FINANCING INFRASTRUCTURE DEVELOPMENT IN MEXICO THROUGH PUBLIC-PRIVATE PARTNERSHIPS: THE HUITES HYDROELECTRIC DAM

By

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Degree of Master of Science in Civil and Environmental Engineering

ABSTRACT

This thesis aims to illustrate the current legal and financial structures being used in Mexico for the development of infrastructure projects. For this purpose an ongoing project in Northwestern Mexico is described and analyzed.

Huites hydroelectric dam is a project being built in the state of Sonora in Northwest Mexico. Once completed, the project will bring various benefits in the agricultural, electricity generation and flood control areas.

The project is being financed through a public-private partnership in which, as will be shown, the bulk of the risk is borne by the Mexican government. Even though the intention of the government was to finance the project with a larger private sector stake, it had no choice but to guarantee both a bond issue and foreign credits. The lack of choice, as is explored in the thesis, was due to the non-existence of a private market for electricity in Mexico.

The thesis will describe the project giving enough background to understand why it became a reality at the present time, it will examine several privatization options for the state run electricity monopoly as well as the financial and legal structures that are being used to develop Huites.

Thesis Supervisor: Professor Fred Moavenzadeh
Title: Director, Center for Construction Research and Education and George Macomber Professor of Construction Engineering and Management
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Acknowledgments

I dedicate this work to the memory of my grandfather Miguel Jinich whose vision, dedication and hard work, laid the foundations for the enterprise I will help continue to build.

I would like to thank my wife Karen for her love, understanding and support, my parents and family for their encouragement and love, my grandmother Consuelo whose generosity made this achievement possible. The staff of the Center for Construction Research and Education who made this past year an unforgettable and extremely rich experience and finally, the officers and staff of Grupo COIN in Mexico.
1. INTRODUCTION

The purpose of this thesis is to describe and analyze current practice in financing the development of infrastructure in Mexico. For such purpose, a characteristic project is examined. Huites hydroelectric dam is presently under construction in the state of Sinaloa in northwestern Mexico. Huites presents a rich example due to its size, complexity and the type of benefits it is expected to provide.

In order to understand why Huites became a reality at this time, it is essential to look at the economic development of the country. Such progress, after years of economic recession, gave rise to the change in government policy towards public-private partnerships for infrastructure development. The new policy came into effect with the highway program of president Carlos Salinas de Gortari. The scheme for the construction of Huites is a direct extrapolation of the experience gained in the highway program.

This thesis is divided in six chapters. The first chapter is an introduction to the work. Chapter two deals with Mexican economic background, the Highway Development Program of the current Mexican administration and the introduction of the Build-Operate-Transfer (BOT) system all necessary concepts to understand why the Huites project was structured as it is.

Chapter three deals with the description of Huites hydroelectric dam. It begins with a description of the area where the project is located followed by the development of the project, a description of the different elements that make up the project, a summary of how the project is being executed including the progress that has been
achieved so far. Finally, the benefits that Huites is expected to bring as well as the environmental impacts are analyzed.

Chapter four deals with the financing options available for the construction and operation of the hydroelectric dam. This chapter looks at the privatization issue and how other financial options could be exploited with it. Lessons of foreign experience as well as a few alternatives for privatizing electricity in Mexico are explored.

Chapter five is an analysis of the actual financial and legal schemes used for the development of the project. The financial scheme includes investments by the Agriculture Ministry through the National Water Commission (CNA), investments by the contractor for the project, a debt issue for 200 million dollars (US) and a credit for the value of the electromechanical equipment necessary for the power station.

The legal scheme reflects the way in which the government manages public-private partnerships and it revolves around a fiduciary trust. Linked to this trust are six contracts that govern everything from equipment suppliers to financial advisors fees. The chapter concludes with an assessment of the various risks involved.

Chapter six is the conclusion of the thesis and it deals with the lessons learned from this type of project for future development of infrastructure works in Mexico.
2. **Background**

2.1 **Economic Developments in the 1980's**

During the 1970's, the Mexican government borrowed heavily in the international financial markets. During the same period, the Mexican economy became increasingly dependent on oil revenues. In 1982, Mexico had the second largest foreign debt in Latin America amounting to 80.1 billion US dollars, surpassed only by Brazil. In 1982, a collapse in international oil prices dealt a major blow to the Mexican economy. Declining government revenues caused the peso to devaluate and deprived Mexico of the foreign exchange needed to service its external debt. At the time, then president Jose Lopez Portillo responded to the crisis by nationalizing the financial sector of the economy and by declaring a moratorium on interest payments for foreign debt. Such response prompted other governments in similar positions to stop servicing their foreign debts and ultimately the availability of financial capital to the region became extinct.

During the tenure of Mexico's next president, Miguel de la Madrid Hurtado (1982-88), public and private investment in the country dropped and many construction projects were either canceled or stopped. President de la Madrid introduced an economic stabilization program which, by the end of his administration, started to show positive results. Economic recovery became a possibility with inflation, interest rates and the government budget deficit decreasing and positive growth in both investment and GNP.

In 1988, de la Madrid's successor took office and by 1989, president Carlos Salinas de Gortari introduced the "Plan
Nacional de Desarrollo" a five year development plan intended to take the policies of the previous president a step further by opening Mexico's economy, stabilizing inflation, improving efficiency and productivity, restructuring Mexico's foreign debt and by continuing to privatize state enterprises which by that time had decreased from 1,171 in 1982 to 414 in 1988. Before such plan, government entities accounted for over 70% of aggregate construction spending and the pattern of such spending was loosely correlated with the timing of Mexico's presidential election (Fig. 2.1).
Figure 2.1 Annual Growth of the GNP and Construction Product

Source: Banco de Mexico and Secretaria de Programacion y Presupuesto
The plan included an expanded role for the private sector in the development of the country's highway system which was in poor condition and posed a threat to the continued overall economic growth. A concession program that enabled private construction firms to invest in new toll roads throughout the country was selected.

After returning the banking industry to the private sector and enjoying positive results from the effort to modernize the economy, Mexico's capital markets showed increasing growth and sophistication. Road concessions were being financed by medium and long term bond issues rather than simple bank loans and by 1992 the government was actively seeking the participation of foreign capital to supplement Mexico's limited internal resources. Figure 2.2 summarizes Mexico's macroeconomic performance from 1979 to 1991.
Figure 2.2 Mexico's Macroeconomic Indicators

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<td>Inflation a</td>
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<td>14%</td>
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<td>12%</td>
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<td>5%</td>
<td>38%</td>
<td>19%</td>
<td>23%</td>
<td>14%</td>
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<td><strong>BALANCE OF PAYMENTS</strong> (US millions)</td>
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<td>Current Account</td>
<td>(4,876)</td>
<td>(6,761)</td>
<td>(12,544)</td>
<td>(2,685)</td>
<td>5,324</td>
<td>4,249</td>
<td>1,237</td>
<td>(1,673)</td>
<td>3,967</td>
<td>(2,443)</td>
<td>(6,004)</td>
<td>(6,349)</td>
<td>(8,620)</td>
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<td>(1,527)</td>
<td>1,837</td>
<td>(576)</td>
<td>(1,448)</td>
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<td>3,248</td>
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<td>Public External Debt as % of GDP</td>
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<td>18%</td>
<td>37%</td>
<td>45%</td>
<td>42%</td>
<td>42%</td>
<td>62%</td>
<td>61%</td>
<td>48%</td>
<td>39%</td>
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<td>Budget Deficit as % of GDP</td>
<td>8%</td>
<td>8%</td>
<td>15%</td>
<td>18%</td>
<td>9%</td>
<td>9%</td>
<td>10%</td>
<td>16%</td>
<td>16%</td>
<td>12%</td>
<td>6%</td>
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Notes:  
a) Percentage increase in the consumer price index.  
b) Average annual interest rate on 90 day Mexican CETES.  
c) Average month-end free market exchange rate.  

Sources: Banco de Mexico, *Indicadores Economicos* and *Informe Anual*.  
Instituto Nacional de Estadistica, Geografia e Informatica, *Sistema de Cuentas Nacionales de Mexico*.  
World Bank, *Trends in Developing Economies*.  
Catalogo CIHAC de la Construccion, *Indicadores Basicos*.  

15
2.2 The Highway Program and BOT System

By the time president Salinas took office Mexico's highway infrastructure was deficient in both magnitude and condition. Shortly after assuming office, the president introduced the road concession program. The Build-Operate-Transfer (BOT) system consisted of the government awarding concessions to private companies for the funding, construction, operation and maintenance of modern toll roads between key cities creating economic corridors. The program also included several international bridges.

The basic concept of the program was developed during the de la Madrid administration when, in 1987, the concessions to two routes totaling 215 kilometers were awarded. Although the experimental concessions were financed almost entirely by the state, the construction firms provided "sweat equity" and gained valuable experience for the future. The program was left for Salinas to execute on a large scale.

The highway development program anticipated the development of 4,000 kilometers of new highways to be built over a period of five years at a cost of 5 billion dollars. It was to be extended to a total of 12,000 kilometers in following years. The rationale for approaching the private sector for the provision of government services is clearly captured in the "Plan Nacional de Desarrollo: 1989-1994" which states that "private participation in this area will contribute to rapid development of infrastructure so necessary for the country and will ensure that funds are made available to take care of other priority programs, which are strictly
the responsibility of the public sector." It is important to state, however, that the users of the new highways would bear the burden through higher tolls. Nevertheless, Mexican law stated that a free alternate route be available in every case. In most cases the free alternate routes were in inferior conditions.

The concession process was very different from the traditional approach in which private companies were involved exclusively with the construction of the roads. Although similar concession programs had been carried out in other countries such as France and Spain, none had the same characteristics as the Mexican program. Under Mexico's traditional approach, the government financed, operated and maintained the roads while private sector firms carried out the construction. Contracts were awarded through a competitive bid process to the lowest unit cost bidder. The government would then reimburse the winner on the basis of progress made. Contracts included escalation clauses that would compensate the firm for inflation. The shortfalls of this approach that the construction firms have to contend with are that the government budget does not coincide with the progress of the project. Therefore, in many cases, construction firms are paid very late for work completed and many times are left exposed when a shortfall of resources occurs in the sponsoring governmental agency.

The concept behind the BOT concession system is that construction firms bid for the right to collect toll revenues on a specific route after financing the construction and building the road. During the concession period (length of concession), the winning firm has to provide the operation and maintenance of the road and when
the concession period is over, the road as well as the tolls return to government ownership.

What distinguishes the Mexican model from other concession programs is that the winning bid is selected by the shortest concession period rather than levels of equity invested, government subsidies requested and toll rates proposed as is the case for France and Spain.

By the end of 1991, investment in BOT concessions totaled 4.6 billion dollars, 700 kilometers were operational and concessions for 2,600 kilometers had been awarded. The government expects that by the end of president Salinas' term (1994) 5,760 kilometers of BOT concessions will be in operation.

2.3 BOT Concession Framework

In the case of the highway development program, the Transportation Ministry "Secretaria de Comunicaciones y Transportes" (SCT) prepared detailed technical specifications for each highway and was responsible for securing the right of way along each route. Such ministry also prepared traffic estimates, specified the maximum allowable toll and placed, along with the Ministry of Finance "Secretaria de Hacienda y Credito Publico" (SHCP), conditions on the financial structure of the concession.

The technical specifications that the SCT prepared included the highway path, locations and specifications of interchanges, toll booths and bridges, number of lanes and minimum standards for construction materials among others. Bidding firms had to rely on the information provided by the SCT to formulate their bids.
The government guaranteed a minimum level of revenues to the concessionaire based on traffic forecasts and maximum tolls. If the projections proved to be conservative, the concession period could be shortened; the opposite was possible if the volume of usage was below the projections. The maximum tolls were set so that a high level of revenues could be obtained. However, the toll could not be too expensive so that users would choose to pay the toll and drive through a safer and faster road rather than use the more dangerous but free and always available alternate roads. The traffic projections, although later proven to be inaccurate, were made by looking at the actual traffic in the area with an increase that accounted for the demand that would be generated when the completed highway system became operational.

The capital structure of each concession was determined on a case by case basis by the SCT, SHCP, the winning firm, the participating financial institution(s) and any other public sector equity contributor such as CAPUFE (the entity that operates and maintains public roads). Usually, the winner of the concession had to provide around 25% of the total capital requirements from its own resources. This created an incentive for the winner to minimize construction costs and increase operating efficiency. Also, construction firms expanded their role to become developers and finance firms as well. In some cases, other government entities were allowed to provide equity capital when the required investment was too large for a single entity to provide. In theory, concessionaires did not have to be construction firms. Any public or private entity
could act as concessionaire. However, in every case, a construction firm was involved either individually or as part of a joint venture.

In order to submit a bid, firms had to secure a commitment from a financial institution that would provide debt capital for the project. By the beginning of 1992, commercial banks were the only ones that had provided debt capital to highway concessions. Such capital was offered at floating interest rates in the form of short to medium term loans that could be renewed over the course of the concession. In many cases, one financial institution would make a commitment with more than one bidder for a particular concession although not under the same terms (Fig. 2.3).
Figure 2.3 Credit Received by the Construction Industry Through Development and Commercial Banks.

Source: Catalogo CIHAC de la Construccion, Indices de la Banca Relacionados con la Construccion y Vivienda.
In order to select the winning bid, the SCT and SHCP required the bidders to submit extensive documentation that proved the technical and financial feasibility of the proposal. Winners were chosen on the basis of the shortest concession period including the time for construction. When more than one bid had the same concession time, the government looked at, in order of priority, shortest construction period, total cost, soundness of financial proposal, and technical qualifications of the bidder. Once the winner was selected, a concession title was signed by the SCT, concession winner and SHCP. Such title defined the length of the concession, the authorized toll levels, the capital structure of the project and the responsibilities of each party during the different phases of the project.

The construction firms that participated in the concession scheme undertook, in many cases, risks that were not proportional to their participation. For instance, some times the financial institution that provided debt capital to a project required collateral consisting of the construction firm's assets for the total value of the loan. Also, certain project risks such as changes in specifications during the construction phase and other government induced delays were guaranteed by the SCT through concession period extensions which only increased the uncertainty for both equity and debt holders. Even though the concession system was very risky for the construction firms, participation in the highway program was enthusiastic because firms sensed that such program was only the beginning of the government's effort to tap the private sector for the development of
the country's infrastructure (Fig. 2.4).
Figure 2.4  Gross Fixed Private Capital Formation in Construction

Source: Catalogo CIHAC de la Construccion, Inversion Privada en Construccion.
Before construction began, a trust was established to manage the cash flows related to the project. All parties involved in the project, including the government agencies that provided equity, deposited the capital in the trust. As expenses were incurred during the construction phase, the concessionaire submitted invoices for reimbursement from the capital held in the trust. Such reimbursements were discounted by a percentage equal to its equity stake in the project and therefore, the share of equity of the concessionaire accumulated over the period of construction in the form of sweat equity. Interest incurred on the debt was capitalized during construction so the outstanding amount increased. The construction firms had a strong incentive to build the road in the shortest possible time to avoid additional interest costs and to start generating toll revenues as soon as possible.

If all the available capital was used before the end of the construction, the participating bank(s), government agencies and/or private firm would have to increase their capital contribution to the project. The SCT would increase the length of concession period only if the cost increases could be proven to be due to factors outside the concessionaire's control. Also, the SCT could invite other public sector entity to provide an equity contribution.

Once construction was completed and the road began operating, the toll revenues flowed through the trust and the income was used to pay the outstanding debt. Residual revenues were paid to the concessionaire in the form of dividends. In some cases, the concessionaire would receive dividends during the entire operating
period and in others, it would have to wait until the debt was paid off before it could receive dividends. The road concession program did not allow public sector equity holders to receive dividends of any kind.

When the concession period expired, ownership of the toll revenues reverted back to the government. The maintenance and operation of the road became the government's responsibility and the trust was dissolved.

Although the highway development program of president Salinas and the BOT system had some difficulties (mainly because of inaccurate traffic flow projections) it became clear that the experience gained in such program could be used in other types of infrastructure projects. The challenge for the construction industry was to change from the traditional contractor role to become developers and providers of capital. This challenge became even more important because the economic policies of the Salinas' administration were clearly geared towards a more open economy where international competition was inevitable. From the government's point of view, the framework had to be adjusted to accommodate other types of projects besides highways. Many public works laws that are outdated have yet to be modernized in order to make the BOT concession system more efficient, less bureaucratic and more equitable for all the parties involved.
3. THE PROJECT

3.1 Background

The agricultural infrastructure built in northwestern Mexico has been, undoubtedly, a key aspect supporting the development of the region as well as an instrument oriented towards guaranteeing the production of food and other agricultural products demanded by the country.

Since the past decade, the irrigateable area in northwestern Mexico has been 1.5 million hectares (3.7 million acres) which accounts for approximately one fourth of the area under irrigation in all the country. The high yields that this region has accomplished have represented 88% of the national production of soy beans, 40% of the cotton produced and 51% of the rice production. In general, the agriculture with irrigation of the northwest represents nearly 30% of the total agricultural production.

The northwest still offers great opportunities for increasing its production. On one hand, it is possible to increase the intensity in the use of the soil in the regions that are currently irrigated, while on the other, there exist vast regions of land that can be incorporated to the irrigated agriculture.

The Agriculture ministry (Secretaria de Agricultura y Recursos Hidraulicos) has defined the Hydraulic Interconnected System of the Northwest in order to make better use of the water and soil resources of the region. Their long term plans include the modernization of the existing irrigated districts as well as the irrigation of 520,000 hectares (1.28 million acres) which represent
65% of the estimated potential area to be irrigated in the region (Figure 3.1).

Included under this general framework is the Sinaloa - Fuerte - Mayo subsystem, in the north of the state of Sinaloa and south of the state of Sonora. Contained in such subsystem is the development of Huites project which includes the construction of a dam with a storage capacity of 4.568 billion cubic meters, the construction of a hydroelectric plant with a capacity of 400 Megawatts and the construction of the infrastructure to irrigate 70,000 hectares (173,000 acres) in the states of Sonora and Sinaloa.

3.1.1 Exploitation of the Fuerte River

Located on the Fuerte River in the northern part of the state of Sinaloa and near the border between the states of Chihuahua and Sonora, Huites dam will enable the complete exploitation of this important stream.
Figure 3.1 Area of Reference
The median annual flow of the Fuerte river downstream from where it meets the Alamo brook surpasses 4.812 billion cubic meters. 80% of this flow has been exploited since two decades ago for the irrigation of 271,000 hectares (670,000 acres). Such exploitation for agricultural purposes has been accomplished with the Miguel Hidalgo dam and the Josefa Ortiz de Dominguez dam. The first is located downstream from Huites' site and the second on the Alamo brook, inflowing the Fuerte river, downstream from the Miguel Hidalgo dam. The storage capacity of the two existing dams is 3.4 billion cubic meters and the Miguel Hidalgo dam has a hydroelectric generating unit with capacity of 60 Megawatts that allows an annual median generating output of 290 Gigawatts hours.

The Fuerte river presents periodic discharges caused by the melting of ice during spring and by tropical storms and cyclones during summer. The record maximum flow registered was 15,000 cubic meters per second and occurred in January of 1960. The most recent flow was of 13,000 cubic meters per second and occurred in December of 1990. Such discharges have caused serious flooding and damage in the region because the installed capacity is not sufficient to manage the maximum flows.

3.2 Project Development

The site known as "Boquilla de Huites" (Huites nozzle) has been explored and studied for five decades by the Agriculture Ministry (Secretaría de Agricultura y Recursos Hidraulicos, SARH). In 1974 and 1977 such ministry conducted detailed surveys of the terrain in order to develop several feasible designs for the dam.
In 1941, a weather station was installed at "Boquilla de Huites" in order to gather information about the flow of the Fuerte river in this particular site. The following information summarizes the relevant findings for the design of the dam:

- The volume of the median annual flow of the Fuerte River at Huites is 3.771 billion cubic meters.
- During the summer between the end of June and middle of October a flood period occurs with maximum registered flows of 7,000 cubic meters per second. Such flows generally occur at the end of the period.
- During the winter between the middle of December and the beginning of March, a second flood period occurs registering the maximum instantaneous flows; the historic maximum was registered in March 1980 with 14,500 cubic meters per second.
- The low water period occurs between March and June. The lowest flows occur in May and have registered as little as 20 cubic meters per second.

The governmental agency in charge of electricity generation Comision Federal de Electricidad (CFE) and the water resource management agency Comision Nacional del Agua (CNA) (a decentralized entity of the SARH) analyzed the above data in order to define the design parameters for Huites dam including the type of spillway structure, the dimensions and characteristics of the embankment and the maximum probable flow at the site of the dam. From the analysis, the structure of the dam was defined (described later) in order to accommodate ordinary flows of 15,000 cubic meters per second which are regulated at 7,000 cubic meters per second.
With the defined structure, the maximum probable flow with peaks of 30,000 cubic meters per second is regulated at 22,445 cubic meters per second. From such analysis, the maximum extraordinary water level and the capacity for flow control of Huites dam was determined (Figure 3.2).

Miguel Hidalgo dam regulates the flows that leave Huites dam. The 7,000 cubic meters per second flow is regulated to 3,000 cubic meters per second and the 22,445 cubic meters per second flow is regulated to 18,500 cubic meters per second. Consequently, the flows that have occurred since 1942 can be regulated up to 80% so that the discharge from Miguel Hidalgo dam results within the capacity of the riverbed down to the mouth of the Fuerte river.
Figure 3.2 Control of the Maximum Probable Flow Into Huites Dam
3.3 Project Description

The site of Huites dam is located in the municipality of Choix in the state of Sinaloa. Its geographic coordinates are 26° 50' 32" latitude north and 108° 22' 12" longitude west.

The exploitation of the Fuerte river at the "Boquilla de Huites" site requires a dam with uncommon characteristics. Its height as well as the design parameters of the spillway will make it one of the most important dams in Mexico. Also impressive are the volumes of materials and excavation required.

3.3.1 The Dam

The embankment of the project is a conventional concrete type in gravity section. It has a maximum height of 166 meters closing in the right bank of the river with an arch type embankment.

The riverbed at the nozzle has a height of 150 meters above sea level and it is filled with alluvium with a maximum depth of 20 meters. Under the alluvium there is granite rock with an approximate depth of 5 meters, this rock is exposed to the elements. Intact granite is located at a height of 125 meters above sea level.

The design of the dam calls for the foundation of the embankment to consist of a consolidation carpet with 15 meters of depth and a waterproof screen with 50 meters of depth. This requires drilling 14,000 meters for the injection in the area of the carpet and an additional 12,000 meters for the waterproof screen.

The cross section of the embankment is 8 meters wide at the crown with an elevation of 290.75 meters above sea level with a blind parapet facing upriver measuring 1.25 meters and
reaching 292 meters above sea level. The upriver face of the wall is vertical in the upper section and has an inclination of 0.1:1 in the lower section. The down river face the wall has an inclination of 0.75:1.

The embankment is 426 meters in length at the crown. For its construction, 2,360,000 cubic meters of concrete will be used and 485,000 cubic meters of excavation are needed. (Fig. 3.3)
Figure 3.3 Cross Section of Dam and Cofferdams
3.3.2 Diversion Channel

In order to build the different components of the dam, the Fuerte river must first be diverted from its original course so that the water from the river does not interfere with the construction activities. The diversion channel is located at the right bank of the nozzle. It has no slope and it's altitude is 150 meters above sea level. Such channel was designed to contain a flow of 8,500 cubic meters per second. The design of the channel consists of a 28 meters wide footprint with a trapeze like cross section that has inclined walls at 0.25:1 and a height of 33 meters. When the maximum flow occurs, the water will reach a height, relative to the bottom of the channel, of 32 meters at the entrance and 20 meters at the exit point.

The cofferdams that will close the riverbed to divert the water flow to the diversion channel will be positioned over the riverbed at an altitude of 150 meters above sea level. A waterproof flexible screen that encompasses the whole area where alluvium material exists will be tied to the waterproof nucleus of each cofferdam. The upriver cofferdam has a height of 33.7 meters while the one down river has a height of 21.5 meters.

The construction of the diversion channel requires 970,000 cubic meters of excavation and 69,000 cubic meters of concrete. The cofferdams require 718,000 cubic meters of material.

3.3.3 Control Structure and Spillway

The control structure and spillway are located on the left bank of the river and consist of a structure that houses four
radial gates over a peak that is tied to a discharge channel. The
discharge channel is divided in the middle by a wall. Such wall
defines, on the left bank, a service canal that handles ordinary flows
and, on the right bank, a canal that handles major flows. The
capacity of the structure is 22,445 cubic meters per second.

The control structure is made up of four sections of
spillway. Each section is controlled with one radial gate that
measures 15.5 meters wide and 21 meters high.

The discharge of the radial gates starts at the
summit towards a channel with a rectangular cross section. Such
channel has a slope of 1.25:1 and is connected to a cylindrical
surface with 176.11 meters of radius. The cylindrical surface
deposits the flow approximately 120 meters from the gates. The
spillway structure can be directly accessed from the crown of the
embankment. (Fig. 3.4)
Figure 3.4 Control Structure and Spillway

Axis of the Spillway

Radial Gates
4 x (15.5 x 21.0 meters)

EL. 258.00

EL. 236.00

EL. 212.00

EL. 188.00

EL. 170.00

EL. 160.00

EL. 142.00
3.3.4 Hydroelectric Plant

The inlet for electricity generation is located on the right bank in the body of the dam and the hydroelectric plant is at the foot of the dam. The plant is equipped with two Francis turbines of 200 MW of generating capacity each for a total of 400 MW. The Francis turbines are designed for a rate of flow of 235 cubic meters per second operating with a plant factor of 0.25. For the discharge, a vent gate is used in each exit pipe.

The water inlet consists of two steel pipes 7.8 meters in diameter located in the embankment. Such pipes feed the generating units from their down river end. From a vertical point of view, the two pipes have a slope of 0.75:1 in their initial section and then, through an elbow, become horizontal with their axis at 147 meters above sea level. The design includes gates for emergency closure that operate mechanically with two servo motors mounted at the same level as the crown of the embankment.

The transformers are located in a patio on the right bank of the river while the substation is located on the roof of the equipment room. The plant will be connected to the northwestern sector of the national electricity grid. (Fig. 3.5)

Table 3.1 summarizes the features of the project and figure 3.6 shows the general layout.
Figure 3.5 Intake Pipes and Generating Units
Table 3.1

Main Characteristics of the Project

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VOLUMES (millions of cubic meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Capacity of the Reservoir During Extraordinary Flows</td>
<td>4,568</td>
</tr>
<tr>
<td>Capacity of the Reservoir During Ordinary Flows</td>
<td>2,908</td>
</tr>
<tr>
<td>Capacity for Sediments</td>
<td>500</td>
</tr>
<tr>
<td>Useful Capacity for Irrigation and Electricity Generation</td>
<td>2,408</td>
</tr>
<tr>
<td>Capacity for Flow Control</td>
<td>1,102</td>
</tr>
<tr>
<td>Superstorage</td>
<td>558</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ALTITUDES (meters above sea level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upriver Blind Parapet of the Dam</td>
<td>292.00</td>
</tr>
<tr>
<td>Crown of the Dam</td>
<td>290.75</td>
</tr>
<tr>
<td>Upper Control Water Level</td>
<td>290.00</td>
</tr>
<tr>
<td>Ordinary Control Water Level</td>
<td>270.00</td>
</tr>
<tr>
<td>Minimum Operational Water Level</td>
<td>215.00</td>
</tr>
<tr>
<td>Spillway Crest</td>
<td>258.00</td>
</tr>
<tr>
<td>Water Inlet Threshold</td>
<td>190.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>RATES OF FLOW (cubic meters per second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Inflow to the Reservoir</td>
<td>30,000</td>
</tr>
<tr>
<td>Maximum Outflow from the Spillway</td>
<td>22,445</td>
</tr>
<tr>
<td>Maximum Flow Through the Diversion Channel</td>
<td>8,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>CONSTRUCTION VOLUMES (cubic meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation for the Diversion Channel</td>
<td>970,000</td>
</tr>
<tr>
<td>Excavation for the Equipment Room</td>
<td>956,000</td>
</tr>
<tr>
<td>Excavation for the Spillway</td>
<td>861,000</td>
</tr>
<tr>
<td>Excavation for the Dam</td>
<td>485,000</td>
</tr>
<tr>
<td>TOTAL EXCAVATION</td>
<td>3,272,000</td>
</tr>
</tbody>
</table>
Table 3.1 Continued

Main Characteristics of the Project

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VOLUMES (cubic meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete for the Diversion Channel</td>
<td>69,000</td>
</tr>
<tr>
<td>Concrete for the Equipment Room</td>
<td>87,000</td>
</tr>
<tr>
<td>Concrete for the Spillway</td>
<td>464,000</td>
</tr>
<tr>
<td>Concrete for the Dam</td>
<td>2,360,000</td>
</tr>
<tr>
<td>TOTAL CONCRETE</td>
<td>2,980,000</td>
</tr>
<tr>
<td>Earth moving for the Cofferdams</td>
<td>718,000</td>
</tr>
</tbody>
</table>

Source: Secretaria de Agricultura y Recursos Hidraulicos, Comision Nacional del Agua.
3.4 Project Execution

3.4.1 Public Bid

The Agriculture and Hydraulic Resources Ministry (SARH) via the National Commission for Water (CNA) invited several construction companies from Mexico to bid for the construction of Huites dam. The project was a BOT arrangement that included the construction of the dam along with any infrastructure necessary such as roads, camps, etc; the construction of a hydroelectric plant along with the supply of all the necessary equipment such as generators, turbines, etc; and finally, an investment scheme to provide the financial resources necessary to complete the project.

After setting the minimum requirements that the competing firms had to cover, only two groups of bidders were left. On one side was a joint venture comprised of Grupo Mexicano de Desarrollo with the Brazilian firm Companhia Brasileira de Projectos e Obras (GMD-CBPO) and on the other was La Nacional Constructora jointly with Ingenieros Civiles Asociados (ICA) through a newly formed company by the name of Desarrolladora Mexicana de Huites (ICA-La Nacional).

The bid had to include the following information:

1. Total amount of the investment.
2. Cost of the project based on unit prices.
3. Financial scheme including the amounts of internal resources, long term and medium term credits and contribution of the federal government.
4. Percentage of Mexican resources and equipment used.
5. Construction schedule.
6. Letters of commitment form the sources of financing.
7. Other legal documents noting that the firm is properly registered and licensed.

The bids had to be presented at 6:00 PM on May 13, 1992. CNA would then take some time to evaluate the two bids and decide on a winner.

After careful evaluation of the bids by several government agencies, it was decided that the two groups, GMD-CBPO and ICA-La Nacional should jointly build the project. For such purposes, the four companies formed a consortium and named it "Consorcio Mexicano Constructor de Huites S.A de C.V." (CMCH).

3.4.2 Organizational Structure

In order to function effectively as a team rather than four individual companies, the participants decided on an organizational scheme that would have its own identity, would function independently from the four participants and one in which all four companies would be represented. Also, it became a goal of the participants to exploit the areas of knowledge and experience of each company in order to create an organization that was more than the sum of its parts. The organization begins with the stockholders of CMCH of which GMD-CBPO have 50% ownership and ICA-La Nacional the other 50%. An "Administration Board" was formed and is made up of two officers each from GMD, La Nacional and ICA
along with one officer of CBPO. Below the board, an executive committee was formed with one officer from each company. Below the executive committee comes the operational organization. Table 3.2 describes the decisions each major component is empowered to take and figures 3.7 and 3.8 show a graphical representation of the complete scheme.
### Table 3.2 Decisional Structure

<table>
<thead>
<tr>
<th>Description</th>
<th>Responsible Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in Organization</td>
<td>Administration Board</td>
</tr>
<tr>
<td>Appointment of top officers</td>
<td>Administration Board</td>
</tr>
<tr>
<td>Salary policies</td>
<td>Administration Board</td>
</tr>
<tr>
<td>Equipment procurement policy</td>
<td>Administration Board</td>
</tr>
<tr>
<td>Cement procurement policy</td>
<td>Administration Board</td>
</tr>
<tr>
<td>Approval of appointed officers</td>
<td>Executive Committee</td>
</tr>
<tr>
<td>Contracting permanent consultants</td>
<td>Executive Committee</td>
</tr>
<tr>
<td>Approval of equipment purchases</td>
<td>Executive Committee</td>
</tr>
<tr>
<td>Procurement procedures</td>
<td>Executive Committee</td>
</tr>
<tr>
<td>Approval of construction schedule</td>
<td>Executive Committee</td>
</tr>
<tr>
<td>Approval of subcontracts</td>
<td>Executive Committee</td>
</tr>
<tr>
<td>Appointment of area managers</td>
<td>Project Director</td>
</tr>
<tr>
<td>Auxiliary service contracting</td>
<td>Project Director</td>
</tr>
</tbody>
</table>
Figure 3.7 First Level Organizational Chart
Figure 3.8 Operational Level Organizational Chart
3.4.3 Construction Schedule and Progress

The schedule for the construction of Huites calls for the termination of the work in 30 months. Construction began in July 1992, all construction work will be finished in December 1994 and the hydroelectric plant is to begin operating in July 1995. The following table shows the work that was planned for and the progress achieved at the time this work was written.

<table>
<thead>
<tr>
<th>Description</th>
<th>Units</th>
<th>Planned</th>
<th>Completed</th>
<th>C/P %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete in diversion channel</td>
<td>m³</td>
<td>103,000</td>
<td>38,313</td>
<td>37 %</td>
</tr>
<tr>
<td>Excavation for equipment room</td>
<td>m³</td>
<td>650,000</td>
<td>515,839</td>
<td>79 %</td>
</tr>
<tr>
<td>Boreholes for precut of</td>
<td>m</td>
<td>7,200</td>
<td>8,219</td>
<td>114 %</td>
</tr>
<tr>
<td>equipment room</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borehole for cut of</td>
<td>m</td>
<td>14,913</td>
<td>17,018</td>
<td>114 %</td>
</tr>
<tr>
<td>equipment room</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation of spillway</td>
<td>m³</td>
<td>881,000</td>
<td>828,925</td>
<td>94 %</td>
</tr>
<tr>
<td>Boreholes for precut of</td>
<td>m</td>
<td>4,900</td>
<td>12,159</td>
<td>248 %</td>
</tr>
<tr>
<td>spillway</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boreholes for spillway cut</td>
<td>m</td>
<td>6,488</td>
<td>10,056</td>
<td>155 %</td>
</tr>
<tr>
<td>Concrete for spillway</td>
<td>m³</td>
<td>0</td>
<td>982</td>
<td>------</td>
</tr>
<tr>
<td>Excavation in dike</td>
<td>m³</td>
<td>75,000</td>
<td>39,532</td>
<td>53 %</td>
</tr>
<tr>
<td>Concrete in dike</td>
<td>m³</td>
<td>25,000</td>
<td>1,083</td>
<td>4 %</td>
</tr>
<tr>
<td>Extraction of alluvium</td>
<td>m³</td>
<td>1,737,500</td>
<td>1,401,953</td>
<td>81 %</td>
</tr>
</tbody>
</table>
3.4.4 Miscellaneous Facts

During May 1993, a 45 kilometer electrical line was installed from the nearest town (Choix) to the site, the license for the operation of a railroad spur was approved, the pavement of the road between Choix and Huites was completed and the waterproof screens of the cofferdams were completed. In the same month, 58 units of heavy machinery and a total of 2,671 people including subcontractors were working at the site. 69 subcontracts had been awarded totaling 66.8 million dollars and the value of the remaining work was 213 million dollars.

3.5 Benefits of the Project

3.5.1 Agricultural Benefits

The joint operation of the Miguel Hidalgo dam, the Josefa Ortiz de Dominguez dam and Huites dam along the Fuerte river and the Gustavo Diaz Ordaz (Bacurato) dam on the Sinaloa river as well as the aquifers located in the valleys of the rivers will generate an increase in the productivity of the irrigated areas that form part of the Sinaloa-Fuerte-Mayo subsystem. The irrigated area will increase by 70,000 hectares and from this, the following benefits will be obtained:

- The use of 3.231 billion cubic meters to irrigate 229,000 hectares in the "Distrito de Riego del Valle del Fuerte" (Fuerte Valley Irrigation District) with an irrigation sheet of 1.54 meters.
- The use of 525 million cubic meters to irrigate 42,000 hectares in the "Distrito de Riego del Valle del Carrizo" (Carrizo Valley Irrigation District) with an irrigation sheet of 1.35 meters.
The use of 402.5 million cubic meters to open 35,000 hectares in the state of Sinaloa with an irrigation sheet of 1.15 meters.

The use of 1.2403 billion cubic meters to irrigate 105,000 hectares in the "Distrito de Riego del Valle del Guasave" (Guasave Valley Irrigation District) with an irrigation sheet of 1.25 meters.

A total of 6.057 billion cubic meters of water will be used to irrigate a total of 446,000 hectares. During average conditions, 4.448 billion cubic meters will be obtained from the Fuerte river; 1.14 billion cubic meters from the Sinaloa river; 250 million cubic meters from the Guasave aquifer and 151 million cubic meters from the Fuerte aquifer.

The agricultural production from the area that will be irrigated once Huites dam is in operation will include wheat, corn, bean, chickpea, soy bean, sorghum, sesame, potatoes and other vegetables (Table 3.3). The total agricultural production is expected at 480,000 tons with a value of 347 million new pesos (1 US dollar = 3.11 new pesos) per year.
Table 3.3
Agricultural Production in the New Irrigation Areas

<table>
<thead>
<tr>
<th>CROP</th>
<th>SURFACE (hectares)</th>
<th>PRODUCTION (tons)</th>
<th>VALUE (millions new pesos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>21,700</td>
<td>97,650</td>
<td>48,434</td>
</tr>
<tr>
<td>Corn</td>
<td>16,050</td>
<td>60,575</td>
<td>35,134</td>
</tr>
<tr>
<td>Beans</td>
<td>5,150</td>
<td>7,725</td>
<td>15,450</td>
</tr>
<tr>
<td>Canola</td>
<td>4,650</td>
<td>8,370</td>
<td>7,473</td>
</tr>
<tr>
<td>Soya Beans</td>
<td>3,650</td>
<td>6,935</td>
<td>6,588</td>
</tr>
<tr>
<td>Sorghum</td>
<td>3,100</td>
<td>15,500</td>
<td>5,580</td>
</tr>
<tr>
<td>Chickpeas</td>
<td>2,450</td>
<td>4,165</td>
<td>4,040</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2,000</td>
<td>50,000</td>
<td>75,000</td>
</tr>
<tr>
<td>Sesame</td>
<td>1,800</td>
<td>2,700</td>
<td>4,050</td>
</tr>
<tr>
<td>Produce</td>
<td>16,450</td>
<td>232,250</td>
<td>145,875</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>77,000</strong></td>
<td><strong>485,870</strong></td>
<td><strong>347,624</strong></td>
</tr>
</tbody>
</table>

Source: Secretaria de Agricultura y Recursos Hidraulicos, Comision Nacional del Agua.
3.5.2 Benefits from the Hydroelectric Project

The Huites hydroelectric plant has an installed capacity of 400 MW that will be an important supply of energy during peak hours. With a plant factor of 0.25, an estimated median annual generation of 875 GWhr is expected. If the price of one KWhr is 7 US cents, the value of the energy generated by Huites is 157.5 million new pesos annually.

3.5.3 Flood Control

With Huites dam in operation, the flood control capabilities in northwestern Mexico will be doubled. It will be possible to contain flows such as the ones that have been registered from the Fuerte river since 1942, reducing the damages to a minimum. The capacity to regulate the flows diminishes the risk of floods in a region of 50,000 hectares.

In 1990, there was a flow in the Fuerte river that caused damage to 40,000 residents resulting in losses of more than 150 million new pesos in lost crops. Huites dam will prevent this sort of disasters.

3.5.4 Other Benefits

Other benefits that are attributable to the project include the generation of jobs during the construction period. An estimated 10 million manpower days will be generated in the region. Also, fishing and other water related activities will be developed as has been the case in other nearby reservoirs.

3.6 Land Ownership and Environmental Concerns

Once the dam is completed, an estimated 9,457 hectares will be flooded by the reservoir. The flooded area includes 323
houses, 8 schools, crops, one church, several roads and other buildings. The federal government is responsible for compensating the local residents as well as relocating them to a new site. So far, the government has begun the process of valuing the properties which includes taking a new census of the region and defining the legal ownership as well as the boundaries of the properties and their contents. The federal government has held over 150 meetings with resident of the area to analyze each case individually.

The basic goals of the relocation program are to guarantee the residents equal or better living conditions, services and communications and to finish the process in a timely manner so that it does not interfere with the construction of the project.

In the environmental aspect, studies have been made with a ten year horizon in mind. It is assumed that in ten years, all the environmental alterations will have happened. Some of the probable negative consequences include solid dispersions, organic pollution and salinization of the soil. Some of the positive consequences include rain periods, water bodies, underground water extraction, handy natural resources, recharge of aquifer bodies and a general increase in the standard of living of the population of the area.
4. FINANCIAL ALTERNATIVES AND PRIVATIZATION

In this chapter, the financial alternatives that were available to the Mexican government, at the time the decision to build Huites was made, will be explored. Clearly, traditional financing methods and instruments were accessible to the government. Such methods include tax financing, debt financing (with the pertinent debt instruments for energy projects) and some limited forms of privatization. The first part of the chapter will provide an overview of the aforementioned traditional alternatives. In the second part of the chapter, the issue of privatization along with the limited forms available to the Mexican government will be described. Also, an explanation of why limits exist on privatization options will ensue. The final part of the chapter deals with the question of transferring the state run electricity monopoly in Mexico, Comision Federal de Electricidad (CFE), to private hands. It is argued, in the final section, that a wider array of financial options would be available for the government to build energy projects such as Huites, if it chose to privatize generation and distribution of electricity. The advantages and disadvantages of such action will be analyzed as well as the lessons learned from the experiences of other countries.

4.1 Traditional Financial Alternatives

The Mexican government has always relied on traditional financing methods to fund infrastructure projects. The two methods mentioned are tax finance and debt finance.

Tax finance means that the federal, state and local governments raise funds through increases in the different types of taxes (income, property, etc.). Sometimes, special taxes are
introduced when funds need to be raised for a special project, for example, the property taxes in a certain area may be increased to fund a development that is thought to raise the value of such properties when finished. Tax finance has two very important disadvantages. First, taxes usually do not keep pace with inflation and second, taxes are very unpopular.

Capital finance can be achieved in several ways ranging from straight borrowing from banks and financial institutions to the issue of debt in national as well as international financial markets. The principal debt instrument used by the Mexican government is the CETE. CETES are the equivalent of treasury bonds in the US. At the time this thesis was written, the interest paid by the benchmark 28 day maturity CETES was 16 percent in nominal terms in Mexican pesos. Since inflation was at 10%, interest paid on 28 day maturity CETES was 6% in real terms.

Capital financing has been extensively used by the government in the past, nevertheless, at the present time, the Mexican government is extremely skeptical about adding more public debt after finally gaining control of the economy and the public sector's finances.

4.2 Privatization

Privatization is the delivery of public sector services, by the private sector. It involves a transfer of responsibilities, risks and benefits from the government to private hands. There are several forms of privatization ranging from total private ownership such as denationalization, to public private partnerships and limited period

58
partnerships such as franchising, contracting through BOT schemes and concessions.

Not every form of privatization can be applied to a single instance, but rather each form is beneficial to a specific type of project or development. For example, it would be very complicated to privatize a banking system through franchising when the denationalization alternative clearly provides a better option in terms of creating an efficient structure for the industry.

Privatization advocates argue that the private sector can produce and deliver a service in a more efficient way because of competition. Since private firms are profit oriented, it is argued that they have an incentive to provide a better service at a lower cost. Private firms also tend to be more flexible and have a faster response times than government entities that have to deal with procedural and bureaucratic delays. Another important consideration is the selectiveness of the private and public sectors. The private sector will only make capital investments when a profit opportunity is present and when confronted with two or more of such opportunities, it will choose the one that maximizes the potential profit. On the other hand, the public sector has other considerations besides profit when choosing between alternative projects. For example, social welfare, need, and political feasibility. Therefore, private sector projects are more efficient and are operated with less waste.

Privatization opponents argue that in many cases, when the market fails (not enough competition exists) private firms will lack the key incentive of providing high quality low cost services and are more likely to take advantage of the consumers than the
government. There also exists a risk of service interruption or termination if a firm finds itself in financial distress. This risk is almost non-existent in the public sector.

Regarding the issue of financing public works, privatization provides several options for governments to fund infrastructure projects like the case in point. The rest of this section will explore the relevant opportunities available to the Mexican government at the time Huites was born.

4.2.1 Privatization Options to Fund Huites

In order to mention the relevant privatization options that can be used to fund a project of the nature of Huites, it is necessary to define what types of goods can be privatized and then which privatization alternatives work best with each type of product or service.

"Goods are classified into four categories: private goods, toll goods, common-pool goods, and collective or public goods. Private goods are individually consumed, and exclusion is possible; toll goods are jointly consumed, and exclusion is possible; common pool goods are individually consumed and exclusion is not possible; and collective goods are jointly consumed and exclusion is not possible." (Liddle 1993). From this classification we gather that electricity is a toll good (in Mexico, unlike water supply, electricity can be shut off if the user fails to pay for it) and exclusion is possible. "Toll goods can be both privately provided and supplied..." (Liddle 1993). Therefore, like the toll road privatization program, in theory, increases in the electricity generating capacity of the country could be financed with some form of private sector participation.
The privatization options that can work with toll goods are contracting, concessions, grants, leases (and sale and leaseback), BOT schemes, user fees and public-private partnerships.

However, at the time this thesis was written, there were two laws in Mexico that greatly reduced the government's financial options through privatization. The first one grants the CNA the exclusive right to operate dams in Mexico. The second one grants the CFE the exclusive right to generate and distribute electricity in Mexico.

Since the private sector cannot provide electricity, it can only be involved in the construction of electricity generating projects. Therefore, only a couple of the privatization forms mentioned above were available to the Mexican government to finance Huites: Public-private partnerships and user fees.

"In a public-private partnership the public and private sectors share the risks and responsibilities of a project." (Liddle 1993). There are many ways in which a partnership of this nature can be structured and each party involved can share the risks of a project in varying degrees. In the case of Huites, a partnership would have to be structured so that most of the risk falls on the government and only the risks involved with the construction fall on the private firms. The government can transfer the construction risks to the private sector through a turnkey approach. This approach requires the private firm to put up a sum of money to fully or partially fund the construction of a project. Once it is finished, the private firms delivers the project in perfect working condition to the government. Once the transfer is complete, a period elapses (to
make sure the project works consistently) and the firm receives the original investment plus a return. In other words, the private firm is required to put a sum of money as a guarantee during the construction phase.

User fees are understood to be "...any fee, charge or dedicated tax that is paid by those benefiting from a facility or the services it provides. For example, user fees would include a gasoline tax where the revenues are dedicated to highway construction and maintenance, tuition charges at state universities or admission fees to state parks." (Vaughan 1983)

In this case, CFE would charge the users of the electricity provided by Huítes an extra fee to cover the expenses incurred in its construction. Since Huítes will also provide irrigation benefits, the users of the water would also be charged a surplus fee to recover the costs. This form of privatization has several inherent flaws because the fees charged will be used to recover money spent in the past, therefore, there is no incentive to keep costs down. Also, it is unclear if CFE can distinguish the users of electricity from a single facility. Since it controls a monopoly, it may simply transfer electricity generated in one region to another and therefore, all the clients of CFE would have to be charged for capacity increases. Making, in effect, user fees become tax increases.

The last form of privatization available to the government is of course, denationalization of CFE. The rest of the chapter will deal with this subject and with the other forms of financing that can be used if electricity could be generated and delivered by the private sector.
4.3 Denationalization of CFE

"Denationalization or divestiture involves the sale of government assets to the private sector. There are a number of ways the transfer of ownership can be achieved." (Liddle 1993). The rest of this section will explore the options of privatizing CFE as a monopoly, as a competitive privatization, the advantages and disadvantages of each, the financial options each could provide, the criteria that should be used in the decision and the lessons of foreign experience.

4.3.1 Denationalization of CFE as a Monopoly

There are several ways in which CFE could be privatized as a monopoly, namely: i) Privatization as a monolith. ii) Initial privatization as a monolith with new power stations open to private ownership. iii) Establishment of integrated regional utilities. In the following paragraphs, each of this options will be analyzed further.

Privatizing CFE as a single unit would require a government entity to control the price structure charged by the new company in order to prevent it from abusing monopoly powers. Such regulation would have to indicate the return the company is entitled to relative to some asset base that would have to be defined.

This option has some clear advantages, it would be easy to understand and describe in a prospectus. And judging from the privatization of other large entities in Mexico (such as Telefonos de Mexico), relatively easy to finance. Another advantage of this option is that it could be completed relatively fast and with minimal opposition since other strategic industries such as
telecommunications and financial have already been privatized. Also, the risk of foreign domination can be minimized.

Regarding the financing of capacity increases with projects such as Huites, the new private company could raise the necessary funds through equity issues in the stock market and/or debt issues with electricity receipts as guarantee. In either case, the Mexican government would achieve the goal of building new projects without incurring more public debt. A different option would be user fees. It is fair to say that since a private firm manages more efficiently and with less waste than a government bureaucracy, the new private electricity company could better identify the users of its product and therefore, take advantage of user fee schemes. This schemes would have to be approved and regulated by the government to prevent abuse.

Nevertheless, the disadvantages of monolithic privatization outweigh the advantages. Maintaining CFE as a monopoly after the transfer to the private sector would mean that no competition would be introduced whatsoever and therefore, the possible economic benefits of such competition would be forfeited. Also, the regulation by the government would not be effective. Essentially, this option would try to achieve through limited regulation, what the virtually unlimited powers of direct public ownership have failed to achieve, namely to establish competitive standards of cost effectiveness.

If CFE maintains its monopoly structure in private hands, the government basically transfers its power to the shareholders of the new company. Supposedly, the shareholders
would pressure management to run and maintain an efficient and profitable operation. However, in such a large entity, there will surely be a large number of shareholders both small and large and none with enough power to influence the company.

Other disadvantages include the great political leverage that such company would have, the great political will and determination that the government entity charged with regulating the industry would need (and would be unlikely to attain) as well as the uncertainties that will surely stem from the discretionary powers of such agency. The effects on the privatization of related industries such as coal and finally, the risk of undervaluing the company at the time of the sale.

Privatizing CFE as a monolith and allowing for competitive new generation would permit private companies to compete to construct and own power stations, and to sell power from their facilities. Private companies would presumably enjoy easy access, on fair terms, to the transmission network and would be able to sell their power to the public. This scheme has many similarities with the previous one, it shares many of the same advantages and disadvantages. The question is weather this prospect is realistic and weather it is significant enough to overcome the unacceptable drawbacks of monolithic privatization.

In order to fully explore this alternative, it is assumed that an independent transmission system would exist that would have to be regulated by the government. If the privatized CFE is allowed to maintain control of the entire transmission system, then there can be no effective competition in the electricity industry.
This privatization option has, like the one before, has more disadvantages than benefits, it is not realistic and it does not introduce significant enough competition to make it attractive. In the first place, to be effective, new entrants must be able to offer a balanced, flexible supply of power, backed up by reserve capacity. This means they must come in with a spread of power stations, not on a single station-by-station basis (Sykes, Robinson 1987). But a single power station takes years to complete since its conception, so competition will unlikely occur for a very long time. Moreover, the incumbent would have overwhelming advantages such as its size, political leverage and relationships with long time customers and suppliers. The private CFE could accommodate any pattern of demand, provide security of supply and require far less stringent contract terms than its competitors since it would enjoy a greater diversity of customers. It could also use its existing assets and cross subsidies to finance capacity increases, further strengthening its powers.

In conclusion, the competitors that would exist in such system would be relegated to supply a minimal amount of power to the private CFE and the monopoly would remain effectively intact.

The third option for privatizing CFE as a monopoly is the establishment of regional monopolies. In this scheme, regions would be defined and a monopoly would control each region. Each monopoly would own the generation and distribution rights in its region with an independent national grid, regulated by the government, that would serve to coordinate inter region sales, oversee fair competition and avoid discrimination.
The advantages of such system are that it would decentralize generation, it would be more responsive to consumers, it can be financed in stages avoiding foreign domination or control and it would permit the privatization of other related industries such as coal mining. There are however, several fatal disadvantages to this system. The most important is the complexity of the privatization. It would be extremely complicated to divide CFE into regions with similar assets and growth opportunities. Negotiations could not be successful without the cooperation of management and the unions involved, and even then, the privatization would take a very long time and be very costly. It is probable that a strict regulating system would have to be created causing regulation delays, costs and ambiguities.

In conclusion, none of the monopoly options are very attractive. In the next section, the options of competitive privatization of CFE will be explored.

4.3.2 Alternatives for Competitive Privatization of CFE

There are several alternatives for competitive privatization of CFE. The first alternative would be to privatize both generation and distribution separately, maintaining the national grid in public hands or if not, closely regulated. By separating distribution from generation, the generating companies would first, face direct competition from others like them and second, have several potential customers, in effect creating a market for electricity in Mexico. The purpose of keeping the national grid either public or closely regulated is so that the different generating firms and other
power sources can be linked, coordinated and have guaranteed access on fair and equal terms.

There are many advantages to this option, it can be achieved without risking foreign control or domination, regulation would not be very complicated and the consumers of electricity would benefit greatly from competition. Regarding the development of new projects to increase generating capacity (such as Huites), the generating companies could sign long term contracts with the distribution firms and use such contracts to raise debt in order to pay for the projects. Generating companies could also issue equity to raise the necessary capital and the government could provide grants or subsidies to complement the capital raised in the case of larger projects. Finally, a whole new range of public-private partnerships could be introduced with risk sharing schemes that do not place the majority of the burden on the government.

The disadvantages of this type of privatization are mainly due to the complexity and size of CFE. Devising a generating system based on five or more independent, viable companies, each with an efficient mix of generating capacity is a complicated technical task. Negotiations with the current managers of CFE and it's unions is also a complicated and time consuming problem. Contractual relationships would have to be set up between the generating companies and the distributors of power, but this can only be done after the generating companies are defined. Finally, two problems have to be contemplated carefully, one is that the only entity that has any knowledge and familiarity with the system is CFE so it has to carry on its own demise. Second, a series of companies
with no profit record, an untried structure and management and in an uncertain regulatory climate would have to be sold to potential private sector buyers.

All the operation would probably take more than six years to complete. Since the presidential term in Mexico is six years, a great political will would be necessary to start the process.

Since it would be extremely difficult to sell parts of CFE directly to the private sector without a transition period, other alternatives can be contemplated to start the process. Such interim alternatives can be achieved only if the two exclusion laws regarding electricity generation and distribution in Mexico are overturned.

The government could use the concession scheme much like it has done with the new highways. In this system, private firms would either pay for existing generating units or build new ones. The government would then grant a concession to the firm that included distribution. In this way, new generating facilities could be financed based on future electricity bills from customers or with the use of funds received through the sale of concessions of existing facilities.

Another alternative is to expand the "Build Operate Transfer" (BOT) system to "Build Own Operate Transfer" (BOOT). With BOOT contracts, the private sector would provide the government with a service in exchange for a fee. After a specified period of time, the private sector would transfer the facility to public ownership through a sale. In this case, the government can increase electrical capacity without incurring in more debt. Private firms
could finance such capacity increases based on the fees to be charged and on a lump sum at the end of the defined period.

Opponents of this method argue that although it is a good short term alternative, in the long run the public sector is adversely affected because it has to pay for a facility twice. Nevertheless, this alternative can be altered to become a straightforward long term service contract (in other words build, own, operate) by extending the original specified period and thus, avoiding the buy-back expense.

A final alternative is the sale and leaseback option. In this case, the government would sell its existing generating facilities, receiving large up-front capital that could be use to finance new facilities. After such sale, the government would have to lease back the facilities. This option would minimize disruption risks and the government would lease a facility that has been proved to operate consistently. For the private sector, it would mean a capital investment like any other.

4.3.3 Privatization Criteria

Although there are many opposing views regarding the different privatization alternatives of a large entity such as CFE, there are several economic, political, essential and desirable characteristics such a privatization should meet. The rest of this section will explore such criteria.

Politically, there are several essential criteria that have to be met. "No government could contemplate changing the structure of so basic an industry as electricity if significant disruption in the supply of power seemed likely to ensue." (Sykes and
Robinson 1987). It seems unlikely this would happen because electricity is supplied everyday without serious disruption. This experience has to be transferred to the private sector.

The government must also minimize the risk of electoral unpopularity. If the consumers are neglected after the privatization and they feel that the service was better when in public hands, the administration that carried out such privatization would pay the price politically.

Since the privatization of such a large entity will require huge sums of money, the government must be careful to include foreign participation without giving up control or domination of the industry to foreign parties.

In the economic area, the essential criteria are the introduction of maximum competition and the attractiveness to individual and corporate investors. Even if CFE is privatized in several stages or goes through a transition period, the government must make sure that the resulting industry can provide all the economic benefits brought by competition. In the long run, if consumers are not satisfied with the gains from the privatization, the government would lose credibility and suffer political consequences.

Finally, the privatization must be structured in such a way that enough individual and corporate investors are attracted to participate. This can be done with clear regulations and the assured cooperation of management and unions. Any action having predictable positive impacts on earnings would enhance the attractiveness of the industry to potential investors.
4.3.4 Lessons of Foreign Experience

The electricity supply industry has many different structures around the world. These range from the monolithic publicly owned systems through diversified public and privately owned systems and to the predominantly privately owned. Systems of electricity prices regulation are also diverse and range from control by government, through strict, detailed regulation and to informal methods. The remainder of this section presents an overview of the electricity supply industries of France and Italy, Germany and Sweden, Bolivia and the United States.

The electricity supply in France and Italy like the one in Mexico is publicly owned with centralized control. Such dominant utilities account for all the supply, production and distribution of electrical power in their respective countries.

Germany and Sweden are examples of countries that operate their electricity supply industries in a decentralized manner. Both have a different types of power and mixed private and public ownership.

"Germany's electricity industry is decentralized, even though the degree of public ownership and influence is still large. There are many electricity utilities ranging from large, integrated systems engaged all activities to simple distribution companies which buy in all their power." (Sykes and Robinson 1987). Most of the power generation and distribution is provided by twelve companies. Such companies are owned by both the private and public sectors. Usually, the public sector has a majority stake in them. The system is organized along regional lines and although there is
frequent interchange of power between such regions, there is no nationally coordinated transmission grid.

Local and federal government involvement is strong. The regional governments (Lander) and local councils partly own and regulate the industry in their regions. Regulation of the industry is very light.

The system in Sweden is an intermediate step between full public and full private ownership. Half of the electricity is supplied by the state through the Vattenfall utility, 20 percent comes from municipal utilities and the remaining 30 percent is generated by the private sector. Vattenfall buys power from several private generators and these generators can rent capacity on the trunk line system which is then used as a common carrier. With this scheme, the state retains control of most of the generating capacity, the national grid and preserves the efficiencies of market systems.

Vattenfall as well as the other municipal utilities are expected to be profitable (i.e. operate as private companies) and to compete with the private sector. Since other companies have access to the grid, there is a genuine market for power in Sweden. Regulation is not directly applied but a mixture of competition and cooperation keeps the prices low.

The US system is based on private regional monopolies that are heavily regulated. About 85 percent of electrical power is produced by privately owned monopolies. The utility companies are subject to detailed state, county or municipal regulations that cover every aspect of their operations. This system has the advantage of limiting the monopoly powers while providing
cheap and uninterrupted power, however, the tight regulations are expensive to enforce, lead to many disputes and many times are ineffective.

In Bolivia, the government supplies about 82 percent of the electrical power. The remaining 18 percent is supplied by Compania Boliviana de Energia Electrica (CBEE). The Bolivian government granted a concession to CBEE for the generation and distribution of electricity in the La Paz region for forty years. In the concession, capacity increases are mandated but it is up to CBEE to implement such increases. The concession also permits CBEE to receive a 9 percent return on its rate base (rate base is roughly equal to the replacement cost of the generating assets minus the observed depreciation).

The advantage of this system is that capacity increases are financed by the private sector and if at any time the private company breaches any part of the concession contract, the government can immediately step in and take over the company. Also, through the sale of concessions, the government can raise funds for new projects. The disadvantage is that since some regions are more profitable than others, the rates will not be uniform around the country and some measure of subsidies will have to take place. Also, companies can over invest in order to increase their rate base and earn a larger return.

4.4 Conclusions

Even though the Mexican government has access to the traditional methods of project financing, it is clear that it is missing out on the financial opportunities that privatization brings. Not
every form of privatization is adequate for Mexico and for an entity such as CFE, therefore, it is imperative that an in depth analysis of the choices and possibilities that the government faces be done before any decision is made.

However, until that decision is made, several steps can be taken in order to take advantage of the financial opportunities that the private sector can bring. The first step should be to overturn the laws against private generation and distribution of electricity so that public-private partnerships that are more equally balanced can emerge. Mexico should apply the experience it gained through the Highway Development Program to the electricity supply industry so that a better service with less interruptions and better prices becomes available.
5. ACTUAL FINANCIAL AND LEGAL STRUCTURES

5.1 Introduction

This chapter is divided in two parts. The first part describes the actual financial structure that is being used for the development of Huites project. The second part of the chapter deals with the legal structure used.

It is necessary to note, however, that the final financial structure is a result of several modifications to the original proposal. The proposed structure called for a bond issue, in Europe, of 250 million US dollars. Such issue was to be guaranteed by lease payments that CFE would make to CNA for the use of the dam for electricity generating purposes. This scheme was not used because of a law that forbids "Hell or High-water" clauses in lease contracts in Mexico (such clauses force the lessee to make lease payments even if the leased property is not completed on time or suffers damage). Therefore, if the project was not completed on time, then CFE would not have to make payments on its lease. To get around this issue, a "support agreement" was written where Nacional Financiera (Nafin), a governmental financial institution, would guarantee payment to the note holders even if the project was not completed. The Mexican government rejected this scheme because it would mean an increase in public debt. The final scheme to be described in the following section ended up causing an increase in public debt. However, different institutions were used and some of the more complicated issues such as the support agreement where avoided.

The legal structure rests on the key component which is a fiduciary trust that was set up by the participants. The trust is a
direct application of the experience learned in the highway development program. In this second section, the trust as well as the other contracts used will be described.

The chapter ends with a section containing the conclusions as well as some of the cash flows of the trust at the time the work was being written.

5.2 Sources of Funds

In the following paragraphs, every source of funds for the project will be described and analyzed, however, for a complete look at the financial scheme as well as for quick reference, figure 5.1 shows a representation of the entire scheme.
Figure 5.1 Summary of Financial Scheme

**SOURCES**

- Contractor Investment
- CNA Contribution
- Bridge Loans from CFE
- Bond Issue
- Equipment Credits

**USES**

- Construction of Dam
- Electromechanical Equipment

**FIDUCIARY TRUST**
5.2.1 Contractor Investment

As part of the trust contract, the contractor, Consorcio Mexicano Constructor de Huites (CMCH) had to invest the sum of twenty million US dollars in the trust. This sum was invested in June 1992 and according to the trust contract, will be returned to CMCH six months after the project is accepted by CNA. The twenty million dollars will be returned with a 10% annual fixed rate in US dollars. The interest generated will be compounded quarterly during the construction of the project.

The funds needed to return the investment to CMCH will come from surplus cash remaining in the trust's treasury and in case there isn't any, from the contributions made by CNA. Figure 5.2 describes the contractor's investment.
**Figure 5.2 CMCH Investment (US dollars)**

Starting Balance $20,000,000  
Annual Interest 10%  
Compounded Quarterly  
Starting Period July 1, 1992.

<table>
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<tr>
<th>End of</th>
<th>Interest Earned</th>
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<td>Mar-93</td>
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<tr>
<td>Jun-95</td>
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The twenty million dollar investment, along with other funds, has been used to fund the construction of the project up to the summer of 1993. In the previous figure, it is assumed that the project will be completed by December 31, 1994.

5.2.2 CNA Contributions

The CNA is contributing funds to the project for two main reasons. First, to provide funds for the repayment of loans and credits and second, as a kind of subsidy to decrease the leveraged amount and therefore, decrease the amount of interest payments by the trust.

The contributions made by CNA are funds from the federal government that will be spent on Huites project. Figure 5.3 describes the contributions made by CNA.
Figure 5.3 Summary of CNA Contributions (US dollars x 1,000)

<table>
<thead>
<tr>
<th></th>
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<th>Sep-95</th>
<th>Oct-95</th>
<th>Nov-95</th>
<th>Dec-95</th>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>

Additional Contributions 646

Total CNA Contributions 158,954

Present Value of Contributions at 12% $129,655.00
5.2.3 CFE Bridge Loans

The bridge loan provided by CFE to the Huites trust totaled 50 million US dollars. Such loan was given for three months at an interest rate equal to Libor plus three points. The funds from the bridge loan were used for the construction at the start of the project. The fifty million were already repaid to CFE by the time this work was being written with funds obtained through the bond issue in Europe.

5.2.4 Bond Issue

On August 5, 1992 the Huites trust issued 200 million dollars of debt through bonds in Europe. The following paragraphs will describe in detail the bond issue.

The notes were issued in an aggregate principal amount of US $200,000,000 and will mature at par on August 5, 2003. The notes will bear interest at 8% per year payable semi-annually on February 5 and August 5 of each year. The issue price was 99.80% of par value. Interest will be paid to the person in whose name the note is registered at the close of business on the preceding January 21 or July 21 as the case may be.

The notes will be "direct, general and unconditional obligations of the Huites trust ranking pari passu, without any preference among themselves, with all other unsecured and unsubordinated obligations of the Huites trust (including the Export Loans), present and future, relating to external indebtedness." (Prospectus of notes). Noteholders do not have any recourse against assets of the Huites trust but rather have the guaranty of Banco Nacional de Comercio Exterior S.N.C. (Bancomext).
The notes have the guaranty of Bancomext which is a national credit institution and development bank of Mexico. The Mexican government is responsible for the transactions entered into by Bancomext. If on the dates of redemption of the notes the fiscal agent has not received sufficient funds from the Huites trust to pay in full the interest and/or principal of the notes, Bancomext will be required to provide funds equal to the deficient amount to the fiscal agent, Citibank, N.A. The notes are unconditionally and irrevocably guaranteed by Bancomext. "The obligations of Bancomext under the Guaranty will be direct, general and unconditional obligations of Bancomext ranking pari passu, with all other unsecured and unsubordinated obligations of Bancomext, present and future, relating to external indebtedness." (Prospectus of notes).

At present, the Huites trust has filed for a tax exemption status for the interest payments on the notes. Usually, a 15% tax is charged on any interest received. However, in case the result of the file is negative, the trust and/or Bancomext will pay an additional amount so that the noteholders receive an amount equal to the amount received by them had no such taxes been required.

The noteholders may redeem the notes in whole, at par plus accrued interest, if the organic law of Bancomext is modified, Bancomext is merged with another institution and is not the surviving entity or if the Mexican government ceases to be responsible for the obligations of Bancomext.

Bancomext is subject to certain covenants in the Guaranty of the notes. This covenants include a "Negative Pledge" which means that Bancomext "will not create or permit to subsist any
Security Interest in the whole or any part of its present or future revenues or assets, including uncalled capital, to secure any of its Public External Indebtedness, unless the notes are secured equally and ratably with such Public External Indebtedness...". A covenant of "Continuation of Activities" is noted as well as a "Consolidation, Merger and Sale of Assets". Continuation of activities means that Bancomext will continue to engage in activities of the same general type as it does now. And the consolidation, merger and sale of assets covenant means that Bancomext will not "consolidate with or merge into any other person or convey, transfer or lease its properties and assets substantially..." to any other entity. (Prospectus)

The notes are subscribed by Lehman Brothers International (Europe), Bear, Sterns International Limited, Bankers Trust International PLC, Banque Indosuez, Chase Investment Bank Limited, Citibank International plc, Deutche Bank, AG London, Goldman Sachs International Limited, Solomon Brothers International Limited and Swiss Bank Corporation. The Huites trust agreed to pay the subscribers a combined underwriting and management fee of .25% of the aggregate principal amount of the notes.

The notes will be listed on the Luxembourg Stock Exchange. The notes will be sold in offshore transactions through Euroclear and Cedel and will be traded through PORTAL (Private Offerings, Resales and Trading through Automated Linkages of the National Association of Securities Dealers, Inc.)

The notes were given a BBB rating by Standard and Poor's. Bancomext had only one previous issue of securities which were straight "Yankee Bonds". Such issue paid an interest equal to
240 basis points above the 5 year Treasury Bond. In the case of the Huites issue, the interest was defined by adding 232 basis points above the 5 year Treasury Bond.

As will be described in the next section, the capital needed to service the bond debt will come from two sources, the contributions of CNA and the lease payments that CFE will make for the use of the dam. However, since the notes are guaranteed by Bancomext (i.e. the Mexican government) the noteholders are indifferent about the source of funds for repayment.

Figure 5.4 describes the cash flow received by a holder of one note.
Figure 5.4 Cash Flow seen by the holder of one note.

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
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</thead>
<tbody>
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<tr>
<td>1994</td>
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<tr>
<td>1995</td>
<td>40</td>
</tr>
<tr>
<td>1996</td>
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<td>1997</td>
<td>40</td>
</tr>
<tr>
<td>1998</td>
<td>40</td>
</tr>
<tr>
<td>1999</td>
<td>40</td>
</tr>
<tr>
<td>2000</td>
<td>40</td>
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<td>2001</td>
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<tr>
<td>2003</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>1,040</td>
</tr>
</tbody>
</table>

IRR Semi-annual 4.0147%
IRR Annualized 8.0295%
5.2.5 **Electromechanical Equipment Credits**

In order to understand the way the credits for the procurement of the electromechanical equipment were structured, it is necessary to point out that the supplier of the equipment is a consortium led by Siemens of Germany. The members of the consortium are Siemens A.G. (Germany), Siemens S.A. de C.V. (Mexico), Siemens Sao Paulo S.A. (Brazil) and Energomachexport of Russia. (together the consortium).

The credit for the procurement of the equipment is made up of three credits; one given by Germany, another by Brazil and finally, one by Russia.

The German credit was granted by KFW, a German bank. The credit is for 112,397,750 German Marks (DM). This credit is divided in two parts: 85% (95,538,088 DM) has the backing of a German export import bank called Hermes and is to be repaid in 12 years with equal semiannual payments. Repayment of this part will begin on June 30, 1995 or six months after the start of operations of the project. The remaining 15% (16,859,662 DM) has no German backing and will be given to Siemens as an advance payment for the equipment. This part will be repaid in 5 years with equal semiannual payments starting on June 30, 1995. The interest charged on both parts is close to 10% annually.

The Russian credit was granted by a trading company called Energomachexport. The credit is for 18,253,575 US dollars and covers 100% of the value of the Russian equipment. This credit will be repaid in 10 years with equal semiannual payments.
starting on June 30, 1995, and the interest rate charged is close to 7%.

Finally, the Brazilian part was granted by Banco Nacional de Desenvolvimento Economico e Social (Bandes). This credit amounts to 85% of the value of the Brazilian equipment which is 21,604,376 US dollars. Repayment will be in 9 years with equal semiannual payments starting on June 30, 1995 or 18 months after the first shipment. An annual interest rate of about 8.5% is being charged. The remaining 15% of the value of the Brazilian equipment will be financed through the capital raised by the bond issue.

All three separate credits are guaranteed, on the part of the Huites trust, by Bancomext. Figure 5.5 shows a summary description of the credits for the procurement of the electromechanical equipment.
Figure 5.5 Summary of Equipment Credits.

Electromechanical Equipment Credits

Germany
- KFW
  - 112,397,750 DM
  - 85%
    - HERMES Backing
      - Term = 12 years
      - Interest = 10%
  - 15%
    - Term = 5 years
    - Interest = 10%

Russia
- Energomachexport
  - $18,253,575 USD
  - Term = 10 years
  - Interest = 7%

Brazil
- BANDES
  - $21,604,376 USD
  - Term = 9 years
  - Interest = 8.5%
5.3 Legal Structure

The legal structure that defines the relationships between the parties involved in Huites consists of six contracts. These contracts determine everything from the ownership of the assets to the financial services received by advisors.

It is necessary to note that even though the credits received and the debt issued by the fiduciary trust is guaranteed by Bancomext, the legal structure outlines the means by which such financial obligations are to be repaid. The following paragraphs present summary descriptions of the contract that make up the structure.

5.3.1 Fiduciary Trust Contract

The fiduciary trust contract takes place between CMCH, Nacional Financiera S.N.C. (Nafin), CNA and CFE and it consists of fifteen clauses.

In the first clause, the members of the trust are defined. In the second, the objectives of the trust are enumerated. Such aims are, first, that Nafin is entitled to receive and conserve in escrow all the goods that make up the resources of the trust. As part of this mandate, Nafin is responsible for all the legal proceedings necessary for the completion of the project. All fees for this purpose are to be charged to the trust.

Second, Nafin is entitled to receive the investment made by CMCH, the contractor, and the contributions made by CNA. Also, Nafin is responsible for the management of all the funds in the trust including the investment of any liquid funds that are not immediately required by the project.
Next, it is Nafin's responsibility to contract for the project builder and the suppliers of equipment. Nafin is also responsible to engage in the lease agreement with CFE for the generating assets of the project. The insurance policies, and legal, financial, fiscal and accounting advisors are also contracted for by Nafin.

Also as part of the second clause, Nafin is responsible for applying the resources it receives from the lease with CFE to the payment of the credits and other financial obligations of the trust. Finally, Nafin has to transfer, free of any charge, ownership of the generating plant to CFE after the lease expires and ownership of the dam to CNA at the same time.

The third clause determines the assets of the trust which include the investment from CMCH, contributions from CNA, the funds raised through debt issues and credits received, the built facilities, the electromechanical equipment and the lease payments from CFE.

The fourth clause deals with the responsibilities of CMCH during the construction of the project. Basically, CMCH is responsible for all the non-liquid funds while construction is in process. Also, CMCH is responsible for any damages to third parties during the same period.

The fifth, sixth and seventh clauses deal with the formation of a "Technical Committee" and with its responsibilities and powers. In summary, the committee is made up of representatives from each member of the trust and serves as the
governing body in matters of investments, contracts, accounting, payments, penalties and reports of the trust.

The last eight clauses deal with the legality and duration of the trust and of its members as well as the fees that Nafin is entitled to charge.

The fiduciary trust is the key element around which all legal structure is formed. It is the body responsible for the successful completion of the project. The use of this type of trust was directly imported from the experience gained by the Mexican government in the Highway Development Program of president Salinas.

5.3.2 CNA Investment and Financial Support Agreement

The agreement defines the financial obligations of CNA with the trust. Basically, CNA agrees to contribute a certain amount to the trust to be used for the construction of Huites. The agreement specifies that in case there are cost overruns due to variations in the technical specifications or amounts of work, CNA is responsible for the provision of the missing resources.

Under the agreement, it is CNA's responsibility to provide the necessary funds to cover inflation escalations, and to maintain the liquidity of the trust fund. In case the CNA is unable to provide such funds, it is responsible for obtaining credits to cover its obligations and for any interest charges resulting from the credits.

Finally, CNA is to assume all the financial responsibilities of the trust if the project is suspended due to causes attributable to it.
5.3.3 **CFE's Lease Agreement**

CFE agrees to lease the 400 megawatt hydroelectric power generation station to be located next to Huites dam and together with the dam constituting Huites project (power station). The lease defines CFE as the lessee and Nafin as the lessor (not in its individual capacity but solely as trustee of Huites fiduciary trust) and it specifies the following actions.

The lessee is responsible for prompt payment of the rent. The lessee is also responsible for the operation and maintenance as well as the replacement of any component of the power station.

CFE is responsible to maintain both property insurance and liability insurance under the lease. The lease currency is Mexican pesos and the laws of Mexico govern the lease.

The scheduled payment dates are June 30 and December 30 of each year starting on June 1995 and ending on December 2006. The yearly payment schedule is as follows:

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<th>YEAR</th>
<th>AMOUNT (Millions of Dollars)</th>
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</tr>
<tr>
<td>1996</td>
<td>66.3</td>
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<tr>
<td>1997</td>
<td>63.3</td>
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<tr>
<td>1998</td>
<td>60.3</td>
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<td>1999</td>
<td>57.3</td>
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<tr>
<td>2000</td>
<td>54.3</td>
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<tr>
<td>2001</td>
<td>51.3</td>
</tr>
<tr>
<td>2002</td>
<td>48.3</td>
</tr>
</tbody>
</table>
5.3.4 Construction Contract

The construction contract took place between CMCH as contractor and Nafin as trustee of Huites trust. In it, CMCH agrees to undertake the construction of Huites project for a predetermined amount and time. Nafin, through directions from CNA reserves the right to change or modify the project as long as the basic nature of the work is not altered and the economic repercussions are resolved. The previous point also applies to increases or decreases in the amount of work to be done.

Nafin is responsible to contract construction supervisory services in order to review the progress on the construction and the invoices filed by the contractor.

The contract is a lump sum type based, on unit prices, with a predetermined time limit. The trust agreed to pay the contractor a prepayment equal to 20% of the total value of the construction and then pay for invoices presented by the contractor according to construction progress. The contractor has to present invoices on the 25th day of each month and after the acceptance of both the supervisor and the CNA, the trust has to pay them.

The responsibilities of CMCH in this contract are many. It has to guarantee its obligations to the trust through two separate bonds, one equal to 100% of the value of the prepayment.
received and the other for 10% of the value of the total construction. Also, CMCH is completely responsible for any subcontracts or activities it engages with third parties for the construction of the project. In case of delays or suspension of work attributable to the contractor, a penalty of 1.5 million US dollars per month will be charged by the trust up to a prespecified amount. In case the suspension of work lasts for less than one month, $50,000 US dollars per day will be charged.

On the other hand, when work on the project is suspended by orders of CNA, the contractor is entitled to receive payment for the work already completed plus the value of the non-amortized machinery and equipment at the time of the suspension. It is necessary to note, however, that the contract defines certain cases where suspension of the work is not attributable to any party (floods, fires, war, etc.). In such cases, both parties are free from any financial reparations to the other.

Finally, the contract specifies that both parties have to submit to the jurisdiction of the Mexico City courts to resolve any legal disputes.

5.3.5 Electromechanical Equipment Supply Contract

This contract takes place between Nafin as trustee of Huites trust and the Siemens consortium aforementioned. The contract is a "turn key" type and assigns the consortium the job of designing, building, mounting, testing and begin operation of the equipment and electromechanical systems that make up the power station of Huites. Since this is a turn key project, Huites trust expects the consortium to deliver a working power station for the
dam, this includes everything from manufacturing the equipment and special installations to the transportation and testing of the power plant. The trust is responsible for the construction and timely delivery of the equipment room to the consortium so that the power station can be installed.

The contract specifies procedures for changes and modifications of the work and makes the consortium responsible for the supply of spare parts as well as for establishing a maintenance program for the equipment.

Siemens consortium is responsible for the instruction and training of personnel provided by CFE on the operation and maintenance of the power station. With such training, all the pertinent operation and maintenance instruction manuals have to be provided.

The consortium is responsible for the safety and upkeep of all the equipment up to the delivery and acceptance of such by the trust. Also, the consortium is responsible for any damage caused by its activities to the trust or to third parties and is compelled to have the necessary insurance to cover property and liability damage.

Finally, it is the responsibility of the consortium to obtain all the necessary permits and licenses as well as a bond that guarantees its work. Both parties submit to the jurisdiction of the Mexico City courts for dispute resolutions.

5.3.6 Financial Services Contract

The financial services contract takes place between CMCH and Grupo Serficor S.A. de C.V., N.M. Rothchild and Sons
Limited and Internacional de Servicios Financieros (together the advisors). In this contract, CMCH assign the duties of economic and financial evaluation of Huites project as well as the design, instrumentation, and promotion of the financial scheme for the development of Huites.

The advisors act as coordinators for obtaining credits and issuing securities on the domestic as well as international financial markets. They are responsible for obtaining funds under the best possible terms in the markets at the time.

CMCH agrees to pay commissions to the advisors for the services rendered. All commissions are to be split in three equal parts between the advisors. The commissions are 1% of the long term credits (at least ten years) destined for the project except credits by cement companies and other materials suppliers, eximbanks and contributions by the government or the contractors themselves. Such commissions are not to exceed 3 million US dollars. CMCH will also pay for expenses incurred by the advisors up to 50,000 US dollars. The commissions described above do not include commissions charged by other financial and stock market intermediaries.

CMCH can terminate, without responsibility, the contract if within one year of the date it was signed, the advisor's officers are replaced or lose control of their respective companies. CMCH is also bound to contract financial services exclusively with the advisors. Figure 5.6 shows a summary of the legal structure.
Figure 5.6 Summary of the Legal Structure

Lease Agreement

- CFE

Investment and Financial Support Agreement

- CNA

Construction Contract

- CMCH

Electromechanical Equipment Supply Contract

- Siemens Consortium

Financial Services Contract

- Financial Advisors
  - ISEFI
  - SERFICOR
  - ROTHCHILD

- HUITES FIDUCIARY TRUST
  - Nafin
  - CNA
  - CFE
  - CMCH
5.4 Conclusions

It is clear from the above description of the financial and legal structures that the burden of the risk falls on the government's shoulders through CNA and Bancomext. Basically, the risk that the private sector faces is limited to the 20 million dollar investment on the project. However, the private sector (CMCH) also faces the risks that are common to any large construction project. CMCH will invest in the course of the construction, large sums on equipment and temporary personnel. The investment made by CMCH can become a bad deal if the construction is faulty or falls behind schedule.

Even though the Mexican government had the intention of financing Huites through a larger if not total private sector stake, it ended up accepting almost all the risk by giving guarantees to both the debt issue and the electromechanical equipment credits. The original scheme that called for the lease payments from CFE to the trust along with the CNA contributions to back up all the credits was unacceptable to investors who refused to take on "project" risks. This situation was compounded when a "Hell or High-water" clause in the lease was found to be illegal. Since the construction companies were unable or unwilling to guarantee the debt issue and equipment credits, the only choice left was for the government to take on the risk.

The legal structure reflects the philosophy that the Mexican government has used ever since the highway program. This type of structure is an efficient and clear way to reflect public-private partnerships.
It is necessary to note that this chapter was written almost in "real time". For example, the bond issue was made on August 5, 1993. Therefore, some contracts and/or credits may still suffer some changes after the thesis is completed. This chapter describes the schemes used as they were on August 1993 and may not be the final ones. Figure 5.7 shows a summary of all the cash flows seen by the trust.
### Figure 5.7 Summary Cash Flow of Huites Trust

<table>
<thead>
<tr>
<th>Description</th>
<th>Construction Period</th>
<th>Lease Period</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Contribution by CFE</td>
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<td>20,000,000</td>
</tr>
<tr>
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<td>37,714,000</td>
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</tr>
<tr>
<td>Contractor Investment</td>
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<td>0</td>
<td>19,258,000</td>
</tr>
<tr>
<td>Credit for Fixed Assets</td>
<td>383,198,000</td>
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<td>383,198,000</td>
</tr>
<tr>
<td>CFE Lease Payments</td>
<td>0</td>
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<td>654,700,000</td>
</tr>
<tr>
<td>Interest Gains (Losses)</td>
<td>4,861,000</td>
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<tr>
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<td>51,671,000</td>
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<tr>
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<td>68,684,000</td>
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<tr>
<td><strong>TOTAL INFLOW</strong></td>
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<td>730,610,000</td>
<td>1,377,555,000</td>
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<td>(24,024,000)</td>
</tr>
<tr>
<td>Construction Payments</td>
<td>462,931,000</td>
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<td>Supervision and Quality Control</td>
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<td>Administration and Insurance</td>
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<td>10,415,000</td>
<td>15,462,000</td>
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<tr>
<td>Financial Cost **</td>
<td>44,380,000</td>
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<td>314,027,000</td>
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<tr>
<td>Payment of Principal</td>
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<tr>
<td>VAT of Construction</td>
<td>50,651,000</td>
<td>1,041,000</td>
<td>51,692,000</td>
</tr>
<tr>
<td>Repayment of Revolving Credit</td>
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<td>18,884,000</td>
<td>68,884,000</td>
</tr>
<tr>
<td>Repayment of Contractors Investment</td>
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<td>25,900,000</td>
<td>25,900,000</td>
</tr>
<tr>
<td><strong>TOTAL OUTFLOW</strong></td>
<td>646,546,000</td>
<td>694,861,000</td>
<td>1,331,407,000</td>
</tr>
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**RESULTING FLOW**

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<td>46,148,000</td>
<td></td>
</tr>
</tbody>
</table>

** Itemized Financial Cost:

<table>
<thead>
<tr>
<th>Description</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bancomext Commissions</td>
<td>2,075,000</td>
</tr>
<tr>
<td>Other Commissions</td>
<td>6,385,000</td>
</tr>
<tr>
<td>Interest in Dollars</td>
<td>30,147,000</td>
</tr>
<tr>
<td>Interest in Pesos</td>
<td>773,000</td>
</tr>
<tr>
<td>Financial Engineering</td>
<td>5,000,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>44,380,000</td>
</tr>
</tbody>
</table>

**Note:** Figures are in US Dollars.
6. **Conclusions**

After a decade of heavy borrowing and a failed strategy of oil revenue reliance, the Mexican economic situation was in a deep crisis which made the country unattractive to foreign investment and which placed the construction industry in a terrible recession. It took all the mandate of president Miguel de la Madrid to stabilize the economy and lower inflation rates enough to begin thinking about infrastructure development. When president Salinas took office in 1988, he introduced order in the government's finances, renegotiated Mexico's external debt and privatized the majority of the state run enterprises including the financial sector. These changes made Mexico an attractive country for foreign investment and renewed the confidence of the country's private sector.

Once confidence was restored, and after enjoying successful results in privatizing Mexico's banks, the government of Mr. Salinas set forth an ambitious plan to modernize the country's highway network. The plan called for heavy private sector participation and the different contracts were awarded using public-private partnerships. Valuable experience was gained both in setting up and managing these partnerships as well as in build-operate-transfer types of contracts. The main challenge the government faced was to apply the newly gained experience to other types of infrastructure projects besides highways and since much of the financial capacity of the construction firms was tied up in the highway program, to tap the international capital markets to finance future projects.

*Huites hydroelectric dam* had been in the drawing table for more than six years. The benefits such project would bring were
clear both in terms of increased agricultural production, additional electricity generating capacity and increased flood control capability for the northwestern region of the country. However, an economically feasible scheme for the construction of the project had not been achieved and the project was put on hold.

Huites became the perfect project to test the exportability of the lessons learned from the highway development program after the idea of leasing the power station of the project to CFE, the state run electricity company, was introduced. The intention was to finance the project with private credits guaranteed by future lease payments from CFE. The project required large amounts of resources and was complex both in a technical and financial sense. The challenge was to complete such large and elaborate project in a very short time so that it could be finished before the end of the presidential term in 1994.

The project was then put up for public bids and the winner of the licitation was a consortium of four construction firms, three Mexican and one Brazilian. A new and interesting challenge arose from this result. Not only was the project complicated enough but now problems of coordination, organization and ability to respond rapidly had to be dealt with.

The winning consortium decided to form a new company called "Consorteio Mexicano Constructor de Huites" (CMCH) to deal with the above challenges. Positions on the company were divided between the four firms and several committees were formed such as the financial and executive committee to oversee the operations of CMCH. Employees of CMCH (made up of personnel from the four
firms) adapted surprisingly well to their new employer putting aside mistrust after years of competing with each other and showing loyalty to the new company. CMCH developed a character of its own integrating the best from each of the founding firms.

After it was discovered that CFE could not include a "Hell or High-water" clause in its lease agreement, it became clear that some sort of guaranty from the Mexican government was going to be needed to back up both a planned bond issue in Europe and credits for the procurement of the electromechanical equipment for the power station. After months of negotiations and changes to the original scheme, a state development bank called Bancomext provided the necessary guarantees. From this situation, two interesting conclusions can be drawn.

First, the Mexican government had no other option than to assume most of the risk of the project. This situation occurred because there is no private market for electricity in Mexico. If Mexico develops a private market for electricity in which long term contracts for the supply of power are possible and users can be easily identified, the government would have a much broader spectrum of financial opportunities to fund projects such as Huites. However, to develop a private market, the state run monopoly on electricity would have to be privatized in some form. Several alternatives for the privatization of CFE are possible and it is clear from the experiences of other nations that some work better than others. Whatever the option chosen, it is imperative that the government guarantees uninterrupted supply of energy without loosing control of such a strategic resource to foreign participants. Also, maximum
competition should be allowed while maintaining an efficient industry in order to reap the benefits that competition brings such as higher productivity, lower costs, higher quality of service and lower prices to the consumers.

Second, the lesson for the Mexican government is that instead of finding creative financing techniques on a project by project basis, it should concentrate on establishing a trustworthy system of laws and regulations where foreign investors feel secure and protected by the contracts they sign. If such a situation would occur in the United States, the capital needed to complete the project could probably be raised with only the twenty million dollars put up as equity by the contractors. Investors would not demand government guarantees to buy securities that include project risks.

The financial scheme that resulted after many changes reflects the government's acceptance of the majority of the risk. The scheme consists of a bond issue in Europe, credits for the procurement of the electromechanical equipment, investments by the contractor, contributions by the CNA and bridge loans from CFE to begin construction. The private sector has a risk of a loss or bad investment of its contribution plus the risks that are associated to any major construction project such as machinery investments. Since the contractor is responsible for the project while the construction is in process, it runs the risk of falling behind schedule (causing harsh penalties). Also, since the contractor has the freedom of subcontracting any part of the job it is also responsible for any adverse outcome from this practice such as bad quality and incomplete or abandoned jobs. Nevertheless, once construction is
finished and the project is accepted by the Mexican authorities, the contractor withdraws from the trust and from any financial obligation of it. Since the contractor is a consortium made up of four large, competent and experienced construction firms (otherwise the government would not have awarded the contract to them) it is reasonable to assume that the job will be finished within a reasonable time and quality standards. Therefore, the private risk in the Huites project is minimal compared with the risk absorbed by the government. It is sound to conclude that even though Huites is a form of public-private partnerships it is a lopsided one in financial terms. The partnership did, however, exploit the private sector's ability to engineer complex financial schemes and negotiate the best possible credit terms. The result of this was the development of a large infrastructure project with minimal fiscal funds. One other important benefit from the partnership is that if the project is finished on time, suffers no major delays or damage and CFE makes the lease payments as planned (which is highly probable), then the Mexican government does not have to use the guarantees given to the note holders and credit institutions and therefore, no additional debt is shown on the government's accounts.

The legal structure arrived at was the result of applying the lessons from previous experience in the highway development program. The structure is centered around a fiduciary trust of which CNA, CMCH, CFE and Nafin are part. The trust provides an entity with which all third parties deal and therefore provides an efficient coordination and information mechanism. Also, the trust provides a body for dispute resolution without having to resort to the judicial
system. The contracts described in the second part of chapter five are intended to give a general idea of the structure and to describe the nature of the relationships between the participants. The contracts are, of course, very thorough in specifying the relationships as completely as possible to avoid any misunderstandings or adverse situation between the parties. It is not the central objective of this document to analyze such relationships in complete detail.

Clearly, many important lessons are to be learned from Huites, especially the privatization issue. It is in the hands of both the government and the private sector to search for alternate financial opportunities in order to continue the development of infrastructure in a country where external debt remains high and internal resources are limited compared to industrialized nations.

Finally, it is important to note that many of the contracts, agreements and credits are probably going to suffer some more modifications before the end of the project. However, this document describes the situation as faithfully as possible under the prevailing circumstances and at the present time.
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