III. ENERGY

A. CONCEPTUAL AND METHODOLOGICAL OBSERVATIONS

As in other sectors, damage in the electrical sector is both direct and indirect, on the basis of which reference is made to secondary effects. Direct damage refers to the immediate alterations suffered by physical infrastructural installations and inventories while the disaster occurs, indirect damage refers to the costs of responding to the demand for electricity during the recovery period and to unperceived net income or earnings during that period, which, in turn, are analyzed jointly with other effects in the evaluation of the overall macroeconomic impact (secondary effects) of the disaster.

With regard to damaged infrastructure, the repair and/or reconstruction costs necessary to restore the operating capacity which sector installations had before the disaster should be considered. As in other sectors, the option must also be faced here of deciding whether the operating capacity to be replaced should be identical to that which obtained prior to the disaster, or whether the normal specifications of efficiency and security for that type of installation, at the time of repair or replacement, should prevail. In fact, the latter criterion will be used when it is necessary to replace works and equipment which were completely destroyed As has been stated often, the criterion of appraising at true replacement cost –which incorporates the technical changes which have occurred– will yield more representative cost estimates of the works actually required and of the needed financial resources.

Cost estimates should include an appraisal of the time required for these projects, which, in turn, will serve as the basis for the quantification of the costs of supplying temporary services, as explained below in the section on indirect damage.

Estimating the stocks of equipment, material and raw materials affected or destroyed by the disaster is much easier and should be based on replacement costs, at current market prices. If identical products are not available at the time of the evaluation, equivalent elements should be used, insofar as they yield adequately similar results.

The quantification of indirect damage is more complex, because it is based largely on estimates On the one hand, the behaviour of supply and demand during the recovery period should be projected; and, on the other, the financial results actually obtained during that period should be contrasted with those which would have occurred if the disaster had not happened. In the projection for the period "after the disaster", volumes will surely be smaller than those foreseen for the situation without disaster, because important consumers will find their needs or purchasing power significantly reduced As well, although less certainly, demand may be higher than normal, when energy is needed in extraordinary quantities for reconstruction works In fact, both these situations may occur, making it necessary to quantify net results.

Once post-disaster demand has been determined, which may be equal to, less or more than normal, the means for replacing it adequately should be identified. As a general criterion, the necessary supply of energy should be geared to achieving opportune and reliable results Then, capital and operating costs should be estimated, the latter based on the time required for the rehabilitation of damaged or destroyed installations. Capital costs cover basically the acquisition of equipment, operating costs and those incurred for labour and material. It should be noted that payments made to permanent employees, temporarily unemployed for reasons attributable to the disaster, should be included in the item of personnel.

Finally, indirect damage should be estimated. To this end, first, net income foreseen for the recovery period should be estimated. In this regard, the cost of providing the supplemental energy supply mentioned above, together with the company's normal operating costs during the period in question, should be subtracted from the estimated sales income for the recovery period, following the disaster. It must be noted that this net income may be negative, in function of the purchasing power of habitual consumers after the disaster. Second, net income which would have obtained if the disaster had not occurred is estimated by subtracting total costs from gross proceeds, as in the preceding exercise That information is usually to be found in the records of sector companies, in their short and mid-term programming departments. The algebraic difference –applicable in the event of real negative income– between the two net incomes is the amount of total indirect damage. It should be noted that the additional costs involved in supplying supplemental energy, together with the income not perceived due to the disaster, are duly considered in this item

These estimates of the costs of direct and indirect damage should be broken down, on the one hand, into their components of domestic and foreign currency, for the overall calculation of impact on the balance of payments. On the other hand, they should be divided into those corresponding to the government and those of the private sector, in function of the estimate of national accounts, for the calculation of secondary effects.

The evaluation methodology to be applied in the electrical and oil sectors is presented separately, as follows:

B. ELECTRICAL SECTOR

1. Direct effects

Direct damage in the electrical sector is grouped into three large categories: power generation installations; transmission and distribution systems; and dispatch centres

a. Power generation installations

The generation of electrical energy involves, on the one hand, hydroelectric and geothermal complexes and, on the other, conventional thermal plants, powered by steam, diesel or gas. For the purposes of this presentation, public installations for the concentration of hydraulic and geothermal energy, corresponding to that type of power generation –given their special characteristics– are discussed first and, then, generating plants themselves, which house equipment for transforming primary energy into electricity, are analyzed

With regard to hydroelectric generation, the management of water resources may involve a wide range of works, such as storage and containment dams, canals, tunnels, oscillation tanks, reinforced pipe lines, etc. In this regard, it must be kept in mind that the damage sustained by these installations must be repaired in such a way that the control of the flows of water required for the generation of electricity is recovered, because, otherwise, the plant will remain inoperable, with the concurrent losses to the system, as a whole. These works are often located far from the main means of communication and access to them may be difficult, at least in certain times of the year. In these cases, the additional costs involved in providing access (which are not considered among the damage analysis of the transportation sector) should be included among the direct effects

Evaluating rehabilitation and/or reconstruction costs for affected installations, requires estimating magnitudes, such as: cubic meters of earth to be moved, including the specific material needed; quantities of concrete, broken down by type and resistance; the length and other characteristics of water channels; lists of main mechanical components and of special installations. Then, costs should be estimated on the basis of current unit values for that type of work Alternatively, and in function of the basic information available, a more detailed procedure may be followed, which will take into account the necessary labour, by specialty, the quantities of raw materials, the time construction equipment will be used, together with the unit cost of each of these inputs. It is worth noting that, in both alternatives, the type of damage sustained by the work in question, the availability of basic natural resources –earth, sand and gravel– as well as of labour, both specialized and common, weigh strongly in the estimate of direct costs. In this regard, the estimates and price quotations of contractors with recent experience in the area or in similar regions constitute a valuable source of information.

With respect to geothermal power generation, the extraction and management of the resource includes supply wells, conduit pipe lines, and specialized equipment for processing and concentrating steam. Estimating damage to the availability and accessibility of subsurface steam requires the intervention of experts and field research which fall outside the limits of this presentation. However, the evaluator should attempt to make estimates in this regard, based on average costs of well infrastructure in the area under study or other sites with similar natural characteristics, all duly up-dated. The alternatives explained above for other hydroelectric works should be employed for the rest of this type of installation

The remaining infrastructural elements for the production of electricity consist in the generating plants themselves, that is, the plant building and all types of mechanical, electrical and electronic equipment. First, the equipment which provides the motive power for the generator should be considered Some of these are hydroelectric plants, while others use heat from boilers, pressure tanks, steam and gas turbines, etc. The former are designed individually in function of the characteristics of the site to be exploited and its replacements require the same consideration. However, respective costs may be estimated by up-dating the original investment on the basis of indexes which reflect trends in international prices for similar equipment. Recourse may also be had to statistics and manufacturer catalogues which provide prices for equipment for the concentration of hydraulic energy in hydroelectric plants, by ranges of water height (meters) and flow (m3/sec) of the water resource used.

Equipment for the mechanical management of steam heat and that produced by the combustion of oil derivatives, although endowed with specific characteristics according to the size and type of installation in question, are more uniform. This category includes geothermal and conventional plants, the latter classified as steam, diesel or gas –according to the fuel they use.

The determination of replacement costs can be made by following the general procedures outlined above for hydroelectric plants, which, in this case, will usually be easier to estimate, given the greater uniformity of the equipment in question. Plants have been provided with a whole range of mainly electric-mechanical equipment which, through the generator, convert the primary energy –hydraulic, geothermal and that derived from oil– into electricity. In general terms, that equipment is similar in the different types of generating plant. However, they may differ in their degree of modernity and according to their specialized function. In order to determine replacement costs, data about the original investments should be examined first –specially if made in the not too distant past–, up-dating them vis-a-vis international inflation An alternative is to examine manufacturer catalogues or available cost statistics for this type of equipment in specialized publications. (In this regard, see the information in the Annex).

These observations are relevant to those cases in which it is necessary to replace installations totally. When less serious damage has been sustained, requiring only repairs or rehabilitation, cost estimates should follow a technical evaluation of the magnitude of the damage and the real possibilities of restoration. This will require the participation of specialized personnel, with broad experience in the repair and maintenance of this type of equipment For more precise estimates, laboratory tests of the equipment affected will be necessary, a requirement which supersedes the relatively brief time available to the evaluator for the calculation of the direct damage caused by a disaster

Finally, there are the buildings which house the generating equipment. Direct damage to these elements is to be evaluated as for other buildings, as explained below.

b. Transmission and distribution systems

Included in this section are transmission, sub-transmission and distribution lines, together with every kind of sub-station directly related to the transportation of electric energy, from generating centres to final consumers.

High voltage lines, which employ large and expensive towers, are considered first. The evaluation of these elements calls for on-site inspections, using expeditious means of locomotion, such as automotive vehicles when lines are near open roads, and light aircraft and helicopters, when the lines go cross country The number of damaged towers should be counted, their type noted, and the kilometres of cable affected estimated. For other derivative lines, with uniform spacing, it will only be necessary to determine the kilometres affected, noting if the damage is limited to the supporting structures or if it also involves important stretches of cable It will also be necessary to quantify the transformers and other equipment which may have been affected

Then, a list of damaged substations should be made, indicating, as precisely as possible, the equipment damaged, including outdoors installations and those within housings, which are part of the main substations.

The corresponding cost estimates should be based on the results of the inspection of these installations. To this end, the information available in affected electric companies or those of neighboring areas should be employed. Since these data are used with relative frequency, it is to hoped that they can be obtained without great difficulty As was the case for generating plants, recourse may also be had to global or detailed costs obtained from contractors with relevant experience in the locality and from statistics and catalogues containing equipment prices

These observations with respect to partially damaged installations, in contrast to those which must be totally replaced, are also applicable to transmission and distribution works.

c. Dispatch centres and other works

Other important electric company installations are the power monitoring and dispatch centres and administrative buildings. The former include buildings which house a wide range of equipment for monitoring and controlling the flow of electricity from generating plants to consumers. These range from the most elemental, which employ manual controls, to the most complex, equipped with modern systems of tele-monitoring and electronic computation, with high levels of automation and optimization of basic functions. In the evaluation of damage, when the total reconstruction of these installations is required, relevant global costs, by type of dispatch centre, should be used When dealing with partially damaged equipment and structures, an inventory of the respective parts and an estimate of the extent and magnitude of the damage, will be necessary a task which only experts in the matter can undertake, when specialized equipment is involved.

Damage to administrative buildings, as well as other installations affected by the disaster, should be relatively easy to evaluate, given that the structures and buildings involved are well known Average global prices, by floor surface unit or horizontal coverage, should be used in the first instance as a basis for the quantification of that damage. More precise estimates can be made on the basis of the unit prices of the principal elements utilized in those works, such as flooring, walls, roofs, windows, etc.

2. Indirect damage

As noted above, indirect damage involves, on the one hand, the additional cost of temporarily supplementing energy needs while the affected installations are being restored and, on the other, the net income or surplus not received by electric companies during that period.

a. Provisional electricity supply

In order to calculate the additional cost incurred in the temporary provision of electric power, the temporal duration of restoration works or for the re-establishment of the normal functioning of damaged infrastructure should be estimated first That factor will depend basically on the extent and magnitude of the disaster and should be determined by evaluating the direct damage mentioned above. Then, the real demand for electric power, during the period in question, should be estimated. In order to determine the scope and characteristics of that demand, the impact of the disaster on the main consumers (which normally include the industry, trade and residential sectors) should be taken into account. As a first step, the prospects for demand should be projected, according to the following criteria: residential demand in function of the number of dwellings not affected; industrial demand, based on the plants of that sector which can continue to operate, together with the anticipated demand for their products; the commercial demand, in light of the operational capacity of the establishments in the affected zone. Conjecture with respect to the purchasing power of consumers during the period after the disaster, which, logically, will affect demand, should be formulated. These exercises will serve as the basis for the estimate of the magnitude and global characteristics of the demand for electrical energy.

Then, the evaluator should examine the available alternatives for responding to the estimated temporary demand for power which, as noted above, will generally be less than that which would have been made if the disaster had not happened, although it may, exceptionally, be greater. Solutions which ensure the rapid restoration of service are to be considered, when addressing the question of the provision of the required electrical power.

When dealing with isolated systems, equipment "packages" , which can be rapidly transported and installed in the main load centres, are to be considered. Capital costs can be obtained with relative ease from specialized catalogues or on the basis of recent purchases of that type of equipment for special needs, such as emergency plants for industrial centres or to supply the needs of populations isolated from the national integrated electrical network.

Operating costs should be estimated on the basis of actual fuel consumption and the cost of locating the equipment in the selected area, which should preferably be placed as near as possible to the centres of gravity of the greatest demand. This estimate of operating costs should be complemented by adding materials and labour costs, which can usually be obtained from the accounting records of electric companies insofar as they deal with the operation of the same or similar equipment.

When dealing with interconnected systems, relatively near to neighboring systems, the cost of obtaining provisional energy is relatively easy to estimate First, it should be discovered if those neighboring systems are able to supply the required energy and power. Then, the cost of interconnecting the systems should be calculated, which, in some cases, may involve new investments, such as in transmission lines, substation equipment, etc Then, the rates at which the required electrical energy can be obtained should be calculated. If agreements for facing this type of emergency do not exist, a reasonable tariff, based on the additional operating costs to be faced by the supplier system for providing temporary electrical service, should be estimated It may also happen that only part of those requirements can be attended by neighboring systems. In that case, the procedures described above for isolated and integrated systems should be followed, prorating the contribution of each. It should be noted that, since the task is to estimate the additional costs implied by the provision of temporary service, any reduction in operating costs, with respect to normal operating costs, such as variable costs of generation units which cease to operate as a result of the disaster, should be subtracted from these estimates and in all the alternatives explained above.

b. Other indirect damage

This section refers basically to the profits not realized by the electric company during the period of the restoration of its installations and the normalization of demand. It is logical to suppose that, during that period, consumers who need electrical energy to accelerate the recovery of their activities (or at least some of them) will be less able to pay for the power they consume, due to a decrease in their normal incomes. In light of this factor, and when relevant, lower rates will probably be established temporarily. On this basis, gross incomes should be estimated, as well as the real anticipated demand referred to in the previous section. From this gross income, total costs for the recovery period, including additional charges for the provisional service mentioned above, and the company's normal operating costs, should be subtracted. Thus, the net income for the period in question is obtained, which may be negative, when costs rise while income decreases.

Then, net income is calculated under the hypothesis that the disaster did not occur. On the one hand, anticipated income should be estimated, by applying the estimated average income to the normal projection of the demand for electricity. On the other hand, anticipated costs are estimated on the basis of recent behaviour, thus calculating net income for a normal situation It is worth noting that this surplus is usually used by electric companies as an essential component for defraying capital investments required to meet future demand adequately and timely. Any significant drop implies the need to contract new loans which, in turn, are granted in function of the profitability of the company. Estimates for this second scenario are normally available in electric companies, given the nature of that activity, which requires permanently up-dated short and mid-term planning. Indirect damage –which, in this case, is equivalent to the benefits or surplus not realized due to the disaster– should be calculated in terms of the algebraic difference between net income, calculated for the normal scenario, without disaster, and that corresponding to the real estimated situation, which includes the additional costs of providing electrical service during the recovery period. It should be noted that, when the net income estimated in the latter scenario is negative, it should be added to the net income estimated for the normal scenario, in order to obtain the total loss of profit due to the disaster.

3. Imported content and cost break down

In order to appraise the impact of the disaster on the balance of payments and national accounts, it is necessary to break direct and indirect costs down into outlays made in foreign and national currencies, on the one hand, and into public and private sector outlays, on the other. With regard to direct costs, all equipment, material and specialized labour, not available in the country and imported for reconstruction, correspond to outlays in foreign currency.

Local outlays cover mainly construction and repair costs, such as surveying, earth moving, structure construction, etc However, the latter element may involve significant components of currency outlays for specialized equipment, tractors, trucks, cranes, etc., not available locally and which must be imported. To estimate this factor, it will be necessary to examine the available cost accounting records of electric companies or the archives of contractors with recent, local experience in that type of project.

The foreign currency component of indirect costs will only be relevant in terms of outlays to temporarily satisfy demands for electricity, in function of the equipment and material imported for that purpose. The cost of importing electricity from other countries, if such is the case, should be managed in the same way.

The break down of costs into public and private depends basically on the insertion of the affected electric company in the official or private sector. Moreover, when the government provides electricity, the possible participation of private operators in the activities undertaken, which usually involve contracts for the reconstruction or repair of affected installations, should be considered.

C. OIL SECTOR

1. Direct damage

a. Production works

Oil production is undertaken through the development of wells on land or at sea, with the subsequent extraction of crude. The following stages of transportation and storage for local refinement or export should be included in the area of specialized transportation and accounted for in the corresponding sector evaluation.

The development and control of producer wells requires the use of structures, equipment and installations, largely custom built according to the needs and characteristics of the local geography. These elements include towers to control drilling, deep well drills, marine platforms and a multiplicity of pipe lines and equipment for the management of the flow produced. The evaluation of damage related to the accessibility of that resource under ground or the sea, as well of the production capacity of the producer wells impacted by a natural disaster, requires the participation of specialized experts, who should undertake the relevant research and field work.

In general, those activities exceed the limits of this presentation, which refers rather to estimates which can be made in the short term. When a certain exploitation site is totally destroyed, a first approximation to the direct damage would be the amount already invested, actualized to the date of the disaster; and to the indirect damage, through the net commercial value of the production which would not be realized during the recovery period. Later, those appraisals can be made more precise by estimating the extent of damage to installations such as towers, drilling machinery and auxiliary equipment

When it is necessary to replace installations completely, the estimates should be made using typical (up-dated) costs, which are usually available in the company's archives. Information about industrial equipment can also be obtained from manufacturers catalogues. Contractors with pertinent experience should also be consulted. When it is only necessary to repair partially damaged structures and equipment, a prior evaluation of the magnitude and extent of the damage should be made That task can only be undertaken by qualified technicians, with broad experience in repair and maintenance, preferably familiar with the affected installations.

b. Refineries

Plants for the transformation of oil into its derivatives may be relatively simple, when only primary distillation is performed, or more complex, insofar as they incorporate more sophisticated equipment for the re-processing of some products or the removal of toxic substances, such as sulfur In general terms, refineries include: different types of processing towers, storage tanks, a multiplicity of metal pipe lines of diverse sizes, and valves and other items for the management and control of fluids The evaluation of damage caused by a disaster should follow the same or similar procedures as those indicated in the previous section, with respect to thermal plants for the generation of electricity. This is the case because many of the elements in these plants are similar to those employed in other industrial-type installations.

c. Distribution works

The distribution and sale of oil derivatives should be broken down in terms of the main consumer sectors, as follows gaseous fuels for domestic-industrial fuel; liquid fuels for highway, shipping and air transportation; and tarry residues generally used in road construction The basic installations consist in, on the one hand, poliducts, storage tanks, pumping stations, etc., and, on the other, typical service stations for supplying automotive vehicles and small boats, individually. The former belong essentially to the transportation or industrial sector. The evaluation of the latter elements should employ the procedures indicated elsewhere for that type of installation

d. Other works

Buildings used for administrative purposes and recreational centres for personnel should be included in this section. This type of structure is common to all sectors, as noted above, and, consequently, the evaluation of damage caused by a disaster should employ the techniques already mentioned in relation to the destruction of housing

2. Indirect damage

Indirect damage includes, on the one hand, the additional cost of supplying oil or its derivatives to satisfy energy demands while damaged installations are being repaired or reconstructed, and, on the other, the net income not perceived during that time, including the additional costs already mentioned.

a. Temporary provision of oil and derivatives

The estimate of the costs involved in the temporary provision of hydrocarbons should be based on the magnitude and characteristics of the damage sustained and the duration of recovery works. Those two factors will have been determined already, when the direct damage mentioned above was evaluated. Then, it is necessary to estimate the demand for oil and derivatives to be met to replace lost capacity and for consumption during the reconstruction process To that end, account should be taken of the impact of the disaster on the main consumers, such as: residences, businesses and industries which will continue to require domestic gas; automotive vehicles and others which continue to function; kilometres of roads to be constructed or repaired with bituminous material, etc On the basis of these data, and taking into account the purchasing power of affected consumers, the estimate of the new market situation should be made, in terms of needs and by type of product required

Then, alternatives for meeting that demand should be analyzed Various possibilities may emerge, depending on the availability and location of resources and the installations available for transportation and transferal. Tank trucks should be used for nearby supply and lesser quantities; previously installed pipe lines should be used for inter-region transfers, or sections should be constructed, if the investment is justified. Finally, marine transportation, the most commonly used means of transportation for the commercialization of oil and derivatives, should be used. This last option requires adequate port conditions and equipment; otherwise, it will be necessary to employ provisional installations, for use in emergencies.

On the basis of these considerations and once the most economical and viable alternative has been selected, the corresponding costs should be estimated. At any rate, the type of activity referred to corresponds more to the transportation sector and should be addressed in the respective chapter. Thus, capital and operating costs, including the cost of the hydrocarbons acquired, will be obtained Given that international prices are well known, it is easy to estimate them.

b. Other indirect damage

As explained in greater detail in the section on the electrical sector, indirect damage arising from unperceived income should be quantified as follows. Net income for the real scenario after the disaster is determined. In this regard, it is worth repeating that it should be expected that gross income will drop, while costs will rise, as higher temporary supply costs are included. The results will very probably be negative Then, the probable net income, which would have been perceived without the disaster, should be established, which is information which can be derived from the archives or projections of the relevant companies. In the extreme case that those archives have also been destroyed, the estimate should be made on the basis of data from other, basically similar companies. The algebraic difference between the net income, in normal conditions, and that of the real situation after the disaster, will yield total indirect damage, which will be equal to the profit not perceived by the company due to the disaster.

3. Break down of direct and indirect damage

See the observations made in the section on the electric sector, which, briefly, explain that direct and indirect costs should be broken down as follows: on the one hand, into national and foreign currencies for the purposes of the balance of payments; and on the other hand, in terms of governmental and private costs, for purposes of national accounts

ANNEX

Costs of some electric installations in the region

By way of general reference, a series of charts is included here, in which the costs of installations for the generation, transmission and distribution of electric energy are broken down. The first two areas, taken from an ECLAC document,[2] cover one hydroelectric and one thermal plant, considered to be representative of that type of installation in Latin America. The documents cited are recommended as reference works for the evaluation of damage in the electric sector caused by natural disasters

The other charts included here refer to electric installations (transmission lines) in the Republic of Panama and were provided by the Instituto de Recursos Hidráulicos y Electrificación (IRHE).

Obviously, adjustments will have to be made in this information, in function of the country or region and the moment in which the disaster being evaluated occurred. In general terms, cash costs require less adjustment because they are based on prices of the international market. Moreover, costs in national currencies require greater adjustments, depending on the relations between salaries and materials for electric installations among the countries involved. At any rate, price fluctuations, both in foreign and local currencies, as a result of the behaviour of international and local inflation, should be taken into account

[2] Evaluación de la demanda de maquinaria y equipo para la generación, transmisión y transformación de energía eléctrica (LC/L.335/Rev.1), Santiago, 1986. This document is part of a study realized by a Working Group on the prospects of the construction of capital goods in Latin America. With regard to electric energy, the Group prepared another document, titled Generación de energía eléctrica. Estudio de posibilidades de fabricación local de equipos (E/CEPAL/G.1312), Santiago, 1984.

COST BREAK DOWN FOR SOME ELECTRIC INSTALLATIONS IN LATIN AMERICA

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Chart 5: Break down of the estimated cost of a 230Kv. transmission line Simple circuit. 750 ACAR conductor

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Chart 12: Cost break down for a simple line Diagramme, new one switch substation. 115Kv. yard.

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Chart 14: Cost break down for Diagramme of a switch and a half, new three switch substation. 115Kv. yard.

Chart 15: Cost break down (base cost: January, 1988). Project N¦ 01. Bid 10 Name of project: monophase line 19.9/34.5 Kv ***typical kilometre***

Chart 16: Cost break down (base cost: January, 1988). Project N¦ 01. Bid 12. Name of project: monophase line 19.9/34 5 Kv ***typical kilometre***

Chart 17: Cost break down (base cost: January, 1988). Project N¦ 01. Bid 13 Name of project· monophase line 19.9/34.5 Kv ***typical kilometre***

Chart 18: Cost break down (base cost· January, 1988). Project N¦ 01. Bid 14. Name of project: monophase line 19.9/34.5 Kv ***typical kilometre***

Chart 19: Cost break down (base cost: January, 1988). Project N¦ 01. Bid 07. Name of project: monophase line 19.9/34.5 Kv ***typical kilometre***

Chart 20: Cost break down (base cost: January, 1988). Project N¦ 01. Bid 19. Name of project: monophase line 19.9/34.5 Kv ***typical kilometre***

FIGURE 1
Diagramme of 230Kv. transmission line.
Simple circuit.
750 ACAR conductor.

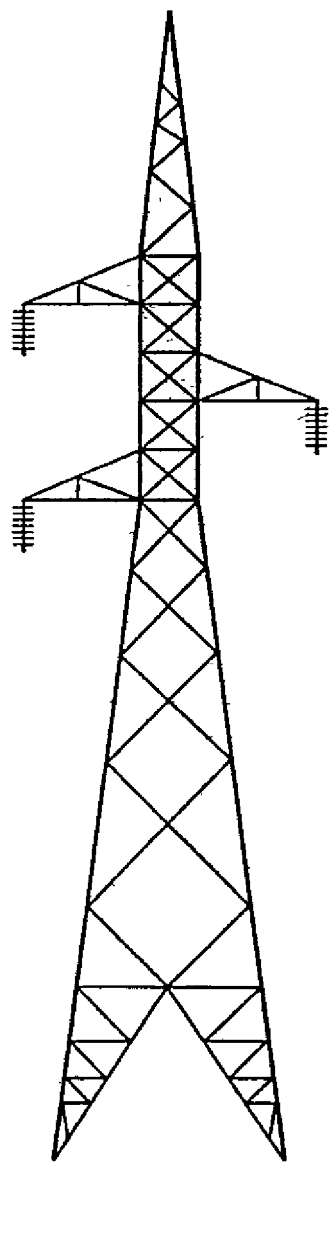

FIGURE 2

Diagramme of 230Kv. transmission line.
Double circuit.
750 ACAR conductor.

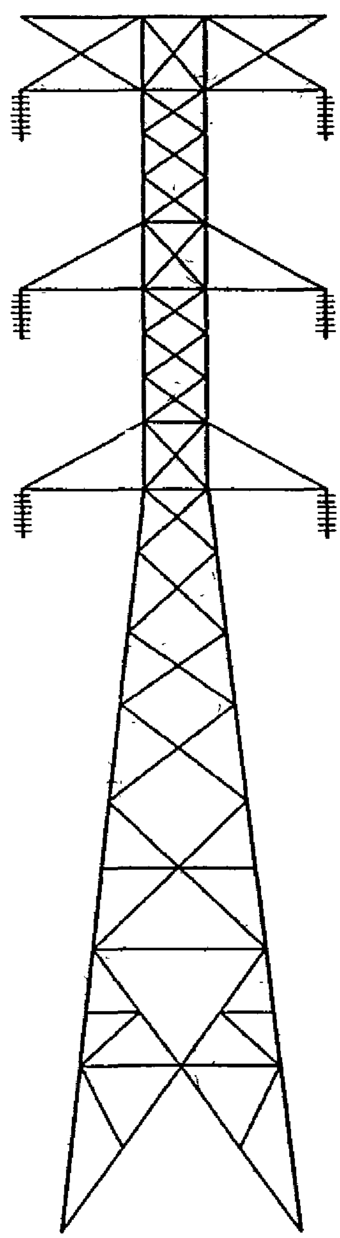

FIGURE 3

Diagramme of 115Kv. transmission line.
Simple circuit.
636 ACSR/AW conductor.

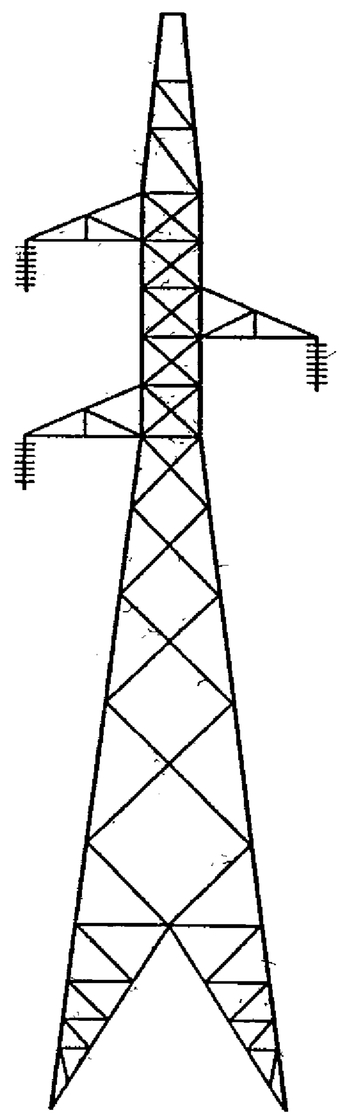

FIGURE 4

Diagramme of 115Kv. transmission line.
Double circuit.
636 ACSR/AW conductor.

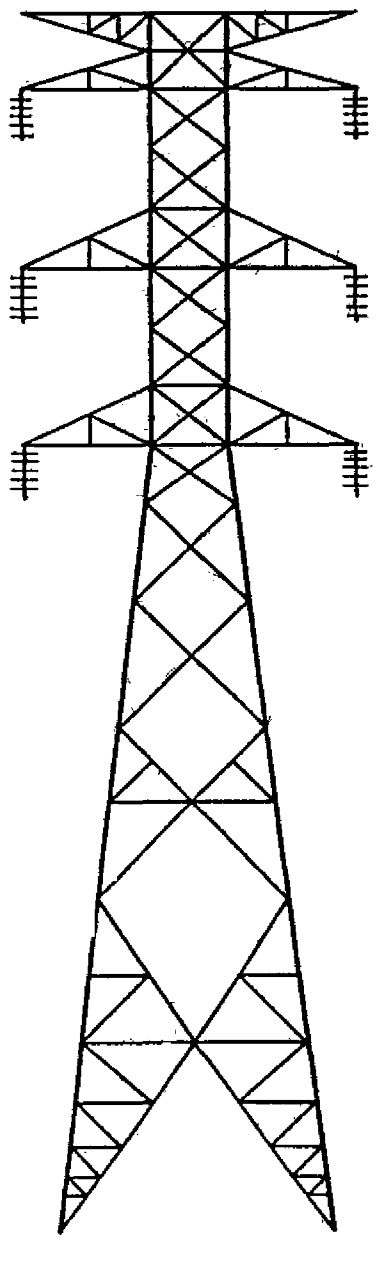

Chart 1
BREAK DOWN OF THE MAIN EQUIPMENT OF A 300W HYDROELECTRIC PLANT

Equipment	Weight (Tons)	Unit price Ton/MW	Unit price (dollars/kilo)	Ex-factory value (millions of dollars)a/
Boiler and structural equipment				
Large gates (radial and flat, more than 30 tons)	703	2.34	5.0	3.52
Mid-size and small gates	367	1.22	5.0	1.84
Hydraulic grills	71	0.24	3.5	1.74
Bridge-crane and gate crane structures	265	0.88	5.0	1.33
Metal structures	580	1.93	3.5	1.74
Galvanized structures (High tension yard)	160	0.53	4.0	0.64
Armour for pressure pipe lines	1 500	5.0	2.5	3.75
Subtotal	3 466	12.15	3.6	13.07
Mechanical and electrical equipment				
Turbines	680	2.27	7.0	4.76
Generators	1 216	4.05	9.3	11.30
Escape valves	834	2.78	8.0	6.67
Power transformers	336	1.12	5.5	1.85
Auxiliary and monitoring transformers	25	0.08	10.0	0.25
Security and maneuvering equipment	20	0.07	20.0	0.40
Mechanical components and controls for bridge cranes and gates	gl.	-	-	4.70
Instruments	gl.	-	-	2.00
diverse equipment	200	0.33	15.0	3.00
Subtotal	3 311	11.04	10.55	34.93
TOTAL	6 957	23.19	6.9	48.00

Source: ECLAC estimates, based on plans.

a/ Does not include mounting.

Chart 2

BREAK DOWN OF THE MAIN EQUIPMENT OF A 150MW THERMAL PLANT, FED ALTERNATELY WITH COAL OR FUEL OIL

Equipment	Weight (Tons)	Unit price (dollars/kilo)	Ex-factory value (millions of dollars)
Boiler and electrostatic precipitator	1750	18	31 500
Support structure, ducts and chimney	700	5	3 500
Air pre-heater	280	5	1 400
Fans	50	10	500
System of pulverizing and moving coal	147	7.5	1 100
Oil storage	200	7 5	1 500
Ash transportation	200	6	1 200
Turbo-generator (158 MW 3,600 rpm)	366	24	8 800
Heaters and heat exchangers	67	12	800
Condensers and *	280	10	2 800
Feed, condenser and circulation pumps	50	10	500
Condensation, recuperation and water tanks	200	3 5	700
Fuel tank	100	3 0	300
Cooling tower	150	6	900
Water treatment system	100	7	700
Condensation treatment system	50	8	400
Fire protection system	75	8	600
Metal structure (main building)	750	3.5	2 625
Secondary metal structures	75	3.5	265
Structure of bridge-crane 35/10 ton and 17m.	50	8	400
Compressed air system (compressors)	4	30	120
Main transformer 175 mVA 230 KV	125	8	1 000
Starter transformer 15/20 mVA 4.16 KV	30	9	270
Auxiliary transformer 15 mVA 16 KV	15	10	150
Power and current transformers	10	10	100
Switch panels and unit substation	50	15	750
Motor control centre	20	25	500
Circuit breakers, lightning rods, switches	46	20	920
High pressure pipe line systems	200	5.5	1 100
Low pressure pipe lines	400	3.5	1 400
Valves (700 units)	120	10.0	1 200
Diverse equipment: ducts, lights, support structures, thermal insulation	250	10	2 500
Bridge-crane mechanism	b)	--	500
Electrical and control instruments	120	25	3 00
Maintenance work shop and laboratory	b)	--	1 000
Total	730	10.67	75 000

Source. ECLAC estimates

a) Does not include mounting.

b) Tons included in other items or insignificant.

Chart 3
COSTS OF HYDROELECTRIC GENERATION

	YEARS OF INTEREST	FACTOR	INTEREST RATE 12%			
			S PAOLO	SOLEDAD	CHANG1	CHANG2
INSTALLATION MW			33	28	300	301
COST /KW WITHOUT IDC			1 972	2 286	2 110	1 752
% YEAR 1	3.5	1.49	9 26	9 22	10	10
% YEAR 2	2.5	1.33	24.63	24.61	20	20
% YEAR 3	1.5	1.19	40 74	40 78	40	40
% YEAR 4	0.5	1.06	25 37	25.39	30	30
% YEAR 5	0	1.00	0	0	0	0
IDC			426 02	423.45	434.24	360.56
TOTAL COST/KW			2 398.02	2 779.45	2 544.24	2 112.56
USEFUL LIFE -YEARS			50	50	50	50
O AND M FIXED/KW-YEAR			13.8	13.8	13.8	13.8
REPLACEMENT B/KW-YEAR			00	,00	.00	00
INSURANCE B/KW-YEAR			.00	.00	.00	00
COST OF GENERATION						
ANNUAL COST OF CAP. B/KW			288.76	334.69	306.37	254.39
AVERAGE ENERGY GWH			145.9	141.5	1 614	1 567
NOMINAL GWH/KW			4 421.21	5 053.57	5 380.00	5 205 98
% PLANT FACTOR			50 47	57.69	61 42	59 43
UNIT COST C/KWH			6.53	6 62	5 69	4 89

Chart 4
COSTS OF THERMAL GENERATION

Type		Interestrate 12% - Fuel Cost Until 2000						
		Years Of Interest	Factor	Coal	Coal	Oil	Oil	TG
N° OF UNITS				1	2	1	2	
MW/NOMINAL UNIT				75	75	75	75	60
COST/KW WITHOUT IDC				1 430	1 245	922	721	410
% YEAR 1		3.5	1 00	17	19	17	19	0
% YEAR 2		2.5	1 00	28	30	28	30	0
% YEAR 3		1.5	1 00	36	34	32	34	35
% YEAR 4		.5	1.00	16	17	16	17	65
% YEAR 5		0	1.00	7		7		
IDC				.00	.00	00	00	.00
TOTAL COST/KW				1 430 00	1 245 00	922 00	721.00	410.00
USEFUL LIFE -YEARS				35	35	35	35	30
O AND M FIXED/KW-YEAR				30	30	30	30	1
O AND M VARIABLE B/MWH				.5	.05	.5	.5	.9
REPLACEMENT B/KW-YEAR				3.58	3.11	2 31	1.80	1.03
INSURANCE B/KW-YEAR				3.58	3.11	2 31	1 80	1.03
FUEL C/MBTU				204 79	204 79	420.23	420.23	613.7
THERMAL OUTPUT BTU/KWH				10 460	10 460	10 000	10 000	13 000
GENERATION COSTS								
FUEL C/KWH				2.14	2.14	4.20	4 20	7.97
ANNUAL * COST B/KW				226.32	200.30	145.92	1116.00	58.39
FP%	KWH/KW							
5	438			53.81	47.87	37.52	30 69	21 30
10	876			27.98	25.81	20 86	17 44	14 64
20	1 752			15.06	13.57	12.53	10 82	11.30
30	2 628			10.75	9 76	9.75	8 62	10 19
40	3 504			8.60	7.86	8.37	7 51	9.64
50	4 380			7.31	6 72	7.53	6 85	9 30
60	5 256			6 45	5 95	6.92	6 41	9 08
70	6 132			5 83	5 41	6.58	6.09	8 92
80	7008			5.37	5 00	6.28	5 86	8 80

Chart 5
BREAK DOWN OF THE ESTIMATED COST OF A 230KV. TRANSMISSION LINE SIMPLE CIRCUIT. 750 ACAR CONDUCTOR
JANUARY, 1988
($/Km)

	DESCRIPTION	MATERIALS	LABOUR	TOTAL
1	Insulators and hardware	3 104	1 117	4 221
2	Conductors	12 090	5 199	17 289
3	Cables*	1 195	514	1 709
4	System grounding	1 503	857	2 359
5.	Towers	13 680	7 524	21 204
6.	Foundations	3 094	9 745	12 839
7	Right of way	-	2 400	2 400
	Total Base Cost	34 665	27 356	62 021
8	Transportation			3 467
9.	Contingencies			3 467
10.	Engineering and Administration			10 343
	Total Cost			79 297

Chart 6

BREAK DOWN OF THE ESTIMATED COST OF A 230KV. TRANSMISSION LINE DOUBLE CIRCUIT. 750 ACAR CONDUCTOR
JANUARY, 1988
($/Km)

	DESCRIPTION	MATERIALS	LABOUR	TOTAL
1.	Insulators and hardware	6 280	2 235	8 443
2.	Conductors	24 180	10 397	34 577
3.	Cables*	2 390	1 028	3 418
4.	System grounding	1 503	857	2 359
5.	Towers	21 803	11 991	33 794
6	Foundations	5 325	16 774	22 099
7.	Right of way	-	2 400	2 400
	Total Base Cost	61 409	45 682	107 090
8	Transportation			6 141
9.	Contingencies			6 141
10.	Engineering and Administration			17 906
	Total Cost			137 277

Chart 7

BREAK DOWN OF THE ESTIMATED COST OF A 115KV. TRANSMISSION LINE SIMPLE CIRCUIT. 636 ACSR/AW CONDUCTOR

JANUARY, 1988

($/Km)

	DESCRIPTION	MATERIALS	LABOUR	TOTAL
1.	Insulators and hardware	1 865	671	2 536
2.	Conductors	11 310	4 863	16 163
3	Cables*	1 195	514	1 709
4	System grounding	1 503	857	2 359
5.	Towers	12 184	6 701	18 885
6.	Foundations	2 625	8 269	10 894
7.	Right of way		1 800	1 800
	Total Base Cost	30 681	23 675	54 356
8	Transportation			3 068
9	Contingencies			3 068
10.	Engineering and Administration			9 074
	Total Cost			69 566

Chart 8

BREAK DOWN OF THE ESTIMATED COST OF A 115KV. TRANSMISSION LINE DOUBLE CIRCUIT. 636 ACSR/AW CONDUCTOR JANUARY, 1988

($/Km)

	DESCRIPTION	MATERIALS	LABOUR	TOTAL
1.	Insulators and hardware	3 720	1 343	5 072
2.	Conductors	22 620	9 727	32 343
3	Cables*	2 390	1 028	3 418
4.	System grounding	1 503	857	2 359
5	Towers	19 494	10 722	30 216
6	Foundations	4 725	14 884	19 609
7	Right of way		1 800	1 800
	Total Base Cost	54 461	40 359	94 820
8	Transportation			5 446
9.	Contingencies			5 446
10.	Engineering and Administration			15 857
	Total Cost			121 569

Chart 9

COST BREAK DOWN FOR A SIMPLE LINE DIAGRAMME, NEW ONE SWITCH SUBSTATION. 230KV. YARD

(Balboas of January, 1988)

		MATERIALS	LABOUR
1.	1 switch 230 KV. 2000A	116 000	
2.	1 manual tri-polar knife switch with 230 KV ground	17 500	
3.	1 manual tri-polar knife switch without 230 KV ground	16 000	
4	Grounding system	3 470	
5	Auxiliary services	45 000	
6.	Illumination	15 000	
7.	3 lightning rods 192 KV	24 000	
8	Hardware, structures and supports	37 915	
9	Cables, conductors and ducts	31 244	
10	Security and monitoring equipment	150 000	
11.	Supervision and control	20 000	
12.	Communications equipment	180 000	
	SUBTOTAL MATERIALS	656 129	
13	Land		6 275
14	Electrical installations		98 419
15.	Civil works	45 929	85 297
	TOTAL BASE COST	708 334	183 716
16.	Transportation	42 500	28 333
17.	Contingencies	70 833	
18	Engineering and administration		106 250
	TOTAL	821 667	318 300
	TOTAL COST	1 139 967	

Chart 10

COST BREAK DOWN FOR A DIAGRAMME OF A NEW SWITCH AND A HALF SUBSTATION WITH TWO SWITCHES. 230KV. YARD

(Balboas of January, 1988)

		MATERIALS	LABOUR
1	2 switch 230 KV. 2000A.	232 000	
2	1 motorized tri-polar knife switch with 230 KV ground	211 500	
3	4 manual tripolar knife switches without 230 KV ground	64 000	
4.	Grounding system	6 830	
5	Auxiliary services	60 000	
6	Illumination	15 000	
7	3 lightning rods 192 KV	24 000	
8.	Hardware, structures and supports	67 733	
9.	Cables, conductors and ducts	42 053	
10.	Security and monitoring equipment	150 000	
11.	Supervision and control	20 000	
12.	Communications equipment	180 000	
	SUBTOTAL MATERIALS	883 116	
13.	Land	9 500	
14.	Electrical installations		132 467
15.	Civil works	61 818	114 805
	TOTAL BASE COST	954 434	247 272
16.	Transportation	57 266	38 177
17.	Contingencies	95 443	
18.	Engineering and administration		143 165
	TOTAL	1 107 144	428 615
	TOTAL COST	1 535 758	

Chart 11

COST BREAK DOWN FOR A DIAGRAMME OF A NEW SWITCH AND A HALF SUBSTATION WITH THREE SWITCHES. 230KV. YARD

(Balboas of January, 1988)

		MATERIALS	LABOUR
1.	3 switch 230 KV. 2000A.	348 000	
2.	2 motorized tri-polar knife switch with 230 KV ground	43 000	
3.	6 manual tripolar knife switches without 230 KV ground	96 000	
4	Grounding system	10 700	
5	Auxiliary services	60 000	
6.	Illumination	15 000	
7.	6 lightning rods 192 KV	48 000	
8	Hardware, structures and supports	99 312	
9.	Cables, conductors and ducts	70 001	
10.	Security and monitoring equipment	300 000	
11.	Supervision and control	20 000	
12.	Communications equipment	360 000	
	SUBTOTAL MATERIALS	1 460 013	
13.	Land	9 500	
14.	Electrical installations		220 502
15.	Civil works	102 901	191 102
	TOTAL BASE COST	1 582 413	411 604
16.	Transportation	94 945	63 297
17.	Contingencies	158 241	
18	Engineering and administration		237 362
	TOTAL	1 835 600	712 262
	TOTAL COST	2 547 862	

Chart 12
COST BREAK DOWN FOR A SIMPLE LINE DIAGRAMME, NEW ONE SWITCH SUBSTATION. 115KV. YARD
(Balboas of January, 1988)

		MATERIALS	LABOUR
1.	1 switch 115 KV 1600A.	73 000	
2.	1 motorized tri-polar knife switch with 115 KV ground	11 600	
3.	1 manual tripolar knife switches without 115 KV ground	10 100	
4.	Grounding system	2 194	
5.	Auxiliary services	33 750	
6	Illumination	15 000	
7.	3 lightning rods 96 KV	15 000	
8	Hardware, structures and supports	25 703	
9.	Cables, conductors and ducts	25 317	
10.	Security and monitoring equipment	150 000	
11	Supervision and control	20 000	
12	Communications equipment	150 000	
	SUBTOTAL MATERIALS	531 664	
13.	Land	3 900	
14.	Electrical installations		79 750
15.	Civil works	37 217	69 116
	TOTAL BASE COST	572 781	148 866
16.	Transportation	34 367	22 911
17.	Contingencies	57 278	
18.	Engineering and administration		85 917
	TOTAL	664 426	257 694
	TOTAL COST	922 120	

Chart 13

COST BREAK DOWN FOR A DIAGRAMME OF A NEW SWITCH AND A HALF SUBSTATION WITH TWO SWITCHES. 115KV. YARD

(Balboas of January, 1988)

			MATERIALS	LABOUR
1	2 switch 230 KV 1600A.		146 000	
2	1 motorized tri-polar knife switch with 115 KV ground		17 400	
3	4 manual tripolar knife switches without 115 KV ground		40 400	
4.	Grounding system		4 376	
5.	Auxiliary services		45 000	
6	Illumination		15 000	
7.	3 lightning rods 96 KV		15 000	
8.	Hardware, structures and supports		45 308	
9	Cables, conductors and ducts		32 424	
10.	Security and monitoring equipment		150 000	
11	Supervision and control		20 000	
12	Communications equipment		150 000	
	SUBTOTAL MATERIALS		680 908	
13.	Land		5 750	
14.	Electrical installations			102 136
15	Civil works		47 664	88 518
	TOTAL BASE COST		734 332	190 654
16	Transportation		44 059	29 373
17	Contingencies		73 432	
18	Engineering and administration			110 148
		TOTAL	851 813	330 176
		TOTAL COST	1 181 989	

Chart 14

COST BREAK DOWN FOR A DIAGRAMME OF A NEW SWITCH AND A HALF SUBSTATION WITH THREE SWITCHES. 115KV. YARD

(Balboas of January, 1988)

		MATERIALS	LABOUR
1	3 switch 115 KV 1600A	219 000	
2.	2 motorized tri-polar knife switch with 115 KV ground	34 800	
3.	6 manual tripolar knife switches without 115 KV ground	60 600	
4.	Grounding system	6 888	
5.	Auxiliary services	45 000	
6.	Illumination	15 000	
7.	6 lightning rods 96 KV	30 000	
8.	Hardware, structures and supports	65 806	
9.	Cables, conductors and ducts	54 855	
10.	Security and monitoring equipment	300 000	
11.	Supervision and control	20 000	
12	Communications equipment	300 000	
	SUBTOTAL MATERIALS	1 151 949	
13.	Land	5 750	
14.	Electrical installations		172 972
15.	Civil works	80 636	149 753
	TOTAL BASE COST	1 238 335	322 546
16.	Transportation	74 300	49 533
17.	Contingencies	123 834	
18.	Engineering and administration		185 750
	TOTAL	1 436 469	557 829
	TOTAL COST	1 994 298	

Chart 15

BREAK DOWN OF COSTS (BASE COST: JANUARY, 1988)

PROJECT N° 01 BID 10

NAME OF PROJECT: MONOPHASE LINE 19.9/34.5 KV ***TYPICAL KILOMETRE***

DESCRIPTION	FOREIGN MATERIAL	DOMESTIC MATERIAL	LABOUR
SUBTOTAL 1	7 027	0.0	3 724
LISTING FACTOR	0.0	0.0	0.0
SUBTOTAL 2	7 027	0.0	3 724
CONTINGENCIES (10% OF MATERIAL)	703	0.0	
SUBTOTAL 3	7 729	0.0	3 724
TRANSPORTATION (6% AND 4% OF MATERIAL IN SUBTOTAL 2)		422	281
SUBTOTAL 4	7 729	422	4 005
ENGINEERING (10% OF TOTAL)			1 216
ADMINISTRATION COSTS (5% OF TOTAL 4)			608
TAXES (30% FOREIGN AND 5% DOMESTIC OF SUBTOTAL 3)		2 821	
TOTALS	7 729	3 243	5 829
TOTAL DOMESTIC COST	9 071		
TOTAL FOREIGN COST	7 729		
TOTAL ESTIMATED COST	16 801		

Source: Instituto de Recursos Hidráulicos y Electrificación (Charts III.3.3.19 to 3.3.24)

Chart 16

BREAK DOWN OF COSTS (BASE COST: JANUARY, 1988)

PROJECT N° 01 BID 12

NAME OF PROJECT: MONOPHASE LINE 19.9/34.5 KV ***TYPICAL KILOMETRE***

DESCRIPTION	FOREIGN MATERIAL	DOMESTIC MATERIAL	LABOUR
SUBTOTAL 1	5 342	0.0	2 831
LISTING FACTOR	0.0	0.0	0.0
SUBTOTAL 2	5 342	0.0	2 831
CONTINGENCIES (10% OF MATERIAL)	534	0.0	
SUBTOTAL 3	5 876	0.0	2 831
TRANSPORTATION (6% AND 4% OF MATERIAL IN SUBTOTAL 2)		321	214
SUBTOTAL 4	5 876	321	3 045
ENGINEERING (10% OF TOTAL)			924
ADMINISTRATION COSTS (5% OF TOTAL 4)			462
TAXES (30% FOREIGN AND 5% DOMESTIC OF SUBTOTAL 3)		2 145	
TOTALS	5 876	2 465	4 431
TOTAL DOMESTIC COST	6 896		
TOTAL FOREIGN COST	5 876		
TOTAL ESTIMATED COST	12 772		

Chart 17

BREAK DOWN OF COSTS (BASE COST: JANUARY, 1988)

PROJECT N¦ 01 BID 13

NAME OF PROJECT: MONOPHASE LINE 19.9/34.5 KV ***TYPICAL KILOMETRE***

DESCRIPTION	FOREIGN MATERIAL	DOMESTIC MATERIAL	LABOUR
SUBTOTAL 1	11 557	0.0	6 125
LISTING FACTOR	0 0	0 0	0 0
SUBTOTAL 2	11 557	0 0	6 125
CONTINGENCIES (10% OF MATERIAL)	1 156	0 0	
SUBTOTAL 3	12 713	0.0	6 125
TRANSPORTATION (6% AND 4% OF MATERIAL IN SUBTOTAL 2)		693	462
SUBTOTAL 4	12 713	693	6 587
ENGINEERING (10% OF TOTAL)			1 999
ADMINISTRATION COSTS (5% OF TOTAL 4)			1000
TAXES (30% FOREIGN AND 5% DOMESTIC OF SUBTOTAL 3)		4 640	
TOTALS	12 713	5 333	9 586
TOTAL DOMESTIC COST	14 920		
TOTAL FOREIGN COST	12 713		
TOTAL ESTIMATED COST	27 6632		

Chart 18
BREAK DOWN OF COSTS (BASE COST: JANUARY, 1988)
PROJECT N° 01 BID 14

NAME OF PROJECT: MONOPHASE LINE 19.9/34.5 KV ***TYPICAL KILOMETRE***

DESCRIPTION	FOREIGN MATERIAL	DOMESTIC MATERIAL	LABOUR
SUBTOTAL 1	6 789	0.0	3 598
LISTING FACTOR	0.0	0.0	0.0
SUBTOTAL 2	6 789	0.0	3 598
CONTINGENCIES (10% OF MATERIAL)	679	0.0	
SUBTOTAL 3	7 468	0.0	3 598
TRANSPORTATION (6% AND 4% OF MATERIAL IN SUBTOTAL 2)		407	272
SUBTOTAL 4	7 468	407	3 870
ENGINEERING (10% OF TOTAL)			1 175
ADMINISTRATION COSTS (5% OF TOTAL 4)			587
TAXES (30% FOREIGN AND 5% DOMESTIC OF SUBTOTAL 3)		2 756	
TOTALS	7 468	3 133	5 632
TOTAL DOMESTIC COST	8 765		
TOTAL FOREIGN COST	7 468		
TOTAL ESTIMATED COST	16 233		

Chart 19

BREAK DOWN OF COSTS (BASE COST: JANUARY, 1988)

PROJECT N° 01 BID 07

NAME OF PROJECT: MONOPHASE LINE 19.9/34.5 KV ***TYPICAL KILOMETRE***

DESCRIPTION	FOREIGN MATERIAL	DOMESTIC MATERIAL	LABOUR
SUBTOTAL 1	14 268	0.0	7 562
LISTING FACTOR	0.0	0.0	0.0
SUBTOTAL 2	14 268	0.0	7 562
CONTINGENCIES (10% OF MATERIAL)	1 427	0.0	
SUBTOTAL 3	15 695	0.0	7 562
TRANSPORTATION (6% AND 4% OF MATERIAL IN SUBTOTAL 2)		856	571
SUBTOTAL 4	15 695	856	8 133
ENGINEERING (10% OF TOTAL)			2 468
ADMINISTRATION COSTS (5% OF TOTAL 4)			1 234
TAXES (30% FOREIGN AND 5% DOMESTIC OF SUBTOTAL 3)		5 729	
TOTALS	15 695	6 585	11 836
TOTAL DOMESTIC COST	18 421		
TOTAL FOREIGN COST	15 695		
TOTAL ESTIMATED COST	34 116		

Chart 20
BREAK DOWN OF COSTS (BASE COST: JANUARY, 1988)
PROJECT N° 01 BID 19
NAME OF PROJECT: MONOPHASE LINE 19.9/34.5 KV ***TYPICAL KILOMETRE***

DESCRIPTION	FOREIGN MATERIAL	DOMESTIC MATERIAL	LABOUR
SUBTOTAL 1	10 347	0.0	5 484
LISTING FACTOR	0.0	0.0	0.0
SUBTOTAL 2	10 347	0.0	5 484
CONTINGENCIES (10% OF MATERIAL)	1 035	0.0	
SUBTOTAL 3	11 382	0.0	5 484
TRANSPORTATION (6% AND 4% OF MATERIAL IN SUBTOTAL 2)		621	414
SUBTOTAL 4	11 382	621	5 898
ENGINEERING (10% OF TOTAL)			1 790
ADMINISTRATION COSTS (5% OF TOTAL 4)			895
TAXES (30% FOREIGN AND 5% DOMESTIC OF SUBTOTAL 3)		4 154	
TOTALS	11 382	4 775	8 583
TOTAL DOMESTIC COST	13 358		
TOTAL FOREIGN COST	11 382		
TOTAL ESTIMATED COST	24 740		