INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

REPORT ON THE ANCHICAYA HYDROELECTRIC PROJECT IN COLOMBIA

October 18, 1950

Loan Department

REPORT ON THE ANCHICAYA HYDROELECTRIC PROJECT

(CALI, COLOMBIA)

I - Purpose and Scope of this Report

This report presents an analysis of the Anchicaya hydroelectric project which is designed to determine its suitability for a loan. It includes the recommendations of the Engineering Staff concerning the project.

The report is based on information obtained from a number of sources, including technical descriptions and drawings by the Charles T. Main Company of Boston, consulting engineers for the project, construction cost estimates supplied by Christiani & Nielsen, Ltda., Morrison-Knudsen, Inc., and by the Central Hidroelectrica del Rio Anchicaya, Ltda., supplemented by personal investigations of Mr. Carl Flesher in his capacity as a member of the Currie Mission and later as a member of the IBRD Engineering Staff.

This report supersedes an earlier document of January 31, 1950, released under the title "Report on Colombian Anchicaya Hydroelectric Project," No. Loan 81.

II - The Borrower

A loan to meet part of the foreign exchange costs of the project has been requested by the Central Hidroelectrica del Rio Anchicaya, Ltda., known as CHIDRAL. This company will build and operate the system, intended for the present to supply the City of Cali, although it is expected that eventually additional transmission lines will be built in order to supply other areas.

CHIDRAL was organized in 1944 under Colombian law as a commercial company of limited liability with the national, state and municipal governments as the only shareholders. The original share capital was 1,500,000 pesos, with the National Government subscribing 51%, the Department of Valle del Cauca 23%, and the Municipality of Cali, 26%. Capitalization was gradually increased to 11,200,000 pesos in the original proportions. Stock subscriptions were in the form of notes maturing over a period of five years, the last maturity date being December 1950. According to the balance sheet as of May 31, 1950, (see Table 5) the notes in hand amounted to 1,638,992 pesos. The payments have been made in the form of notes with varying maturity dates because the cash resources of the participating official agencies are subject to annual budget appropriations.

NOTES: (1) Rates of exchange used in this report
$1 = 1.96 pesos
1 peso = $.51

(2) The $ sign is used exclusively for U.S. dollars; pesos are designated as such.

On April 28, 1950, at a shareholders' meeting, it was decided to increase the capitalization of the company by another 10 million pesos, still retaining the original ratio of subscriptions. The National Government and the Department have paid up the new subscriptions in cash. The Municipality of Cali has turned over to CHIDRAL its generating facilities in lieu of cash. According to the latest available information, these have been appraised at 4,076,000 pesos. During the construction period, these properties will be leased back to the Municipality of Cali at a rental of 4½% per year plus depreciation charges calculated in conformity with Colombian law at 3.2091% per year.

Because part of the capital has in the past been provided in forms other than cash, a "nulidad absoluta," a technical defect in the incorporation, has been incurred. CHIDRAL has been so notified and will take steps to remedy the situation, in order to comply with the provisions of Colombian law governing limited liability companies.

In the opinion of Bank observers who have visited Colombia, the management of CHIDRAL is competent and capable of satisfactory execution of the project and its operation after completion.

III - Description of the Project

CHIDRAL has full rights to the development of the Anchicaya River which is estimated to have a power potential of between 350,000 and 400,000 kw. The immediate project concerns the development of only one station known as the Anchicaya Center with an initial capacity of 24,000 kw. The original plans for the project were developed by Colombian engineers and called for the construction of an arch dam on the Anchicaya River, about 30 miles from Cali, which was expected to connect through a gravity tunnel to a power station containing six 15,000 kw generating units. Work was started on the project in 1945 and was stopped in 1948, due primarily to the fact that unsatisfactory foundation conditions developed which rendered the arch dam originally designed for the project unsuitable for the site.

In view of the difficulty encountered on the project, the management retained Charles T. Main, Inc., to review the entire project and to make modifications in the design of the dam and other works which would overcome the difficulties encountered. Charles T. Main recommended that the arch type dam be abandoned in favor of a gravity type dam and that the planned eventual production from this station be reduced from 90,000 kw to 72,000 kw.

In the revised project, the dam will be a gravity type concrete structure having a maximum height of 180 feet and a length of at least 625 feet. The spillway will run approximately 485 feet, which is considered adequate to handle the maximum flood discharge in the river. The reservoir created by the dam will have a useable capacity of 2.3 million cubic meters which amounts to little more than weekly regulations for the station.

Water will be carried from the reservoir through a concrete lined gravity tunnel approximately 20 feet in diameter and 4,400 feet long equipped

with a differential surge tank at the lower end. The penstock consists of steel pipe with fittings at the base for connection to the turbines.

Generating equipment will consist of two 17,100 h.p. Francis type turbines, each directly connected to a 12,000 kw generator. The effective average head on the turbines is 240 feet. Auxiliary electrical equipment is conventional. The powerhouse will be of the outdoor type with the substation located on an auxiliary platform in the rear of the powerhouse. Transformer equipment will step up from the generator voltage of 6,600 to the transmission voltage of 115,000.

The transmission line will consist of a double circuit system from the power station to Cali. It will be of aluminum cable with a steel core, strung on steel towers. Total length of the line is about 30 miles. A substation will be provided in Cali having characteristics necessary to feed the power into the existing distribution system.

IV - Water Availability

Stream flow records for the Anchicaya River date from 1942 and are not continuous. The watershed above the dam has not been surveyed and rainfall data in the valley are available only since 1945. However, by correlation with data available on the nearby Cauca River which date back to 1934, it has been estimated that the minimum daily flow of the Anchicaya River at the site of the dam will not be less than 20 cubic meters per second. This assumption seems to be reasonable.

On the basis of a minimum flow of 20 cubic meters per second, continuous power (i.e. 100% load factor) is estimated at 15,600 kw taking into account the storage which will be provided in the reservoir. Charles T. Main estimates that continuous power equivalent to 24,000 kw will be available 95% of the time. With storage of 2.3 million cubic meters and on the basis of a 52% weekly load factor, they estimate a firm capacity of 30,000 kw for the project.

This is a very conservative basis of calculating firm power, since it may be expected that the system load factor will decline to about 40 percent as more power becomes available. Under these conditions, firm power will be about 40,000 kw if the periods of minimum flow are less than about one week. This is obviously more than adequate to meet the requirements of the initial installation.

V - Estimated Cost of the Project

A clear presentation of the estimated cost of the project cannot be given at the present time, as construction contracts for completing the project have not yet been awarded. It appears likely that the contract will be given either to Christiani & Nielsen, Ltda., or to Morrison-Knudsen, Inc., as the bids submitted by these companies are the two lowest of all the bids submitted and, in addition, agree closely in respect of total cost. It should be noted, however, that the two proposals differ considerably in the relative quantities and values of construction machinery required, in the cost of foreign personnel, and in the unit prices used for major construction

materials such as cement and steel. For purposes of this report, the Christiani & Nielsen proposal was used as it is the lower of the two bids.

The estimated cost of the project given below represents a synthesis of figures presented as of May 31, 1950:

(a) by CHIDRAL on expenditures to date and on commitments for equipment to be imported;

(b) by Charles T. Main on the cost of certain equipment items and construction materials not yet ordered, and

(c) by Christiani & Nielsen on costs of completing the project not included under (a) or (b).

The estimates of the costs remaining to be met have been adjusted to include equipment for and installation of two units only, this representing the project to be financed by the Bank.

The total cost of the project as such, which in the report of January 31, 1950, was estimated at 23.8 million pesos, is currently estimated at 26.1 million pesos, broken down as follows (figures rounded):

	Total Cost	Local Currency Cost	Foreign Currency Cost
	(In thousands of pesos; thousands of U.S. dollars equivalents in parentheses)		
Expended and committed to 5/31/50	10,190 (5,198)	6,950 (3,545)	3,240 (1,653)
Required to complete	15,340 (7,828)	9,710 (4,956)	5,630 (2,872)
Interest during construction	530 (270)	- (-)	530 (270)
Total	26,060 (13,296)	16,660 (8,501)	9,400 (4,795)

(Note: These figures do not include working capital estimated at about 400,000 pesos.)

The increase over the earlier estimate reflects the increase in the estimated cost of completing the project, the earlier figure being based upon a preliminary estimate submitted by Christiani & Nielsen, while the current figure is based on the most recent estimate available.

The difference in the relative shares of local currency and foreign exchange costs results from (a) the substitution of revised bids for the completion of the project, (b) a revision by CHIDRAL in the estimated amounts spent to date, and (c) a change in the basis upon which the estimate of the foreign exchange costs required to complete the project was computed. More specifically, the current estimate of foreign exchange costs required to complete the project excludes contractors' fees and miscellaneous overhead items, here included in the local currency costs, since it is not known in what proportion these will be divided between foreign and local currencies. Also excluded from the current estimates of foreign exchange costs required to complete the project are certain progress payments on imported machinery and equipment, which have been made periodically during the period in which the loan has been under consideration.

Additional detail on the cost of the project is presented in Table 2.

VI - Schedule of Construction

Approximately 20% of the construction has been finished. The construction program furnished by Christiani & Nielsen provides for the starting of work approximately three months after signing of the construction contract. The estimated completion times for the different items are as follows:

Item	Number of months estimated to complete: After resumption of work on Anchicaya	Number of months estimated to complete: Item
A. Preparatory work (camps, shops and concrete plant)	12	12
B. Diversion of river, new diversion tunnel	8	6
C. Existing diversion tunnel	9	6
D. Dam	29	28
E. Pressure tunnel	25	25
F. Surge tank	18	14
G. Powerhouse	30	29
H. Transmission line	24	18
I. Cali substation	19	11

NOTE: This table does not include the plugging of the new diversion tunnel and the installation of the valve in the old tunnel. These are minor operations and are scheduled for convenience near the end of the project.

Christiani & Nielsen estimate that it will be possible to deliver power to Cali within 28 months after resumption of work.

VII - Schedule of Expenditures

Expenditures to date represent about 38% of the estimated cost of the project. The scheduling of future expenditures cannot be completely given at the present time. However, the Christiani & Nielsen bid includes a schedule of construction expenditures excluding the purchase of construction machinery and fees. This schedule, which covers about 61% of the estimated cost required to complete the project, is reproduced below on a percentage basis:

End of Specified Quarter	Percent Spent: In Quarter	Percent Spent: Cumulant
1st	5	5
2nd	10	15
3rd	12	27
4th (1st year)	10	37
5th	14	51
6th	13	64
7th	14	78
8th (2nd year)	10	88
9th	7	95
10th (project completed)	5	100

Because contracts requiring the expenditure of the bulk of the foreign exchange still needed for the project have not been placed, it is not possible to present a schedule of expenditures of foreign currencies. However, for the purposes of estimating interest during construction, it was assumed that the construction equipment and materials would all be imported during the first quarter after the effective date of the loan, and that the remaining expenditures would be made at a constant rate.

Since the equivalent of about $2 million has not yet been committed, it is quite possible that orders for some items may be placed in member countries other than the U.S. Should such orders be placed, it may be possible to use a part of the 18 percent subscriptions of these countries.

VIII - Methods of Financing

The original plan for financing this project contemplated that it could be done entirely through stock subscriptions of 11.2 million pesos ($5.7 million). When it was found, however, that the cost of the project would exceed substantially the originally estimated amount, a request for a loan was presented to the IBRD in the amount of $5.4 million, a sum which included reimbursement for foreign exchange expenditures already made. The analysis of January 31, 1950, indicated that the total cost of the project would be the equivalent of $12.2 million. As the equivalent of about $4.9 million had been spent, additional expenditure of about $7.3 million could be expected to be made, of which about $3.5 million represented the foreign exchange component. Therefore, in the previous report a loan of up to $3.53 million was recommended, sufficient to meet all foreign exchange requirements, including interest during construction and working capital sufficient for six months' debt service on the proposed loan.

At that time the estimated total cost of the project had not yet been accurately determined. The Engineering Staff therefore based its calculations, resulting in the above-mentioned total, upon information available in January 1950, which consisted of estimates of construction costs made in the summer of 1949. The above calculation indicated that 6 million pesos of additional capital would have to be subscribed and paid in, bringing the total share capital up to 17.2 million pesos. However, it was understood that the National Government, the Municipality of Cali, and the Department of Valle del Cauca were going to supply whatever equity capital would be required to complete the project over and above the amount of the proposed loan.

At a fairly early phase of the discussions, the Bank had advised CHIDRAL that it considered it important that CHIDRAL be in a position to control the operation of the existing diesel generating facilities of Cali for the reason that these facilities would be utilized for peaking and standby purposes and must therefore be within the control of the management of the hydroelectric project.

Subsequent to January 1950, the management of CHIDRAL decided to negotiate for the purchase of both the hydro and diesel generating facilities owned by the Empresas Municipales of Cali. A contract therefore has been concluded under which the Municipality of Cali will sell to CHIDRAL the above-mentioned power plants for the sum of 4,076,000 pesos. This arrangement contemplated that the purchase by CHIDRAL will be, in a sense, in the form of a wash transaction to the extent that the Municipality was called upon to provide its share of the original capital for which it has given promissory notes in part. During the period of construction of the Anchicaya project, CHIDRAL will lease back to Cali the existing generating facilities at an annual rental of 4.5% of the net value, plus charges for depreciation. Based upon the contract of purchase of the generating facilities of Cali, the management of CHIDRAL had decided to increase its capital by 4 million pesos in addition to the 6 million pesos shown to be required in our January estimates, bringing the total up to 21.2 million pesos, still maintaining the original

subscription percentages of 51% for the National Government, 23% for the Department of Valle del Cauca, and 26% for the Municipality of Cali.

There is a difference of 398,000 pesos between the purchase price of Cali's generating facilities and its unpaid share in the capital of CHIDRAL (3,678,000 pesos). This amount will be amortized by applying the above-mentioned depreciation charges against it.

Although the competing contractors, of which Christiani & Nielsen, Ltda. and Morrison-Knudsen, Inc., were the two lowest bidders, had filed their bids with CHIDRAL in the late summer of 1949, the Bank did not receive copies of them until March 1950. In the fall of 1949, the Bank was informed by a representative of Christiani & Nielsen, the lowest bidder, that the bid as filed was consistent with the estimate, on the basis of which the Bank's calculations of January 1950 were subsequently made. Furthermore, the bids as filed by both the competing contractors mentioned were on the basis of three 12,000 kw units rather than two, as contemplated for the Bank-financed project. On the basis of information which came in the Bank's hand, no new analysis of the bids was made until July 1950 for the purpose of preparing this report. When the bids were analyzed and reduced to the scale of two units, it was discovered that the completion of the project based upon the bid of Christiani & Nielsen, Ltda. exceeded earlier estimates of the Bank by 2,245,000 pesos, making a total of 26,060,000 pesos.

A comparison between the situation in January and the present is shown in the following summary table:

	(In thousands of pesos) January 31 estimate	September estimate
1. Overall cost of project	23,815	26,060
2. Additional working capital required	400	400
3. Acquisition costs of Cali plants	-	4,076
4. Total cost to be covered	24,215	30,536
Proposed sources of funds:		
1. Amount of IBRD loan ($3,530,000 at 1.96)	6,919	6,919
2. Capital paid in or committed for	11,200	21,200
3. Credit from Cali 1/	-	398
	18,119	28,517
Indicated shortage of resources	6,096	2,019
Less estimate cash revenues during construction from lease of Cali plants to Municipality per Table 4		485
Net deficiency	6,096	1,534

1/ I.e. the difference between acquisition cost of the Cali plants and the amount owed by Cali.

In the light of the comparative figures given in the above table, it is evident that CHIDRAL will have to increase its capital by 1,534,000 pesos or, say, 1,600,000 pesos, in order to cover the estimated costs based upon the proposed contract of construction.

The Bank is aware that the proposed contract contains escalation clauses calling for increases in the contract price in the event that cost of labor or material rises from the levels originally assumed by the bidders. There is no doubt that these costs have risen appreciably since the late summer of 1949 and may rise further during the construction period. It is, however, not recommended that on account of these factors additional subscription to the capital of CHIDRAL should be required precedent to signature of the loan agreement or to the effective date of the loan.

IX - The Market for Power

The Municipality of Cali is estimated to have a population of 165,000 inhabitants. The city is located in the rich agricultural Cauca Valley not far from the southern boundary of the Department of Valle del Cauca, and is the center of an air, rail and highway network connecting other population centers such as Popayan in the south, Manizales and Medellin in the north, and Buenaventura, which is the major port of Colombia.

Except for Cali and Buenaventura, which is some 80 air kilometers from Cali, the population is predominantly rural. The growing of coffee, corn, rice, plantains and sugar cane, and cattle raising are the major agricultural activities. Industry, as in other sections of the country, is relatively unimportant, although growing actively. Large-scale plants are few and, in this area, limited mainly to textiles and sugar refining, although in recent years both cement and container manufacturing have assumed some importance. Electric power is, in this area as elsewhere in Colombia, in short supply and prospects for selling the power to be produced by the new station appear good, as considerable industrial expansion is being planned.

At present Cali and the immediately surrounding areas are being served by five municipally owned generating plants and in addition, peak power is purchased from the Compania Colombiana de Electricidad at Palmira.

The generating capacity of the municipally owned plants consists of one hydro plant of 400 kw, one diesel and two hydro plants of 1,000 kw each and one diesel plant of 5,040 kw. These plants were formerly owned by the Compania Colombiana de Electricidad, a subsidiary of American and Foreign Power. Its properties within the legal limits of the Municipality of Cali were expropriated several years ago and the price to be paid for them was the subject of protracted negotiations, but the matter has finally been settled on mutually acceptable terms.

The Empresas Municipales of Cali have recently purchased a new diesel electric unit with a capacity of 1,680 kw which was scheduled to go into operation on October 1, 1950, thereby increasing the total capacity of the hydro and diesel plants to about 10,100 kw. Peak load requirements can be obtained to the extent of about 4,500 kw from the "Nima" hydro station of the Compania Colombiana de Electricidad.

A contract has been drawn up and approved between CHIDRAL and Cali under which the former will be the sole supplier of electric energy to Cali, and Cali will be the sole distributor of energy generated by CHIDRAL. These provisions will go into effect as soon as CHIDRAL is capable of supplying 24,000 kw to Cali. The latter will also be bound by the terms of its contract to expand its distribution system so that it will be capable of absorbing 100 million kwh per year. This expansion is to be programmed so that both the Anchicaya plant and the distribution system shall be completed at the same time. It appears, therefore, that there will be adequate distribution facilities for the electric energy to be generated by CHIDRAL.

The probable development of the market for power is presented in Table 1. It is based on records for 1948 and 1949 of energy generated by Empresas Municipales of Cali, plus purchases of power from Palmira, since generation by CHIDRAL will replace both sources. An annual rate of increase of 6% in kwh generated was assumed for the period 1951-1963. While possibly a higher rate might be experienced in earlier years, it is probable that distribution losses will be substantially reduced from their present level of about 20%. This will result from the fact that additional capacity will be provided for existing grids, while new distribution lines will at first be lightly loaded. The percentage increase in kwh generated will therefore be lower than the increase in kwh sold. For this reason, it seemed advisable to adopt the more moderate rate of increase in kwh generated of 6% throughout the entire period.

The load factor in 1948 was approximately 47 percent. It is probable that as the availabilities of energy increase, the load factor will gradually decline to about 40 percent. On this basis, the two units to be installed at Anchicaya will be fully loaded by the end of 1955, at which time it will be necessary to draw upon the generating facilities purchased from Cali. These should be adequate to meet the growing demand until 1960 or 1961, when it will be necessary to install a third unit.

It should be noted that the current estimate of CHIDRAL's market for power, as presented in Table 1, is considerably higher than the estimate presented in the report of January 31, 1950. Thus, the current estimate of kwh to be generated by Anchicaya in 1954 is 51% higher than the estimate of January 31, 1950, for the same year. At the time of writing of the earlier report, the information available to the Bank indicated that kwh sold to consumers in Cali amounted to about 35 million kwh in 1948. The projections for future years were based upon this figure, adjusted for distribution losses. Information received recently indicates that the earlier consumption figure represented only metered consumption, which should be increased by about 23% to take into account public street lighting and unmetered sales. Also, in the absence of any basis for determining distribution system losses, it had been assumed that these were 10 percent, in order to provide a conservative basis for forecasting the probable future market. It now appears that distribution losses amount to about 18% - 20% of kwh generated and purchased. Finally, an increase of 20 percent in consumption took place between 1948 and 1949. The current forecast for future years has taken into account

the three factors mentioned above, the combined effect of which is to increase the estimated market for power in Cali by approximately one-half. The estimated sales by CHIDRAL to Cali show an even greater increase over the earlier figures. For, while at the earlier date it appeared that Cali would continue to own and operate the existing plants, using the hydro plants for base load operation, and the diesel plants for peak loads in later years, under the present arrangement, with CHIDRAL owning the existing plants, all power generated by these plants will be sold by it.

X - Earnings and Cash Position

The Anchicaya station is a high cost installation, the investment amounting to about $560 per installed kw. If it were necessary to service the full amount of the investment, the cost of power even at full capacity would be about 1.4¢ U.S. per kwh, as compared with 0.5¢ U.S. in comparable plants in Europe and North America. However, about 73% of the cost of this plant is estimated to be met with share capital so that service is required on only about 27% of the investment.

Estimated revenues, expenses, earnings and the cash position of CHIDRAL from 1950 through 1960 are summarized in Tables 3 and 4. In the calculations on which the tables are based, revenues have been estimated on the basis of a wholesale rate equivalent to 2.6 centavos per kwh. This rate is based upon the following rate schedule agreed upon between CHIDRAL and the Municipality of Cali, and approved by the shareholders of CHIDRAL:

2.6 centavos per kwh for the first 10 million kwh consumed during the month;

2.2 centavos per kwh for the next 2.5 million kwh consumed during the month;

1.5 centavos per kwh for the next 2.5 million kwh consumed during the month;

1.0 centavo for each additional kwh consumed during the month.

Since monthly sales by Anchicaya will average less than 10 million kwh until 1961, the effective rate will be 2.6 centavos throughout the period covered by Tables 3 and 4, except to the extent that seasonal variations may result in consumption in some months in excess of 10 million kwh. The loss in revenues resulting from this factor would in any case be of minor importance during the period 1953-1960, and for that reason no attempt was made to adjust the figures for this possibility.

The above rates, while expressed in local currency, will be subject to adjustment should the Colombian peso be devalued in relation to the dollar.

Operating expenses used in the calculations are those estimated by CHIDRAL for the Anchicaya plant, adjusted for the operation of two units, plus the cost of keeping the Cali stations in standby condition until 1955.

For later years the above figures have been increased by the costs of operation of the Cali diesel plants.

Debt service is on the basis of an assumed loan of $3.53 million. The term of the loan is assumed to be 20 years, including a 3-year moratorium on amortization. A commitment charge of three-fourths of one percent was assumed, with an interest rate, including commission, of 4%.

It appears that this project will show a net surplus after service of the proposed loan of about $186,000 in the first half-year of operation. The net surplus rate for the next year will be somewhat lower, but will rise at a moderate rate of about $60,000 a year throughout 1960. The rate of return on the total investment, including the existing plants, will rise from 2.7% per year in 1954 to about 5.5% by 1960. Sometime during 1960 or in early 1961, the system will be overloaded and it will be necessary to install additional generating capacity. Probably the most economical means of providing this additional capacity will be through the installation at Anchicaya of a third hydro unit similar to the first two. Since the civil works will have been completed, the new investment for a unit of this size will be moderate. If it is assumed that the cost per kw will amount to as much as $150 for the third unit, an investment of about $1,800,000 will be required. The accumulated surplus throughout these years will be more than sufficient to cover this new investment.

It should be noted that the estimates of the cost of the project and of the market for power must be accepted with some qualifications. The cost of completing the project may exceed the current estimates. The market for power may be lower than has been estimated here, since it is not certain that the figures for kwh generated and distributed in Cali are correct. Nevertheless, the earnings prospects on sales as low as 56 million kwh per year (i.e. 10% lower than the 1949 generation plus purchases by Cali), would be sufficient to meet all operating and financial charges, including service of the IBRD loan and depreciation on both the Rio Anchicaya and the Cali generating facilities. Should the cost of completing the project rise above the current estimates, it would become necessary for CHIDRAL to raise additional equity capital, but once the necessary amounts are obtained, earnings would be more than sufficient to assure service of the IBRD loan.

XI - Recommended Basis for a Loan

A loan on this project appears to be justified for the following reasons:

1. The estimated expansion of the market for power in the Cali area seems to assure an adequate initial demand on the Anchicaya station and indicates that capacity operation will be obtained by 1956.

2. Estimated earnings show that the project is self-liquidating in terms of local currency equivalent of the amounts required to service the proposed loan.

3. The project provides a basis for future expansion to a capacity of 72,000 kw at relatively low cost, provided that this amount is supplemented with steam and diesel units.

4. An investment equivalent to about $5.2 million has already been made in the project and the additional investment of about $8.1 million which is required for completion has satisfactory earning prospects.

5. The existence of a new supply of power with the possibility of easy expansion should accelerate industrial expansion, rural electrification and increased use of irrigation in the Cauca Valley.

It appears that the Bank can favorably consider a loan on this project up to $3.53 million to cover part of the foreign exchange cost of the project.

The distribution of foreign exchange requirements by subsections of the entire project cannot at the present time be properly specified because of the wide variations between the two lowest bidders in the composition of the total expenses. A tentative breakdown, based on the Christiani & Nielsen bid, is approximately as follows:

1.	Dam and headworks.....	$ 77,000
2.	Powerhouse and step-up substation.....	313,000
3.	Transmission line.....	377,000
4.	Cali substation.....	47,000
5.	Construction equipment and materials.....	1,365,000
6.	Interest during construction.....	270,000
7.	Freight, escalation, and contingencies....	535,000
8.	Unspecified, including fees, overhead, and miscellaneous items.....	546,000
	Total.....	$3,530,000

NOTE: The allocation between the powerhouse and the Cali substation is somewhat arbitrary, as CHIDRAL does not allocate payments on a Westinghouse order for electrical equipment for the two subprojects.

If a loan is granted on the project, it should be subject to the following conditions:

1. Before the effective date of the loan, additional share capital will be assured to cover the local currency required to complete the project and to provide adequate working capital for its operation. This is estimated at approximately 1.6 million pesos. The increase in capital shall be obtained in a manner that is in conformity with existing Colombian law and shall also be on a schedule that will permit maintenance of the construction schedule established for this project by the contractor chosen for the job.

2. Before the effective date of the loan, satisfactory contracts between CHIDRAL and the proper authorities in Cali shall be submitted to the Bank covering the terms and conditions under which the sale of power to Cali will take place.

3. A complete list of goods should not be submitted until international bids have been received on all principal items to be purchased with the proceeds of the loan. Any substantial reduction in the estimated foreign exchange costs of the project should bring about a reduction in the amount of the loan.

J. Grauman

This report has been prepared in cooperation with the Assistant Loan Officer.

TABLE 1. Forecast of Electric Energy Requirements and of K.W. Demand by Cali

	Energy requirements for Cali (millions of K.W.H.)	Load factor (percent) 4/	K.W. demand by Cali
1948	51.7 1/		
1949	62.2 1/		
1951	68.1 2/		
1953	76.5 3/	45	19,400
1954	81.1	43	21,500
1955	86.0	42	23,400
1956	91.2	41	25,400
1957	96.7	40	27,600
1958	102.5	40	29,300
1959	108.7	40	31,000
1960	115.2	40	32,900
1961	122.1	40	34,800

1/ Actual, according to information transmitted by CHIDRAL in "Informe, 1948" published by Empresas Municipales, Cali, and in letter No. 220/50-G, of July 26, 1950. Figures represent generation by Cali's own plants plus purchases of peak power from Palmira.

2/ Calculated on the assumption that a new diesel unit of about 1700 K.W., now being installed, would be operated at a 40% load factor, and that the generation of the remaining units, plus purchases from Palmira would be held at the 1949 level.

3/ It is assumed that the annual rate of increase in energy requirements will be approximately 6% per annum for the period 1953-1961.

4/ The load factor in 1948 was approximately 47 per cent. It is assumed here that as the supply of electric energy is improved, the load factor will decline in the manner shown in this column.

Table 2 - Estimated Cost of Construction and Equipment of the Anchicaya Hydroelectric Station, Including Transmission and Cali Substation
(All figures expressed in U.S. dollar equivalents)

	Estimated Cost Spent			Estimated Cost to be Spent			Total Estimated Cost		
	Total	Local Currency	U.S.$	Total	Local Currency	U.S. $	Total	Local Currency	U.S.$
I - Const.& Const.Mach. & Supplies -									
1. Land and rights	27,000	27,000	0	0	0	0	27,000	27,000	0
2. Roads and auxiliary works	719,200	-	-	78,200	-	-	797,400	-	-
3. Auxiliary plant	253,300	-	-	0	0	0	253,300	-	-
4. Dam,headworks,diversion tunnel	1,341,200	-	-	3,115,700	-	-	4,456,900	-	-
5. Power tunnel	806,100	-	-	727,800	-	-	1,533,900	-	-
6. Penstocks	100	-	-	173,300	-	-	173,400	-	-
7. Powerhouse and tailworks	703,900	-	-	1,152,700	-	-	1,856,600	-	-
8. Station mech. & elec.equipment incl. step-up substation	6,000	-	-	158,500	-	-	164,500	-	-
9. Transmission lines	99,300	-	-	230,300	-	-	329,600	-	-
10. Cali substation	1,300	-	-	144,400	-	-	145,700	-	-
11. Other 1/	50,000	0	50,000	147,100	0	147,100	197,100	0	197,100
12. Total I 2/	4,007,400	3,545,100	462,300	5,928,000	4,246,400	1,681,600	9,935,400	7,791,500	2,143,900
II - Mach. & Equip. excl.construction -									
13. Tunnel gates	31,100	0	31,100	0	0	0	31,100	0	31,100
14. Mechanism for tunnel gates	62,400	0	62,400	1,800	0	1,800	64,200	0	64,200
15. Penstocks	95,800	0	95,800	0	0	0	95,800	0	95,800
16. Turbines and governors	309,500	0	309,500	4,900	0	4,900	314,400	0	314,400
17. Generators,switchboard, transf.	486,300	0	486,300	125,700	0	125,700	612,000	0	612,000
18. Auxiliary hydraulic equipment	58,600	0	58,600	0	0	0	58,600	0	58,600
19. Cali substation	130,000	0	130,000	46,400	0	46,400	176,400	0	176,400
20. Towers for transmission line	0	0	0	126,100	0	126,100	126,100	0	126,100
21. Trans.lines & accessories	0	0	0	250,300	0	250,300	250,300	0	250,300
22. Cranes	0	0	0	33,900	0	33,900	33,900	0	33,900
23. Misc.Equipment for Dam	0	0	0	74,600	0	74,600	74,600	0	74,600
24. Misc.Powerhouse Equipment	0	0	0	149,900	0	149,900	149,900	0	149,900
25. Freight, Insurance, Misc. 3/	17,300	0	17,300	200,000	0	200,000	217,300	0	217,300
26. Overhead 4/	0	0	0	270,000	270,000	0	270,000	270,000	0
27. Escalation & contingencies (10%)	0	0	0	165,000	0	165,000	165,000	0	165,000

Table 2 (Cont.)

	Estimated Cost Spent			Estimated Cost to be Spent			Total Estimated Cost		
	Total	Local Currency	U.S.$	Total	Local Currency	U.S.$	Total	Local Currency	U.S.$
28. Fees not included in above	0	0	0	450,700	439,200	11,500	450,700	439,200	11,500
29. Total above	1,191,000	0	1,191,000	1,899,300	709,200	1,190,100	3,090,300	709,200	2,381,100
30. Total I and II	5,198,400	3,545,100	1,653,300	7,827,300	4,955,600	2,871,700	13,025,700	8,500,700	4,525,000
III - Interest during construction	0	0	0	270,000	0	270,000	270,000	0	270,000
Grand Total	5,198,400	3,545,100	1,653,300	8,097,300	4,955,600	3,141,700	13,295,700	8,500,700	4,795,000

Note: This table was obtained by adjusting the figures in IBRD document No. Loan 81, Table 3, in accordance with revisions supplied by CHIDRAL and Christiani and Nielsen. The figures in items 15, 16, 18, 19 and 21 represent a somewhat arbitrary allocation of two orders placed with S. Morgan Smith and Westinghouse. In the above table, the dash (-) indicates that the breakdown of expenditures into local and foreign currencies is not available.

1/ Includes design fees and costs of foreign personnel.

2/ The U.S. dollar component represents the sum of line 11 and of the delivered cost of construction machinery and supplies which have been allocated to items 2 - 10.

3/ For items 13 - 24 only.

4/ Represents the cost of the central office and of a construction supervisory and auditing staff.

TABLE 3. Forecast of Current Income of and Expenditures by CHIDRAL, 1953-1960

(All figures in thousands of U.S. dollars)

Year	Income from Energy sales 1/	Operating expenses including depreciation 2/	Income available for IBRD debt service	IBRD debt service 3/	Net Surplus Annual	Net Surplus Cumulative
1953 4/	507	214	293	107	186	186
1954	1,076	428	648	288	360	546
1955	1,141	428	713	288	425	971
1956	1,210	436	774	288	486	1,457
1957	1,283	469	814	288	526	1,983
1958	1,360	483	877	288	589	2,572
1959	1,442	498	944	288	656	3,228
1960	1,528	515	1,013	288	725	3,953

1/ Based on forecast of kwh requirements of Cali, to be sold at a price of 2.6 centavos (1.3265 cents U.S.) per kwh.

2/ Composed of the following items: Operating expenses of Anchicaya station = $123,000 per year; cost of keeping the generating facilities purchased from Cali in standby condition = $25,000 per year; depreciation = $213,000 for the Anchicaya plant and $67,000 for the Cali facilities; operating costs of Cali's diesel units = .75 cents U.S. per kwh.

3/ Calculated on the basis of a loan of $3.53 million, at 4% interest, and three year moratorium on amortization. For the purposes of this table, it is assumed that the effective date of the loan was October 1, 1950. Debt service is charged to the period in which it is accrued.

4/ Figures represent one-half year's operation.

Table 4 – Estimated Cash Position of Central Hidroelectrica del Rio Anchicaya Ltda. 1/

	To 12/31 1950	1951 I	1951 II	1952 I	1952 II	1953 I	1953 II	1954	1955	1956	1957	1958	1959	1960
A. Local currency in thousands of pesos–														
Balance from preceding period	–	7,379	6,127	4,247	1,918	– 144	-1,134	– 768	– 62	771	1,724	2,755	3,910	5,195
Payments on capital subscriptions	21,200	–	–	–	–	–	–	–	–	–	–	–	–	–
Loan from Cali 2/	398	–	–	–	–	–	–	–	–	–	–	–	–	–
Sales of power	–	–	–	–	–	–	995	2,109	2,236	2,372	2,515	2,666	2,826	2,995
Other: Rental Charges on Cali plants 3/	46	91	89	86	86	84	–	–	–	–	–	–	–	–
Depreciation " " " 2/	33	66	66	66	66	66	–	–	–	–	–	–	–	–
Total funds available	21,677	7,536	6,282	4,401	2,070	7	– 139	1,341	2,174	3,143	4,239	5,421	6,736	8,190
Constr. expenditures 4/ 5/	10,189	1,343	1,969	2,417	2,148	1,073	–	–	–	–	–	–	–	–
Purchase of Cali gen. plants	4,076	–	–	–	–	–	–	–	–	–	–	–	–	–
Amortiz. & int. on loan from Cali 2/	33	66	66	66	66	66	–	–	–	–	–	–	–	–
Operating expenses incl. depreciation & IBRD debt service	–	–	–	–	–	–	629	1,403	1,403	1,419	1,484	1,511	1,541	1,574
Balance at end of period	7,379	6,127	4,247	1,918	– 144	-1,134	– 768	– 62	771	1,724	2,755	3,910	5,195	6,616
B. Foreign Exchange in thous. of dollars–														
Bal. from preceding period	–	1,996	1,609	1,215	816	412								
IBRD loan	3,530	–	–	–	–	–								
Expenditures including interest during construction 5/	1,534	387	394	399	404	412								
Balance at end of period	1,996	1,609	1,215	816	412	–								

1/ It is assumed that the transfer of the Cali generating plants was effected and that rental and depreciation charges began as of October 1, 1950. This Table does not include working capital requirements, estimated at 400,000 pesos.

2/ The sum of 398,000 pesos represents the difference between the assessed value of the Cali generating plants and the amounts still owed by Cali to CHIDRAL on its share in the old subscription of 11.2 million pesos plus the new subscription of 10 million pesos. The sum will be amortized by applying the depreciation charges (3.2091% per year calculated quarterly) against principal and interest at 4.5% per year.

3/ Calculated quarterly at the rate of 4.5% per year on the depreciated value of the Cali generating plants.

4/ The timing of peso expenditures is based upon the expenditures schedule of Christiani & Nielsen.

5/ For the purposes of this table, it is assumed that the total amount of the Bank loan will be withdrawn; the total peso expenditures for construction represent the difference between the estimated cost required to complete the project and the amount of the loan.

TABLE 5. Balance Sheet of CHIDRAL as of May 31, 1950

(in thousand pesos, rounded)

ASSETS				LIABILITIES	
Cash		0.1		Subscribed capital	11,200.0
Banks		54.9		Various creditors	238.4
Shareholders notes				Current accounts	269.7
National Government	561.0			Interest, discounts & sundries	160.2
Municipality of Cali	1,078.0				
		1,639.0			
Investments		2.5			
Funds available			1,696.5		
Production of materials		8.8			
Equipment and supplies	1,128.7				
Less: Accumulated depreciation	273.0				
		855.7			
Permanent machinery		2,592.0			
Cost of construction to date		6,715.3			
			10,171.8		
			11,868.3		11,868.3
Contingent Assets (contra)			436.1	Contingent Liabilities (contra)	436.1