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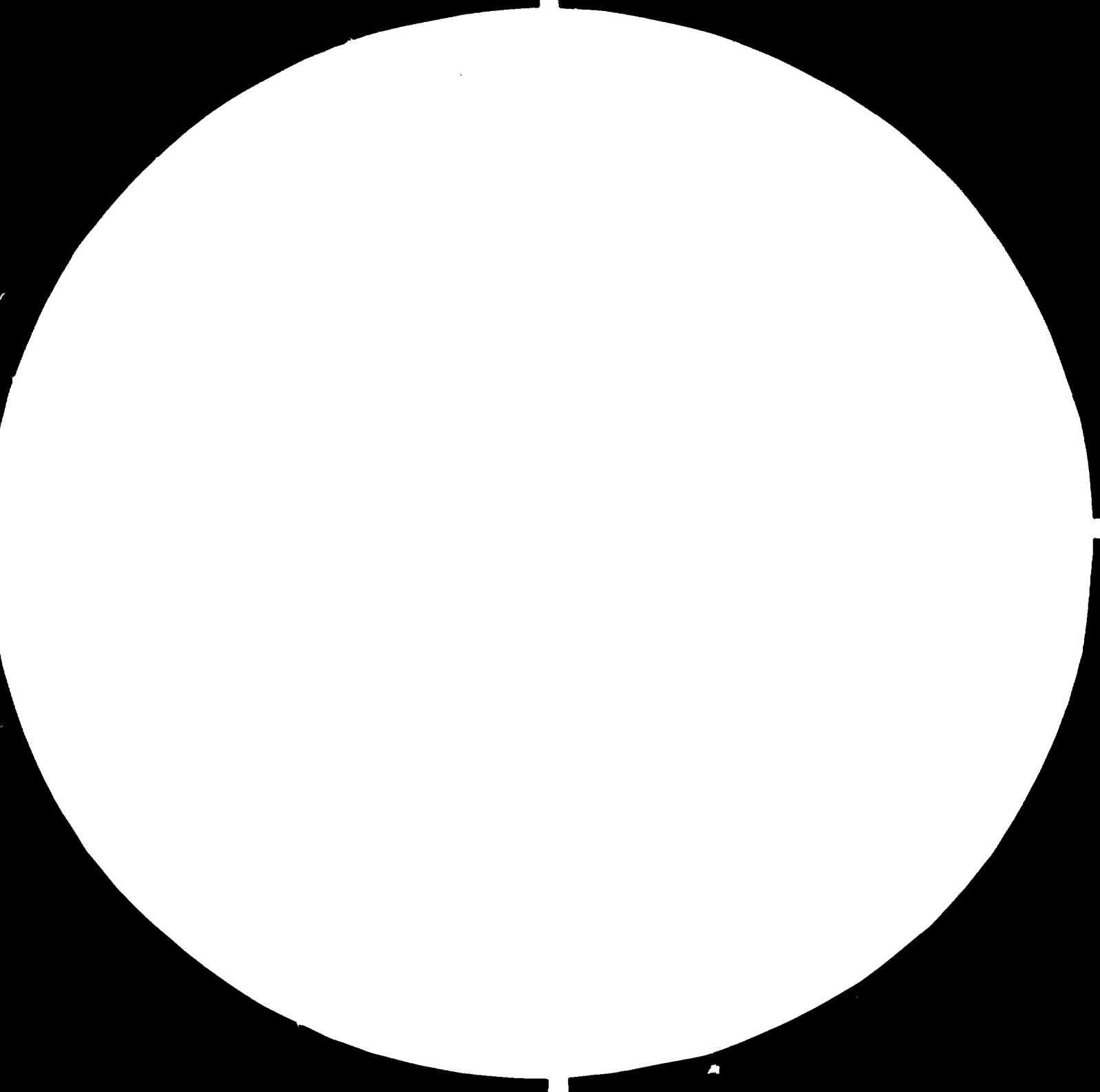

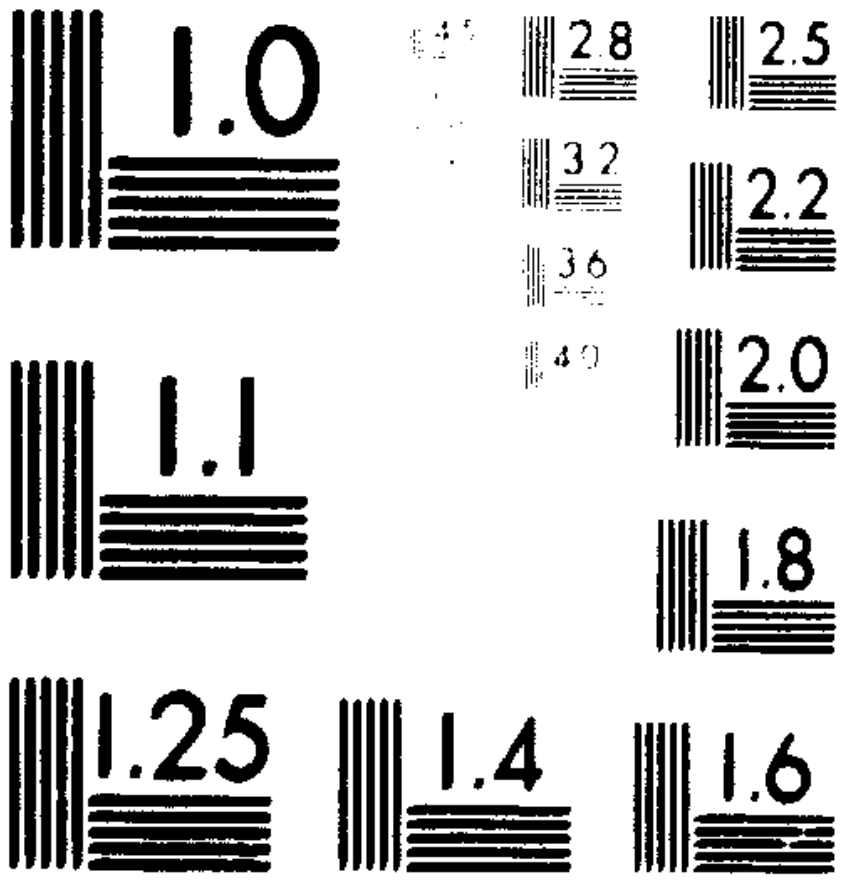

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DP/ID/SER.A/283
25 November 1980
English

ASSISTANCE TO THE CEMENT INDUSTRY

SI/BOL/80/802

BOLIVIA

Technical report: Assistance to CODETAR

Prepared for the Government of Bolivia
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Harald C. Boeck,
cement expert

United Nations Industrial Development Organization
Vienna

80-46134

Explanatory notes

The monetary unit in Bolivia is the Bolivian peso ($b). During the period covered by this report, the value of the peso in relation to the United States dollar was $US 1 = $b 24.51.

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands.

The following abbreviations have been used in this report:

ASTM	American Standard Test Measurement
Btu	British thermal unit
CODETAR	Corporación Regional de Desarrollo de Tarija
CORDEOR	Corporación Regional de Desarrollo de Oruro
EPCP	El Puente, cement project
GEOBOL	Servicio Geologico de Bolivia, La Paz
mtpy	metric tons per year
YPFB	Yecimientos Petroliferos Fiscules Bolivianos

Mention of firm names and commercial products does not imply endorsement by the United Nations Industrial Development Organization (UNIDO).

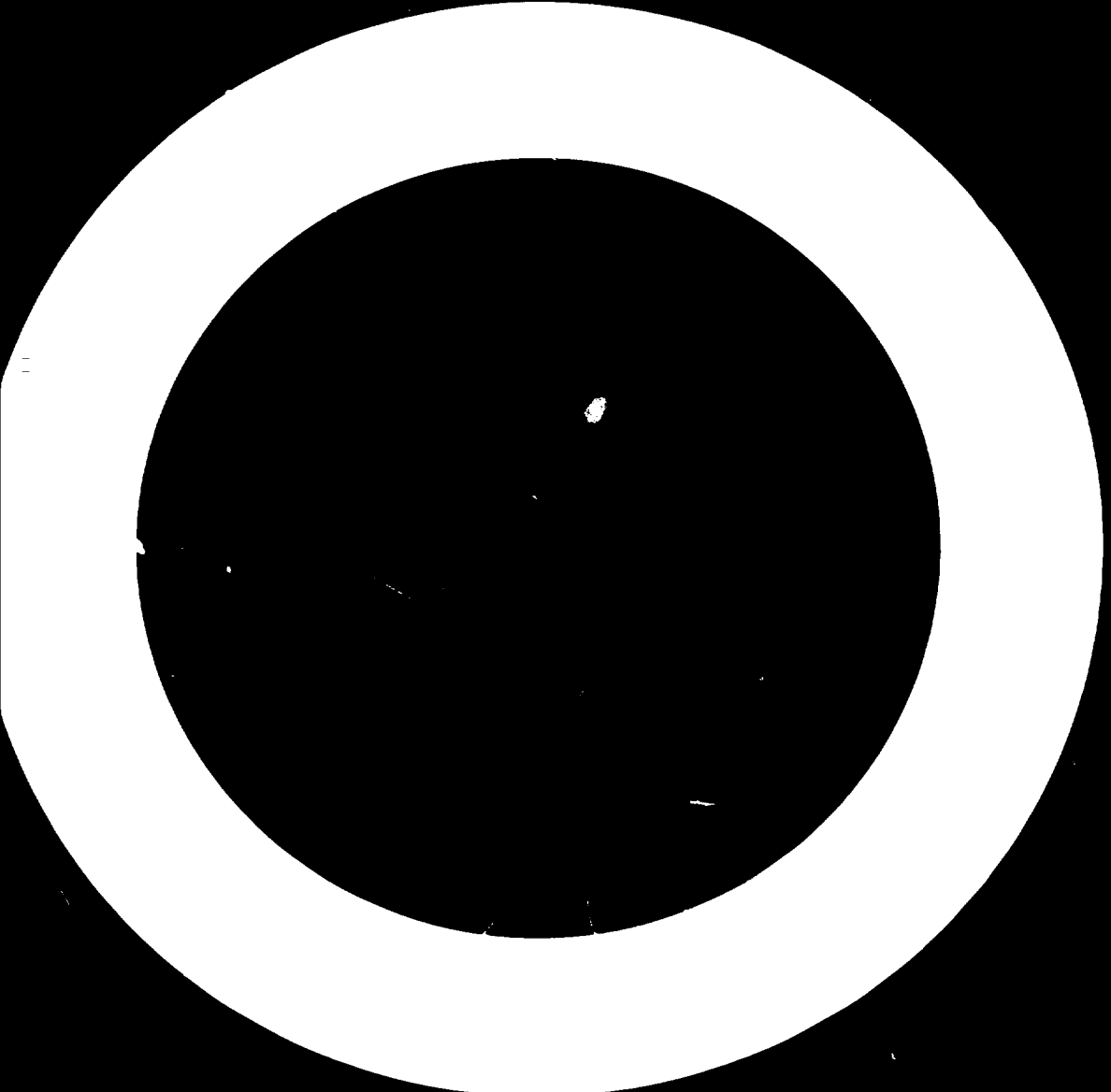
ABSTRACT

The project "Assistance to the cement industry" (IS/BOL/80/802) was approved by the United Nations Industrial Development Organization (UNIDO) on 10 April 1980 following a request by the Government of Bolivia for technical assistance in the establishment of cement factories at El Puente, Tarija and at Sevaruyo, Oruro. The project provided originally the services of three months each of a cement expert and a cement raw materials specialist.

The cement expert was fielded on 9 July and concluded his mission on 5 October 1980. He was requested to assist first the Corporación Regional de Desarrollo de Tarija (CODETAR) in the evaluation of different proposals and bids for the establishment of a 60,000 mtpy cement plant at El Puente and he indicated to his counterparts various problems and bottle-necks arising from the layout of the plant as offered. Since all offers were based on a feasibility study which was conducted in 1977 for a 230,000 mtpy plant, the expert pointed out that the raw material investigations made at that time cannot, for a number of reasons, be considered satisfactory for a plant even of a considerably smaller capacity. He therefore recommends to the Government to close further negotiations with all bidders, to carry out additional core drillings and other raw material investigations in order to confirm the availability of the necessary quantities of good-quality limestone and to re-invite prospective suppliers to submit new bids at a later date.

In addition, investigations in the following areas should be carried out in the meantime: feasibility of production of pozzolana cement; market situation; local manufacture of equipment; and possibilities of financing.

Since the work on the El Puente project took up all three months of the expert's assignment, an extension of his services has been requested which would enable him to assist also the Corporación Regional de Desarrollo de Oruro (CORDEOR).



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INTRODUCTION

Official arrangements

In February 1980 the United Nations Industrial Development Organization (UNIDO) received two requests by the Government of Bolivia for technical assistance in the establishment of cement factories, one at El Puente, Tarija, the second at Sevaruyo, Oruro.

The resulting project entitled "Assistance to the cement industry" (SI/BOL/80/802) was approved on 10 April 1980 and provided the services of three months each of a cement expert and a cement raw material specialist. The cement expert was fielded on 9 July 1980 and terminated his mission on 5 October 1980. As the cement project in Tarija was in a more advanced stage, the expert was requested to assist first the Corporación Regional de Desarrollo de Tarija (CODETAR). This work, which is the subject of the present report, took up all three months of his detail and consequently an extension of his services has been requested enabling him to assist also the Corporación Regional de Desarrollo de Oruro (CORDEOR).

Project background

Within less than one year the price of one bag of cement landed in Tarija, the capital of the State of Tarija, has risen by more than 100%, the actual price being about $b 180/bag which is equal to about $US 144/t. A skilled labourer earns about $US 200 per month.

In 1977 a feasibility study was conducted by a United States/Japanese consultancy consortium for a 230,000 mtpy cement plant using the raw materials of a limestone deposit located at El Puente, about 110 km north-west of Tarija town. The study was based on a rather complicated quarrying system in order to ensure the supply of an adequate quantity and quality of limestone for a plant of such a large capacity. In order to obtain a satisfactory raw mix, four different limestone qualities would have had to be mixed with clay and iron ore. As the cement consumption in the State of Tarija is only a fraction of 230,000 mtpy the project never materialized.

Owing to the increasing cost and the short supply of cement in Tarija, CODETAR has revitalized the El Puente cement project (EPCP) by selecting the best limestone for a cement plant with a capacity of only 60,000 mtpy, reusing the above-mentioned feasibility study without making further core drillings.

By the end of 1979 fourteen companies had been invited to bid for a complete 60,000 mtpy cement plant, including a power station. Only four companies responded and the prices quoted differed by as much as about 100%.

In May 1980 the CODETAR carried out a techno-economical evaluation of the four offers and one of the bidders, an American/French consortium was selected for further negotiation. When the cement expert arrived in Tarija on 11 July 1980, he was expected to assist CODETAR in the final negotiation before signing of the contract which was scheduled to take place on 30 July 1980. Because of the change of the Government in Bolivia on 17 July the signing of the contract has been postponed by two months to 30 September 1980.

RECOMMENDATIONS

1. All four bidders should be informed that further raw material investigations will have to be made and that none of them would, for the time being, be considered. When proved reserves of suitable raw materials are confirmed they should be invited again together with other prospective suppliers.

2. New raw material investigations should be carried out as soon as possible. Core drillings are indispensable and about 300 m in the limestone and 100 m in the clay would probably be needed at a cost of approximately $US 100 per core-metre. Such core drillings could easily be carried out by GEOBOL. An ideal quarry face would be about 15-20 m high and 200-300 m wide.

3. The services of a cement raw material expert are urgently needed as it is recommended to produce more than one type of cement and not only ASTM 1.

4. Investigation for the production of pozzolana cement should be carried out. In Tarija exists a pozzolana deposit and this could save the EPCP provided that a cement market of about 80,000 mtpy could be developed.

5. A comprehensive market study should be undertaken as strong competition is likely to occur in the future (Sucre and perhaps Sevaruyo in Bolivia; Jujuy and Salta in Argentina).

6. Once suitable raw materials and a market are confirmed, a tender document should be elaborated based on a split-up and do-it-yourself supply for the EPCP. Turnkey supply should be abandoned as it is the most expensive way for building a cement plant and also making poor use of local professionals and skilled workers.

7. The manufacture of equipment should preferably be undertaken in Argentina or Brazil where payment could be made by means of natural-gas supply from Bolivia. In this way the fixed cost could be brought down considerably e.g. by savings in transport costs.

8. UNIDO technical assistance would be needed on a rather big scale and thus funds should be searched for.

9. After having received detailed budget proposals, different development banks should be consulted and asked for loans. In addition, bilateral aid and suppliers' credit should be investigated. It should be mentioned here that, for instance, the World Bank is in search of a new approach for the supply of mini-cement plants to the developing world. EPCP could be an example of such a new approach.

10. The CODETAR should investigate the establishment of other industries in the El Puente area and keep the power station outside the cement plant as an independent unit.

11. Civil work and even engineering should not be imported.

12. The cement plant might be successfully split up in two units. A clinker-production unit at El Puente and a clinker-grinding unit near the market e.g. close to the new glass factory in Tarija.

In spite of a more time consuming procedure the implementation of these recommendations could create considerable savings in foreign currencies expenditures. In addition, other land-locked or islands countries having the same conditions like Bolivia, could profit from the experience gained in connection with this project, as today it would seem next to impossible to establish a plant of a size of 60,000 mtpy due to the relatively high capital cost involved.

FINDINGS

The raw material investigation made in 1977 by the consulting consortium Ingenieria Polytecnica Americana S.R.L., Ishikavajima-Harima, Ishibras aimed for a minimum plant capacity of 230,000 mtpy. The available survey cannot be considered satisfactory for a plant capacity of only 60,000 mtpy, the reason being that the limestone deposit at El Puente is quite difficult to exploit due to wide fluctuation in the chemical composition and the presence of undesirable magnesium oxide.

Within an area of 6 km^2 about 158 trenches, 10 pits and 15 core drillings have been done. The total length of core drilling is 273 m with 244 m in the limestone deposit in the area named "Chaupiuno" and 29 m in the clay deposit, which is located a few kilometres from the limestone deposit. Core recoveries have been rather poor, namely 55-99% in the limestone and only 65% in the clay.

No company will be able to guarantee the annual capacity of a plant or the quality of the cement produced based on such an indicative investigation only.

In May 1980, an evaluation committee consisting of 10 professionals from CODETAR has elaborated a 300-page evaluation document on the four offers for the EPCP. According to Bolivian law a statement was made to the effect that negotiations should take place with the successful bidder, Gatx-Fuller S.A. and CGEE Alsthom, France. The cement expert and the CODETAR cement-project team went through the offer in all details. Unfortunately, the offered plant layout is far from being satisfactory. A large number of bottle-necks have been discovered and it seems next to impossible to clear up all the discrepancies.

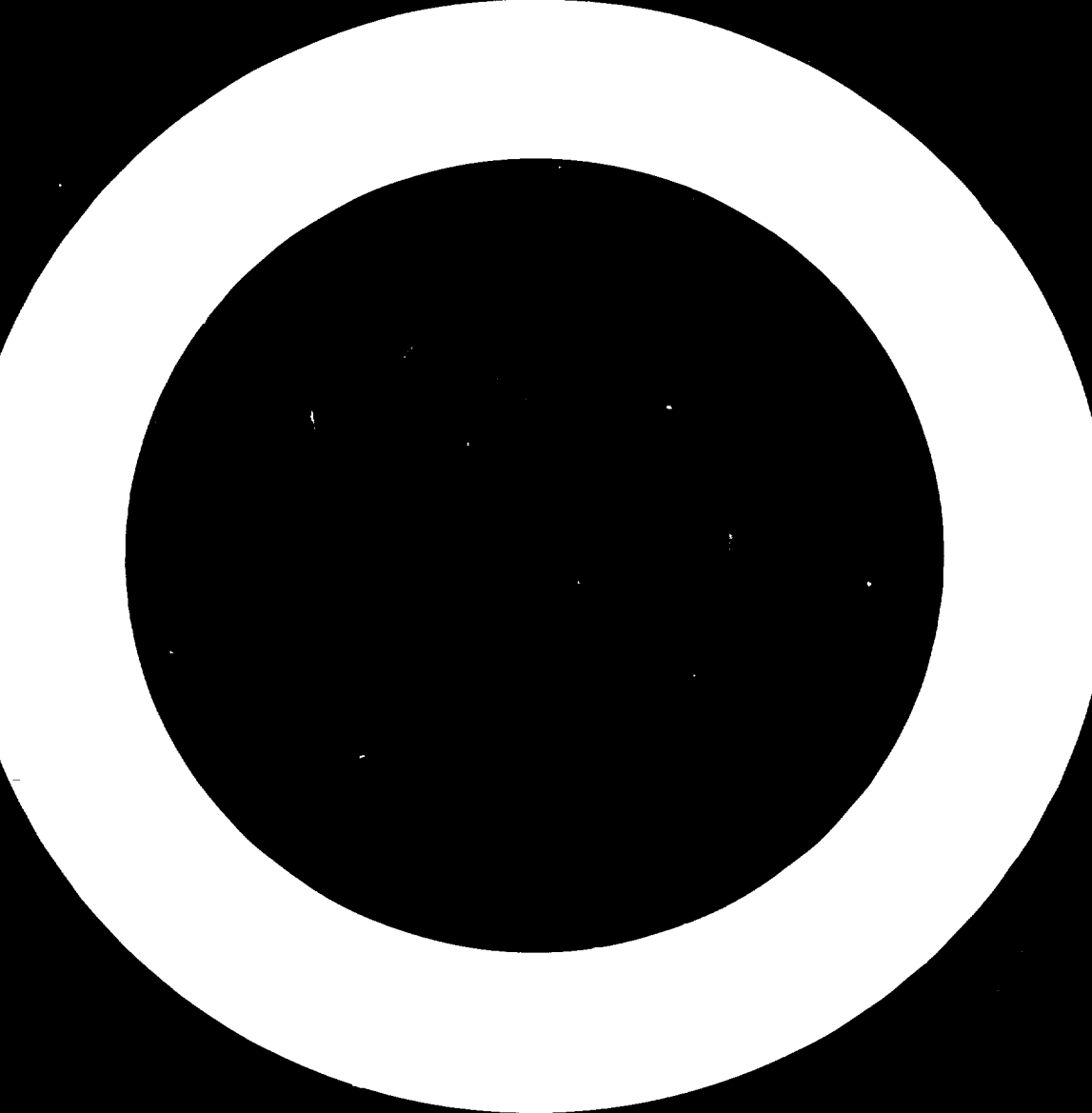
According to Bolivian law both, technical and economical, features are taken into consideration in the selection of the successful bidder. In this case the bidder has been successful mainly due to an attractive financial package subject to a guarantee by the Banco Central de Bolivia.

For the final negotiations with the successful bidder, CODETAR has requested an extension of the UNIDO assistance. However, it is not recommendable to enter into final negotiations with any company before

further raw material investigations have been made. Although the above-mentioned comprehensive evaluation document constitutes a very useful instrument for further studies and negotiations, it should not be used as an instrument in decision-making as none of the four bidders are in the position to guarantee e.g. the cement quality and/or the fuel consumption.

The total investment cost for the four offers is estimated by CODETAR to vary from approximately $US 21 to 37 million which most probably will result in a net production cost of $US 100 to 150 per ton of cement.

The energy costs in Bolivia are among the lowest in the world (see annex I).



Annex I

JOB DESCRIPTION

Post title:	Cement expert
Duration:	Three months (6 July to 5 October 1980)
Date required:	As soon as possible
Duty station:	Sevaruyo and El Puente with travel in the country
Purpose of project:	To assist in the preparations for the establishment of a cement industry
Duties:	The expert will be assigned to the Government of Bolivia and delegated to CORDEOR and CODETAR to advise and assist in the preparatory work required for the possible establishment of a cement industry in Sevaruyo and/or El Puente Specifically the expert is expected to: - Advise and assist in the selection of technology as well as plant harmonization to secure plans for the building of a simple and robust cement factory with minimum transport distances and costs as well as minimum energy requirements for processing - Assist in elaborating technical specifications for the necessary equipment from quarry exploitation to packing and distribution of finished cement in bulk and in bags - Assist in evaluating the project as a whole from both technical and economical viewpoints possibly with the establishment of a pre-feasibility study - Advise on training requirements - The expert will also be expected to prepare a final report setting out the findings of his mission and his recommendations to the authorities on further action which might be taken
Qualifications:	Industrial engineer with relevant experience from the cement industry
Language:	English, Spanish desirable
Background information:	During 1980 a study for the building of cement industry in Sevaruyo and El Puente is planned The study should include all aspects that require attention before a decision of the establishment of the cement industry can be taken. This includes: the raw material situation, plant layout, civil works, infrastructure, technical and financial feasibility study, equipment recommendations, transport study, market study etc.

The study will be executed by an international company in co-operation with a national group. The present assistance is requested because the individual nationals involved in the study require support to ensure that all technical aspects are covered in sufficient depth

Annex II

ENERGY COST IN BOLIVIA, SEPTEMBER 1980

Conversions

1 kcal = 4.1868 kJ = 3.968 Btu
10^6 kJ = 1 gJ = 238,845.90 kcal
10^6 Btu = 252,016.13 kcal
$US 1 = $b 25

1 lb = 0.4536 kg
1 cu.ft. = 0.02832
1 barrel = 159 litres

Prices[a/] and specific weights[b/]

	kg/litre	$b/litre	$b/kg
Industrial naphtha	0.82	1.85	2.26
Diesel fuel	0.84	1.30	1.55
Fuel oil	0.87	1.10	1.26
Liquid gas	0.548	0.82	1.50

Calorific values[a/]

Industrial naphtha	20,030 Btu/lb	11,128 kcal/kg
Diesel fuel	10,973 kcal/kg	10,973 kcal/kg
Fuel oil	18,300 Btu/lb	10,167 kcal/kg
Liquid gas	21,300 Btu/lb	11,834 kcal/kg

Prices at gas stations[c/]

	kg/litre	$b/litre	$b/kg
Gasoline, ROZ 60	0.72	2.50	3.47
Gasoline, ROZ 65	0.74	5.00	6.76
Diesel fuel	0.83	4.00	4.82

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a/ According to tender document dated August 1979.

b/ Estimated by the expert.

c/ At gas stations in Bolivia September 1980. Estimated average calorific value: 10,000 kcal/kg.

d/ General information from Yacimientos Petroliferos Fiscales Bolivianos (YPFB) in the newspaper "hoy".

OPEC price for bunker "C" fuel oil (For comparison only)

Bunker "C" fuel oil, calorific value 9,500 kcal/kg, 1 ton = 6.92 barrels, price about $US 35/barrel = 6.92 x 35 = $US 242.20/t.

Natural gas price[d/]

Natural gas, CH_4, export price beginning 1980: $US 2.50/1,000 cu.ft. (0.72 kg/Nm^3, 11,950 kcal/kg)[b/]

Summary of prices

	$US/$10^6$kcal	$US/$10^6$kJ	$US/$10^6$Btu
Industrial naphtha	8.12	1.94	2.05
Diesel fuel	5.65	1.35	1.42
Fuel oil	4.96	1.19	1.25
Liquid gas, 37% propane 60% propane 2% propane 1% etane	5.07	1.21	1.28
Bunker "C" (OPEC)	25.26	6.03	6.37
Gasoline, ROZ 60 [c/]	13.88	3.32	3.50
Gasoline, ROZ 65[c/]	27.04	6.46	6.82
Diesel fuel[c/]	19.28	4.60	4.86
Natural gas, CH_4, at 0°C, 760 Torr	10.26	2.45	2.59