	5
II.2.1.1 Works and activities located outside the project's jurisdiction	5
II.2.1.2 Works and activities located within the project's jurisdiction.....	6
II.2.1.3 Description of provisional and associated works and activities	8
II.2.2 Project's location	13
II.2.2.1 Total surface required.....	16
II.2.2.2 Access roads to the area where the works or activities will be developed....	19
II.2.2.3 Description of services required.....	20
II.3 Description of works and activities	20
II.3.1 General work program.....	29
II.3.2 Selection of site or trajectory	31
II.3.2.1 Field research.....	31
II.3.2.2 Alternative sites or trajectories	32
II.3.2.3 <i>Legal status of the the project sites and its boundary lines</i>	37
II.3.2.4 <i>Current use of land in the project site and its boundary lines</i>	39
II.3.2.5 <i>Urbanization of the area</i>	42
II.3.2.6 <i>Natural Protected Area</i>	42
II.3.2.7 <i>Other priority attention areas</i>	43

II.3.3	Site preparation and construction.....	44
II.3.3.1	Site preparation	44
II.3.3.2	Construction	50
II.3.4	Operation and maintenance	58
II.3.4.1	Operation Program	58
II.3.4.2	Predictive and preventive maintenance program.	59
II.3.5	Site abandonment	65
II.4	Personnel and supplies requirement	65
II.4.1	Personnel.....	65
II.4.2	Supplies	71
II.4.2.1	Water.....	72
II.4.2.2	Materials and substances	73
II.4.2.3	Power and fuels.....	75
II.4.2.4	Machinery and equipment	78
II.5	Generation, handling and final disposal of solid waste.....	79
II.5.1	Generation of waste	79
II.5.2	Handling of hazardous and non hazardous waste	81
II.5.3	Final disposal of hazardous and non hazardous waste.....	81
II.5.3.1	Throw sites	81
II.5.3.2	Confinment of hazardous waste.....	84
II.5.3.3	Municipal tiraderos.....	84
II.5.3.4	Rellenos sanitarios.	84
II.6	Generation, handling and discharge of liquid waste, lodos and residual water.....	85
II.6.1	Generation	85
II.6.1.1	Liquid waste	85

II.6.1.2	Residual water	85
II.6.1.3	Sludge	86
II.6.1.4	Handling	86
II.6.2	Disposal	86
II.6.2.1	<i>Characteristics</i>	86
II.6.2.2	<i>Water corps</i>	Error! Bookmark not defined.
II.6.2.3	<i>Ground and underground</i>	87
II.6.2.4	<i>Drainage</i>	87
II.7	Generation, handling and control of emissions into the atmosphere	88
II.8	Contamination due to noise, vibrations, thermic or luminous radioactivity.....	88
II.9	Safety measures	90
II.9.1	Signals and preventive measures.....	95
II.10	Identification of the possible affectations to the environment characteristic of the kind of project	97