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Appraisal of Bethioua Port Project Algeria

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Regional Projects Department
Europe, Middle East and North Africa Regional Office

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CURRENCY EQUIVALENTS[1/]

Currency Unit	= Algerian Dinar (DA)
US$0.2443	= DA 1.00
US$1.0	= DA 4.093
US$ 244,300	= DA 1 million

SYSTEM OF WEIGHTS AND MEASURES
Traffic Data - Metric

1 meter (m)	= 3.28 feet (ft)
1 kilometer	= 0.62 mile (mi)
1 metric ton (m ton)	= 2.2046 pounds (lb)
1 ton of crude oil	= 7.33 barrels (b)

Water Depth - Meters at Mean Low Water Spring Tides (MLWST)

ACRONYMS AND ABBREVIATIONS[2/]

AFESD	- Arab Fund for Economic and Social Development
BTU	- British Thermal Unit
CAMEL	- Compagnie Algerienne du Methane Liquide
CNAN	- Compagnie Nationale de Navigation
DI	- Directorat des Infrastructures
FPC	- Federal Power Commission (USA)
KfW	- Kreditanstalt für Wiederaufbau
LNG	- Liquefied Natural Gas
LPG	- Liquefied Petroleum Gas
MPWC	- Ministry of Public Works and Construction
ONP	- Office National des Ports
RPC	- Ralph M. Parsons Company (Consultants)
SONAMA	- Société Nationale de Manutention
SONATRACH	- Société Nationale de Transport et de Commercilisation des Hydrocarbures

DEMOCRATIC AND POPULAR GOVERNMENT OF ALGERIA
FISCAL YEAR

January 1 - December 31

1/ Adjusted as of February 1, 1974.

2/ Acronyms of organization names relate to French titles or organizations as used in Algeria.

APPRAISAL OF

BETHIOUA PORT PROJECT

ALGERIA

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Messrs. A.A. Fateen (Engineer), A.H. Clark (Financial Analyst), J.O. Fraisse (Young Professional), H. Harries (Economist, Consultant) and Mrs. P. Valad (Editor) prepared this Appraisal Report.

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SUMMARY AND CONCLUSIONS

i. Since the Democratic and Popular Republic of Algeria (Algeria) became independent in 1962, the Bank has been involved in two of its transport projects. The first, a US$33.1 million project for road improvement, construction, and maintenance, was partially financed by a US$18.5 million loan in June 1973 (912-AL). The second, a US$108 million project for procurement of rolling stock and rehabilitation of railway track, for which the Government has asked for a loan of US$49 million, is currently being prepared in the Bank.

ii. A third transport project is the subject of this Appraisal Report. In 1971, the Government asked the Bank to help finance a project to expand Arzew port so that sufficient facilities would be available mainly for natural gas exports. In late 1972, the Government and the Bank found that even expanded facilities at Arzew would not be sufficient to handle the large quantities of natural gas now being committed for export. The Government then decided that a new port should be constructed at Bethioua, about 6 km east of Arzew, to export liquefied natural gas (LNG) to the United States and Europe, and its by-products--condensates, liquid ammonia, and liquefied petroleum gas (LPG)--and crude oil to the United States, Europe, Africa, and Asia. The combination of the new port, extensive proven recoverable reserves of natural gas, and unique experience in liquefaction will enable Algeria to become an active participant in the growing LNG trade.

iii. The main elements of the project port are civil works and consultants' services. Civil works include: construction of breakwaters, berths, and a shallow draft basin; removal of two sea lines; and dredging of two channels and the harbor basin. Consultants services comprise: project design; preparation of tender documents; construction supervision; and studies of and training in port management, administration, operations and planning. Training is an essential part of the project and will be provided for personnel from the three agencies involved in port operations: Office National des Ports (ONP), Compagnie Nationale de Navigation, and Societe Nationale de Manutention. To ensure full use of the port, Societe Nationale de Transport, et de Commercialisation des Hydrocarbures, a national oil and gas enterprise, will finance, procure, and install the necessary LNG plants, sea lines, pipelines, and loading arms.

iv. The project cost is estimated at US$293.2 million, including contingency allowances, domestic taxes, and customs duties and excluding interest on external loans during construction. The foreign exchange component is US$182 million, or 62%. Costs of the civil works have been derived largely from completed detailed engineering and prices of similar works now

being completed at Skikda port; the cost of the consulting services have been based on fees for project preparation, expected supervision terms of reference and estimated man-months required for management consultancy services.

v. A US$70 million Bank loan to the Government is proposed for a 25-year term, including 4 years of grace. The Government has contracted from the Arab Fund for Economic and Social Development (AFESD) a loan of US$20 million equivalent, and has issued to the Kuwait Investment Company bonds in the aggregate amount of US$60 million equivalent. The Banque National d'Algerie intends to contract from the Kreditanstalt fur Wiederaufbau (KfW) a loan for US$32 million equivalent. The Government will provide all other funds needed for the project. Retroactive financing of US$4.5 million is needed to cover preparation of preliminary and detailed engineering and bidding procedures, and payments in foreign currency to the contractor before loan signature. It will be shared between the financing partners, the Bank's share being not more than US$1.7 million.

vi. Project implementation will be the responsibility of the Directorate for Infrastructure of the Ministry of Public Works and Construction, which is considered competent. Consultants will be employed for construction supervision in accordance with the "Uses of Consultants by the World Bank and its Borrowers"; they will be assisted by qualified counterparts. Consultants designed the civil works, and contracts were put to tender in December 1973, based on international competitive bidding in accordance with the Bank Group "Guidelines for Procurement". Prequalification resulted in acceptance of 45 firms from 13 countries, including 3 firms from Algeria. Tenders have been received on March 18, 1974, and are being analyzed. Most probably, a joint venture of foreign and Algerian firms will win the contract. Construction is expected to start in June 1974 and to be completed by October 1977. Some LNG berths are scheduled to be completed before then and will be put to use as ready. The project port will be operated by a management authority to be designated by the Government before June 30, 1976.

vii. In 1964 the Bank provided a US$20.5 million loan (378-AL) to help finance construction of the first LNG plant in the world at the port of Arzew. Since then, Algeria has developed an ambitious scheme for natural gas exports, which has considerable economic benefits and is important for further economic development. The project port is an integral part of that scheme. For Algeria, earnings from the scheme will contribute to savings and to development of other essential economic and social activities; new jobs in natural gas operations and in port operations will provide employment for several thousand people. For importing countries, natural gas acquired through the scheme will ensure supplies of needed energy.

viii. No separate economic rate of return has been calculated for the project port, since it is a part of the LNG export scheme. The discounted cash flow financial rate of return, for the 25 years' estimated economic life, varies between 7.5% and 9.7%, depending on the base year adopted and on the expected or most pessimistic assumptions. The Government has agreed that the total investment cost will be repaid to the Government by way of an annuity for 25 years at 7-1/4% interest, commencing 1978. Tariffs at the port will be set to meet these payments. Similar tariff levels will be set at other oil and gas export ports.

ix. Port operations at general cargo ports, which ONP shares with two other Government entities, require improvement and the project includes management consultant services to effect improvements and to provide necessary training. The project also includes consultant services for a master plan for port development.

x. On the basis of agreements reached during loan negotiations, the project provides a suitable basis for a Bank loan of US$70 million to the Government for a 25-year term, including four years of grace.

APPRAISAL OF

BETHIOUA PORT PROJECT

ALGERIA

I. INTRODUCTION

1.01 This report appraises a port project intended for export of liquefied natural gas (LNG) to the United States of America and Europe and its by-products--condensates, liquid ammonia, and liquefied petroleum gas (LPG)--and crude oil to the United States, Europe, Africa, and Asia. Over the last few years, natural gas liquefaction plants have been developed extensively throughout the world as a result of the rapid growth of world demand for energy and of the share of natural gas in the energy balance of industrialized countries. Annex 1 discusses world demand for natural gas up to 1980. With proven recoverable reserves of about 4,000 billion m^3 and unique experience in the liquefaction field, Algeria is in an ideal position to actively participate in LNG trade. Natural gas for commercial sale is produced currently from the Hassi R'Mel field (Map 10784), one of the world's largest natural gas fields with a proven recoverable reserve of about 3,000 billion m^3. The 1,000 billion m^3 balance of the country's reserves is distributed among eight other fields. Annex 2 gives information on Algeria's natural gas export projects and Annex 3 describes natural gas contracts already concluded and those being negotiated by Societe Nationale de Transport et de Commercialisation des Hydrocarbures (SONATRACH).

1.02 In October 1971 the Government of the Democratic and Popular Republic of Algeria (Algeria) asked the Bank to help finance expansion of Arzew port so that sufficient facilities would be available to export natural gas to the United States, as provided in a contract with El Paso Natural Gas (USA). In December 1971 a mission visited the country to identify the project, but late in 1972 the Government and the Bank found that even expanded facilities at Arzew would not be sufficient to handle the large quantities of natural gas exports now committed. Construction of a new port was necessary, and Bethioua, about 6 km east of Arzew (Map 10785), was chosen as the location. A mission preappraised this project in July 1973.

1.03 The estimated cost of the project is US$293.2 million, including a foreign exchange component of US$182 million. To help finance the foreign exchange costs, a Bank loan of US$70 million is proposed. The US$112 million balance will be financed by loans from the Arab Fund for Economic and Social Development (AFESD), the Kuwait Investment Company (KIC) and Kreditanstalt fur Wiederaufbau (KfW). The Government will be the borrower and it will provide the balance of the project cost.

1.04 Other Bank involvements in the transportation sector are a highway loan for US$18.5 million equivalent (Loan 912-AL approved June 19, 1973) and a request for a US$49.0 million railway loan, scheduled for board presentation in late FY74.

1.05 This report is based on: information from the Ministry of Finance, SONATRACH, the Directorate for Infrastructure (DI) of the Ministry of Public Works and Construction (MPWC) and the Office National des Ports (ONP); a 1970 feasibility study by the consulting firm Bechtel (USA) for the Algerian natural gas export project, updated in 1972; a 1970 feasibility study by the consulting firm Engelbrecht (Federal Republic of Germany) for identifying the most suitable location on the Algerian coast for a petroleum and natural gas port; a 1971-72 feasibility study by Engelbrecht for the proposed port project: 1972-73 preliminary and final engineering by the consulting firm Ralph M. Parsons Co. (RPC) (USA); results of 1973 hydraulic model studies by the consulting firm Tetra Tech (USA); 1973 soil investigations by the consulting firm Dames & Moore (USA); and findings of an October 1973 Bank appraisal mission composed of Messrs. A.A. Fateen (Engineer), A.H. Clark (Financial Analyst), J.O. Fraisse (Young Professional), and H. Harries (Economist, Consultant). Mrs. P. Valad (Editor) assisted in preparing the Appraisal Report.

II. BACKGROUND

A. Effects of Geography and Economic Growth on Transport

2.01 Algeria is divided into two distinct regions by the desert line. The northern region, with about 20% of the land area and 90% of the 14.6 million population, is economically more advanced than the southern region, with 80% of the land area and 10% of the population. The northern region comprises the narrow but fertile coastal strip as well as the semi-arid valleys and rugged mountains of the Atlas chain, while the southern region includes the vast desert that is part of the Saharan tableland. The transport system has been largely determined by the country's geography and is relatively well developed in the northern region, whereas few communication routes penetrate the desert and many areas are inaccessible. Discovery of large petroleum and natural gas deposits in the Sahara in the mid-1950's led to construction of several pipelines from the deposits to the Mediterranean Sea.

2.02 After Algeria became independent in 1962, traffic declined temporarily while investments in transport infrastructure continued, resulting in some excess infrastructure capacity. Since the mid-1960's, however, Algeria's economic growth has accelerated and has generated an equally rapid expansion in transport demand. Investments continued in certain new projects, mainly connected with petroleum and natural gas exploration and export. But expenditures for improving and maintaining existing ports and road and rail networks and for purchasing new equipment for cargo-handling and road and rail maintenance were relatively low. As a result, operations in the commercial ports have become unsatisfactory and sections of the road and rail networks have deteriorated and are now below standard for the traffic they carry. In addition, cargo-handling equipment, vehicles, and rolling stock are old. As a first step towards improving the situation, the Government is according high priority to maintaining and improving present infrastructure and purchasing new equipment.

B. The Transport System

2.03 The transport system consists of: 8 commercial ports and about 20 fishing ports; a small fleet of seagoing ships; about 3,700 km of petroleum pipeline and about 1,100 km of natural gas pipeline; 4,000 km of railways and about 79,000 km of national, regional, and local roads connecting major Algerian cities, and connecting Algeria with Tunisia and Morocco; and 3 international and 10 secondary airports and 2 national airlines. Ports are discussed further in Chapter III and details of other transport modes are given below.

Pipelines

2.04 Algeria has an extensive network of pipelines (Map 10784) for transporting petroleum and natural gas from the Sahara to several Mediterranean ports. Petroleum production increased substantially after 1956 following discoveries of major fields in the Sahara. Crude oil exports reached 48 million m tons in 1972, of which about 40 million m tons were via Algerian ports and the balance via Tunisia, and were forecast before the recent increase in petroleum prices to increase to 60 million m tons by 1980. No new forecast are available since then. However, even if the quantity forecast is not realized, total revenue from exports is expected to be substantially higher than originally envisaged. Natural gas exports already contracted by SONATRACH are about 40 billion m^3 annually and are expected to rise to about 70-80 billion m^3 in the near future. A natural gas pipeline from the Hassi R'Mel field to the site of Bethioua port was constructed in 1973.

Railways

2.05 Societe Nationale des Chemins de Fer Algeriens, an autonomous company in which the Government is sole stockholder, operates the railways. The network consists of about 4,000 km of track, including 2,700 km of standard gauge and 1,300 km of narrow gauge. It comprises an east-west axis linking Algeria with Rabat (Morocco) and Tunis (Tunisia), with branches to the coast, and three lines into the interior, including an electrified ore line of 320 km. Passenger and freight traffic has been increasing since the mid-1960's, and is expected to continue expanding with further development of the economy. It is mainly concentrated in the northern region. Most freight traffic is ore and phosphates.

2.06 Several track sections are in poor condition and require rehabilitation. Locomotive power and other rolling stock are partly obsolete and insufficient in capacity. The Government is aware that additional rolling stock and increased track rehabilitation are urgently needed to avoid decreased efficiency, and it has supported a US$108 million project prepared by the railways for this purpose. In 1971, the Government asked the Bank for a US$49 million loan to help finance the project. The project was appraised in September 1973 and is scheduled for board presentation in late FY74.

Roads

2.07 Northern Algeria has a well developed network of six major highways. Only a few lower class routes penetrate the vast arid Sahara Desert in the south. The classified network consists of about 79,000 km of national, regional and local roads, 45% of which is paved. In addition, an unclassified network of tracks penetrates the Sahara. Traffic is largely concentrated in the coastal area, with most national roads carrying average daily traffic of more than 1,000 vehicles.

2.08 Development of the road network has not kept pace with the rapid economic growth since the mid-1960's and roads have also deteriorated because of poor maintenance and delay of essential improvement works. The Bank-financed project (para. 1.04) will help to overcome the deficiencies.

Aviation

2.09 The country has 3 international airports (Algiers, Annaba, and Oran), 10 secondary airports with paved runways, some smaller local public airports, and numerous private airports built mostly by oil companies. Two airlines, Air Algeria and Societe de Travail Aerien, offer international and domestic flights. Although air transport has been increasing most rapidly and plays a vital role, especially in serving the more isolated centers, its total share in the transport market is still modest. In recent years, expenditures have been essentially for maintenance works and strengthening of runways at major airports.

C. Transport Policy and Planning

Policy

2.10 Since Independence in 1962, the Government has aimed to develop the economy along socialist lines, under strong central control and with most of the transport sector in the hands of public enterprises. The main instruments of development policy have been Four-Year Development Plans as well as ordinary and investment budgets.

Planning

2.11 The Ministry of Planning is responsible for preparing the Development Plans. In the 1970-1973 Plan, low priority was accorded to development of transport infrastructure. But in the 1974-1977 Plan, the Government intends to increase considerably transport sector investments so that arrears in renewal works for roads and railways can be eliminated. Expansion of port facilities and rehabilitation of roads and railway track will play a greater role in that Plan than in previous ones.

2.12 Investment planning suffers from several weaknesses, including inadequate data collection and project preparation as well as unsatisfactory coordination and exchange of information between government agencies and

transport modes. Government's attempts to improve the quality of its planning have been hampered by a severe shortage of qualified staff. Until more are available, Algeria will need assistance from foreign consultants. A joint Bank/Fund mission has recently returned from Algeria after discussing with officials at various levels the provision of advice and assistance in financial planning.

III. THE PORTS

A. Facilities

3.01 Algeria has eight main commercial ports (Algiers, Annaba, Arzew, Bejaia, Ghazaouet, Mostaganem, Oran, and Skikda), as shown on Map 10784. Annex 4 gives information about facilities in the most important ports. Algiers is the major port, with berthing facilities totalling about 10 km long and 8 to 12 m deep; it handles general cargo imports and exports. The cargoes which the other main ports handle are: Annaba--steel and iron ore exports; Arzew--ammonia, crude oil, and LNG exports; Oran--general cargo imports; and Skikda--ammonia, refined petroleum products, crude oil, LPG, and LNG exports.

B. Traffic

3.02 Annex 5 shows traffic through the eight commercial ports for 1968-72. General cargo handled declined from 12.2 million tons in 1968 to 10.8 million tons in 1972 and combined general cargo and minerals also declined from 14.9 million tons in 1968 to 12.5 million tons in 1972. Petroleum products handled increased, however, from 31.5 million tons to about 40 million tons during the same period. Algiers handles about 30% of all general cargo traffic and Arzew handles about 50% of all petroleum traffic. Because of lack of coordination and exchange of information between ONF, public enterprises, and government agencies, as well as a severe shortage of qualified ONP staff, realistic traffic forecasts are available only for petroleum and natural gas traffic. The Government is aware that properly prepared traffic forecasts are the basis for port development planning. During loan negotiations, the Government undertook to employ qualified consultants to assist in preparing a master plan for Algerian commercial ports based on adequate traffic forecasts (see para. 3.06).

C. Organization, Management and Operations

3.03 Responsibility for ports and port operations, under the Ministry of Transport, is shared between:

a) ONP - created by Ordinance in May, 1971; it is a financially autonomous legal entity, regulated as an industrial and commercial public enterprise, and responsible for administration, exploitation and development; and for port police, security and pilotage;

b) Compagnie Nationale de Navigation (CNAN) - a long-established company in which the Government is the sole shareholder, owns and operates all tugboats and controls berth allocations and cargo movement and disposition;

c) Societe Nationale de Manutention (SONAMA) - a Government entity created in 1971, owns and operates general and dry bulk cargo-handling equipment and undertakes all cargo-handling on ship and shore.

3.04 General cargo port operations are inefficient, with serious congestion in transit and storage areas. Ship turnaround time is unusually long, berth occupancy rates are high and ship delays frequent. Both the Government and ONP are aware of these shortcomings and would welcome technical assistance to improve the situation. The project includes technical assistance by management consultants for studies to review present port operations and to recommend improvements; training of personnel from ONP, CNAN, and SONOMA is also included. Annex 6 gives the main outlines of the assistance program. During loan negotiations, the Bank obtained an assurance from the Government that it will cause management consultants acceptable to the Bank to be appointed before June 30, 1975 to carry out the assistance program under terms of reference to be agreed with the Bank. SONATRACH is an efficient public enterprise which owns and operates, under concession, pipelines and loading equipment for petroleum and natural gas export. Similar arrangements will be made at Bethioua, but no technical assistance is needed for these operations.

Project Port

3.05 The port of Bethioua is a specialized port designed for the export of LNG and other hydrocarbon products; it will not be used for general cargo or other bulk cargo. Because of this and because of ONP's recent formation, stage of development and onerous responsibilities regarding general cargo ports, the Government has not yet decided whether to charge ONP with the responsibility for administration of the new port, and other ports of like nature. During loan negotiations the Government gave an assurance to the Bank that it will, no later than June 30, 1976, make a decision on this matter and charge ONP or some other agency as the Management Authority with the responsibility for the administration of the port of Bethioua and all other ports specializing in the export of hydrocarbon products. The port master plan study referred to in para. 3.06 will include a study and recommendation as regards the Management Authority's structure.

D. Planning

3.06 The DI prepares four-year development plans for port infrastructure and ONP prepares four-year capital expenditure budgets for replacement, renewal, and improvement of its own fixed assets. The methodology used by DI to prepare its plan does not seem to be based on data used by the Ministry of Planning to prepare the country's Four Year Plans, except for investments needed to meet petroleum and natural gas exports. In preparing its plan, DI has been concerned mainly with constructing major additions to existing facilities at Arzew, Annaba, and Skikda for handling petroleum, natural gas and ore exports. During loan negotiations, the Government undertook to employ, not later than December 31, 1974, qualified consultants upon terms and conditions satisfactory to the Bank, to assist the DI in the preparation of a master plan for Algerian commercial ports. Such plan will include, inter alia, site investigations, traffic forecasts, development programs, preliminary engineering, cost estimates, economic evaluations, financial analysis, and proposals for tariff setting and organizational structure including that of the Management Authority of Bethioua port. The Government also undertook to consult with the Bank on the results of the study and on the steps to be taken thereafter. The study will be financed by the proposed Bank loan.

IV. PORT DEVELOPMENT AND THE PROJECT

A. Port Development Plan

4.01 The Port Development Plan for 1974-77, prepared by DI, totals DA 1,550 million (US$378.7 million) compared with its 1970-73 Plan for DA 542 million (US$132.4 million). Annex 7 gives details of these Plans. The 1974-77 Plan allocates DA 1,200 million for the proposed port project. The financing plan for the 1974-77 DI Plan is as follows:

Source of Finance	DA Million
State Budget	806
External Financing (proposed project):	
IBRD	286
AFESD and KIC	327
KfW	131
Total	1,550

B. Project Objectives

4.02 The project will: (a) enable Algeria to meet its obligations for the next 25 years under natural gas export contracts already concluded and some of those now being negotiated; (b) allow export of crude oil and by-products associated with the natural gas export scheme; and (c) assist in improving port management, administration, operations, planning, accounting, and tariff setting.

C. Project Description (Map 10786)

4.03 The proposed project is the construction of a new port at Bethioua and consists of:

(a) Civil Works:

(i) construction of

- a main breakwater about 2 km long in water 25 m deep at Mean Low Water Spring Tides (MLWST); 1/
- two secondary breakwaters, each about 1 km long reaching 20 m deep water at MLWST;
- six berths for LNG export, three berths for condensate and crude oil exports, and one berth for LPG and ammonia exports; and
- a shallow draft basin for harbor craft;

(ii) removal of two of the three sea lines now existing at the port site; and

(iii) provision of supporting facilities (navigation aids, access road, potable water, sewage treatment, power and lighting, telecommunications, fire protection, deballasting system and Harbor Master building).

(iv) dredging of two leading channels to 25 m and of the harbor basin to 25 m in front of the condensate and crude oil berths and to 13 m in front of LNG and LPG berths.

1/ Water depths in this report are related to MLWST. Tidal range is 0.6-1.0 m.

(b) Consultants' Services:

(i) project design, preparation of tender documents, and construction supervision;

(ii) technical assistance for improving port management, administration, and operations, and training of personnel for ONP, CNAN, and SONAMA; and

(iii) technical assistance for preparing a master plan for Algerian commercial ports.

4.04 SONATRACH will finance, procure, and install for its own account the following elements needed to insure the full use of the project port; (see Annex 1 for Algerian Gas Export Project):

(a) LNG plants;

(b) sea lines to condensate and crude oil berths; and

(c) pipelines and loading arms for exporting LNG, LPG, condensates, crude oil and ammonia.

During loan negotiations, the Bank obtained an assurance from the Government that it will cause SONATRACH to finance, procure, and install these elements by the respective dates specified in para. 4.13.

D. Project Cost Estimate

4.05 The project cost is estimated at US$293.2 million. It includes contingency allowances, domestic taxes (about 17% of total project cost), and customs duties. The Government does not intend to waive the taxes or duties. The cost excludes interest on external loans during construction. The foreign exchange component is estimated at US$182 million or 62%. Annex 8 gives details of the cost estimate, which is summarized below, and Annex 9 indicates phasing of expenditure spread in 1974-77.

Summary of Project Cost Estimate

Project Element	Project Cost DA Million Local	DA Million Foreign	DA Million Total	US$ Million Local	US$ Million Foreign	US$ Million Total	% of Foreign Exchange
A. Civil Works							
1. Construction	293.8	386.0	679.8	71.8	94.3	166.1	56.8
2. Dredging	58.1	135.9	194.0	14.2	33.2	47.4	70.0
Subtotal A	351.9	521.9	873.8	86.0	127.5	213.5	59.7
B. Consulting Services							
1. Project Design and Supervision	15.2	23.9	39.1	3.7	5.9	9.6	61.4
2. Training and Studies	4.9	9.0	13.9	1.2	2.2	3.4	64.7
Subtotal B	20.1	32.9	53.0	4.9	8.1	13.0	62.3
C. Contingency Allowances							
1. Physical (10% of A+B)	37.1	55.8	92.9	9.1	13.6	22.7	59.9
Price (19.4% of A+B)	45.9	134.4	180.3	11.2	32.8	44.0	74.5
Subtotal C	83.0	190.2	273.2	20.3	46.4	66.7	69.6
Total Project Cost	455.0	745.0	1,200.0	111.2	182.0	293.2	62.0

4.06 Cost estimates for civil works have been derived largely from prices of similar works completed in 1973 at Skikda port and reflect cost levels in April 1974. Costs of the consulting services have been based on fees for project preparation as agreed upon with the Government, and expected supervision, management and Master Plan studies terms of reference. A physical contingency of 10% on civil works has been allowed. Detailed engineering of the project is available, but the possibility of encountering cavities (para. 4.11) at breakwater and berth sites may result in additional measures to be taken to ensure the safety of these structures. The 10% physical contingency includes cover for such measures. Price contingencies of 6% p.a. on local costs and 12% for 1974, 10% for 1975 and 8% for 1976 and thereafter on foreign costs of all project elements have also been allowed as these are the expected percentage increases during project construction. These price contingencies take into account the recent increases in petroleum prices. The 6% p.a. increase of local labor and material costs is reasonable because of Government's heterogeneous system of gradually rising costs and controlled prices.

4.07 The foreign exchange component is reasonable, considering conditions in Algeria and abroad, and is based on the assumption that a foreign contractor will win the contract. Most probably, however, a joint venture of foreign and

Algerian firms will win the contract. In this case, major works are expected to be assigned to the foreign firm, and no change in the foreign exchange component would arise. During loan negotiations, the Government and the Bank discussed and confirmed the project cost estimates.

E. Project Financing

4.08 It is the Government's policy to execute and provide the finance for all projects in its development programs, including commitments for external loans and credits, and to hand completed projects over to the responsible enterprise for operation. Consequently, the Government requested that the loan be made to it. This has been accepted by the Bank. A Bank loan of US$70 million is proposed, for a 25-year term, including four years of grace. The balance of the foreign exchange cost (US$112 million equivalent) will be financed as follows: (a) a loan contracted from AFESD of US$20 million equivalent, for 20 years including four years of grace, at 6% per annum; (b) bonds in the aggregate amount of US$60 million equivalent issued to the Kuwait Investment Company for 16 years, including four years of grace, at 7% per annum; and (c) a loan to be contracted from KfW of US$32 million equivalent, for 30 years, including 10 years of grace, at 2% per annum. The Government will provide all other funds needed to finance the project. A condition of effectiveness is that the conditions precedent, if any, to initial disbursements under the AFESD and the KfW loan agreements shall have been fulfilled.

4.09 Retroactive financing, totalling US$4.5 million (of which US$1.5 million will be for preparation of preliminary and detailed engineering and bidding procedures and US$3 million for payments in foreign currency to the accepted contractor), is recommended from April 1, 1973 to July 30, 1974. It will be shared between the financing partners. The Executive Directors of the Bank have been informed of this request in IBRD/IDA Report No. SecM74-94 "Monthly Operational Summary to Executive Directors" dated February 19, 1974. During loan negotiations, the Government and the Bank discussed and confirmed the amount to be proposed for retroactive financing of which the Bank's share would be up to US$1.7 million.

F. Project Implementation

Responsibility

4.10 The consulting firm Ralph Parsons Co. (RPC) designed the project; Annex 10 gives design criteria. The DI of the MPWC will be responsible for carrying out the project, and is competent to do so (see Annex 11 for MPWC's organization). Consultants will be employed to supervise construction. During loan negotiations, the Bank obtained assurances from the Government that it will: (a) employ for construction supervision qualified consultants under terms and conditions acceptable to the Bank; and (b) make qualified counterparts available to work with them.

4.11 Land needed for the project is owned by the Government and will be available for the project as needed. Borings at the project site indicate the presence of loose calcareous sand, readily removable by normal dredging, overlying strata of calcarenite/sandstone and marl, some requiring blasting for removal. Borings also indicate some cavities in the calcareous sand resulting from dissolution of its lime cementing agent by groundwater migrating from land to sea. Additional borings at each foundation site will be carried out before construction begins, to determine what measures must be taken to ensure the safety of the structures. During loan negotiations, the Bank obtained an assurance from the Government that during construction of the works included in the project, it will take all necessary measures to ensure the safety and stability of such works.

Procurement

4.12 Procurement involves one main civil work contract only. Prospective bidders were prequalified in October 1973 and the contract for construction and dredging was put to tender in December 1973, based on international competitive bidding in accordance with the Bank Group "Guidelines for Procurement". Prequalification resulted in acceptance of 45 firms from 13 countries, including 3 firms from Algeria. Tenders were received on March 18, 1974, and are being analyzed. Most probably a joint venture of foreign and Algerian firms will win the contract. The Government will not accord such a joint venture any margin of preference. Algerian firms recently started to be active, on a small-scale, in port construction. Their collaboration with established foreign firms will increase local capabilities over the long run by practical training and experience.

Construction Schedule

4.13 Construction is expected to start in June 1974 and to be completed by October 1977. Annex 12 shows the work program. To meet LNG deliveries under contracts concluded and those being negotiated (Annex 2), LNG Berth No. 1 (Map 10786) is required to be ready by mid-1976, Berth No. 2 by end-1976, Berth No. 5 by mid-1977, Berth No. 6 by end-1977, Berth No. 3 by mid-1978, and Berth No. 4 by mid-1979. Berths Nos. 1 to 3 are for the United States market and Berths Nos. 4 to 6 are for the European market. The above schedule is in accordance with the construction schedule of the LNG plants. However, the total project is scheduled for completion by October 1977, with Berths Nos. 1, 2 and 5 handed over for use according to the above schedule. Berths for condensate, crude oil, LPG, and ammonia exports should be ready by end-1976. Depending upon the degree of hardness of rock encountered, completion of dredging may be delayed for up to about 6 months, however, the dates expected for initial operations of the various berths can be easily met. Such delay in dredging completion would increase the total project cost by about DA 1.2 million (US$293,000). During loan negotiations, the Government and the Bank discussed and confirmed the timing of project execution.

G. Project Disbursements

4.14 Disbursements under the Bank, AFESD and KfW loans will be on the basis of the percentage of each loan to the total foreign exchange component. The proposed Bank loan represents 38% of the total foreign exchange component. Therefore disbursements from the Loan Account for the civil works will be: (a) 38% of the 57% estimated foreign exchange for construction; and (b) 38% of the 70% estimated foreign exchange component for dredging. Disbursements for the consulting services will be: (a) 38% of the foreign cost of project design and supervision; and (b) 100% of the foreign cost of training and studies. In accordance with the foregoing and the construction schedule of project execution (para. 4.13), an Estimated Schedule of Loan Disbursements has been prepared as Annex 13. The Government and the Bank discussed and confirmed the Schedule during loan negotiations. Surplus funds remaining in the Loan Account after the project has been completed should be cancelled because the proposed project is self-contained.

H. Safety Measures

4.15 To ensure the safety of LNG carriers, port facilities and adjacent industrial complex, special safety measures should be taken for maneuvering and berthing LNG carriers (see Annex 10, Part C). In particular, the use of tugboats equipped with efficient fire-fighting equipment in berthing and unberthing should be compulsory. The project does not include acquisition of tugboats because an adequate number are stationed at Arzew and the Government has agreed to assign the required tugboats to Bethioua port as soon as it comes into use. The Government and the Bank discussed and confirmed this agreement during loan negotiations. Also during negotiations, the Bank obtained an assurance from the Government that it will cause the Management Authority for the port of Bethioua to take all steps necessary to ensure safe operation of the facilities under its management at the said port.

I. Ecology and Urban Development

4.16 Investigations by the consulting firm RPC showed that the LNG plants' cooling water (800,000 m^3 per hour) will not adversely affect ecological conditions in the area. During loan negotiations the Bank obtained an assurance from the Government that it will take all reasonable measures to ensure that the execution and operation of the Project are carried out with due regard to the safeguarding of the environment and its biota, including pollution of the harbor from land and vessel sources and unfavorable alterations of the coastline resulting from changed current and tide patterns. The Bank also obtained an assurance from the Government that it will, not later than December 31, 1974, employ qualified experts to study the effects of the project on the ecological conditions in the area affected thereby, and will, after consultation with the Bank, implement all reasonable recommendations of such study in accordance with its national development plan.

4.17 The project and its supporting industrial complex conform to the planned urban development scheme for Bethioua.

J. Possible Port Expansion

4.18 The port has been so designed that its capacity can be increased about 50% by further deepening to 16 m alongside the berths so that LNG carriers of 200,000 m^3 can be accommodated. The berths have been designed to accommodate ships of that size.

V. FINANCES

Port Tariffs

5.01 Uniform tariff rates were set in 1971 when ONP was created, prior to which each port entity imposed its own tariffs. Tariffs are not based on costs of providing facilities or services. The principal tariff items are given below; rates are detailed in Annex 14.

(a) Ships' Harbor Dues (Taxe de Peage), based on cargo loaded;

Berthage (Droit de Quai), based on ships' net registered tonnage (NRT), including charge for extended stay;

Pilotage and Berthing (Amarrage), based on NRT;

(b) Cargo - wharfage (Droit de Quai), per metric ton.

Financial Objectives (Annex 15)

5.02 Financial objectives for state enterprises have been prescribed in principle by the Government. They cover a pricing policy on the basis of current values of total fixed assets, an acceptable return on investment, payment of income tax and mobilization of resources (profits and depreciation resources) to facilitate nationwide planning and financing of development projects.

Project Port

5.03 Because the project port is being built to service specialized requirements over an economic life of about 25 years, as determined by the confirmed LNG contracts and proven recoverable reserves of natural gas, the financial evaluation has been made on the basis of that limited economic life. Further, since there are at present no plans for extending the facilities of Bethioua (although further capital dredging could provide greater water depths later, para 4.18), there is no reason for the management authority to accumulate cash funds generated by operations at the port. Therefore,

a practical financial objective would be such as to enable the Government to recover the whole investment on an annuity basis over the project's 25 year life, at a reasonable interest rate; this would be in line with the Government's financial objectives (para 5.02) and would provide funds to service debt incurred for the project, pay a return on the Government's own equity capital and return that equity for reinvestment in other projects.

5.04 The DCF rate of return, based on project costs, construction timing, current tariffs and traffic forecasts, is 8.1%, 8.5% or 9.7%, depending on whether the base year is taken as 1976, 1977 or 1978. The most probable variables are that exports under contracts being negotiated for the production from LNG plants Nos. 3 and 4 will be delayed by up to one year and that completion of the port facilities to handle these exports will be delayed by six months. On these assumptions the DCF rate of return would fall to 7.5%, 7.8% and 8.2% respectively.

5.05 During loan negotiations the Government gave to the Bank assurances that it will cause the Management Authority to:

(a) pay to the Government the equivalent of the total investment cost of the project over a period of 25 years, commencing December 31, 1978, or such other date as shall be agreed, at a rate of interest not less than the rate of interest applicable to the Bank loan; and

(b) take all measures, including but not limited to adjustments of dues, rates and other charges for services and facilities at the Port of Bethioua, as shall be necessary to provide the Management Authority with net revenues (before charging depreciation) sufficient to make the above payments.

5.06 This investment is financially self-liquidating. The interest rate is higher than rates for other financing for the project (para 4.08), some of which is on concessionary terms, and would help to ensure that the economic benefits of the project and of the gas export scheme as a whole accrue to the economy of the country.

5.07 The range of rates of return given in para 5.04 are adequate and provide a margin for a 7-1/4% annuity. This is borne out by financial accounting forecasts. The annuity factor is about 8.8%, requiring annual payments of DA 113 million on total investment (including interest during construction) of DA 1,287 million. Cash generation commences in 1976 and by 1978 there would be a cumulative surplus of DA 115 million after meeting the first year's annuity payment. Thereafter, there would be moderate annual surpluses of about DA 12 million. Annex 18 gives a combined revenue and cash flow statement. No allowance has been made for cost increases above those already included in the cost estimate, since it is assumed that tariff rates will be adjusted to meet the financial objective. The bases and assumptions used in the forecasts are given in Annex 16 and the methodology of the financial analysis in Annex 17.

5.08 During loan negotiations the Government also gave an assurance to the Bank that it would ensure that tariffs and charges, similar to those referred to in para 5.06, are applied to all Algerian ports specializing in the export of oil and gas and their by-products.

5.09 The Government further gave assurances that the Management Authority will keep its financial accounts in accordance with appropriate accounting practices and that the annual financial statements of the Management Authority will be audited by independent auditors acceptable to the Bank. The Bank agreed that the Controle Financier de l'Etat would be acceptable auditors for this purpose.

VI. ECONOMIC EVALUATION

A. Main Benefits and Beneficiaries

6.01 Under the Algerian natural gas export scheme, SONATRACH has made or is negotiating commitments for 1,755 1/ billion m^3, or 44%, of Algeria's proven recoverable reserves. Of the total, it has committed 810 billion m^3, or about 20%, for export via Bethioua and Skikda. Based on the committed contracts and those being negotiated about 900 billion m^3, or 30%, of proven recoverable reserves from Hassi R'Mel field will be exported via Bethioua over the next 25 years. World demand for natural gas is continuously increasing (Annex 1), but Algerian demand is hard to predict although it is unlikely to exceed 2% of proven recoverable reserves over the next 25 years. To satisfy expected increasing foreign demand, specialized firms are now exploring for new natural gas fields. 2/

6.02 The project port is an integral part of the Algerian natural gas export scheme, which has considerable benefits for the Algerian economy (Annex 3). The scheme is important for further development of the economy and the Government estimates net earnings at US$60 billion over the next 25 years. These earnings will contribute to the country's savings and to development of other essential economic and social activities. The scheme will provide immediate employment for several thousand people in gas production, transport, and transformation, as well as in port operations. Therefore, it is to Algeria's economic advantage to exploit this valuable resource now, while foreign demand is high. Importing countries will also benefit by insuring supplies of needed energy.

1/ About 562 m^3 of natural gas at atmospheric pressure and temperature is equivalent to one m^3 of LNG (at - 162° C).

2/ The natural gas and petroleum exploration program includes contracts between SONATRACH and: (a) Elf/ERAP (French State Company) covering 3,282 sq mi; (b) Aquitaine (France), 3,260 sq mi; (c) Deminex (Federal Republic of Germany), 9,650 sq mi; and (d) Kopez (Polish State Oil Agency), undisclosed area.

B. Economic Approach

Traffic

6.03 Traffic through Bethioua port will be LNG and its by-products (condensates, liquid ammonia, and LPG) as well as crude oil. Two types of LNG that cannot be mixed will be manufactured for the United States and European markets by four liquefaction plants along the shore adjacent to the port. Condensates will be produced at Hassi R'Mel field and transported to the port by a special pipeline. Liquid ammonia will be prepared at a plant east of the LNG plants. LPG will be produced as a by-product from the LNG plants. Finally, crude oil will be exported via the pipeline now connecting the oil-fields to the three existing sea-lines (two of which have to be removed).

6.04 Based on LNG contracts already concluded and those being negotiated, LNG exports to the United States and Europe via Bethioua will be 8.9 million m^3 in 1976 rising to 71.2 million m^3 in 1979 and thereafter. Condensate exports to the United States, Europe, Africa, and Asia will be 13.5 million tons in 1976 and will reach a maximum of 16.7 million tons in 1979. Liquid ammonia traffic will be 360,000 tons in 1977 and thereafter, of which 120,000 tons will be for Algeria and 240,000 tons for Europe, Africa, and Asia. LPG exports will be: 1976, 100,000 tons; 1977, 350,000 tons; 1978, 600,000 tons; and 1979 and thereafter, 800,000 tons. SONATRACH has forecast the exports of condensates, liquid ammonia, and LPG. Crude oil exports from Bethioua port (apart from those from the remaining sea-line) will be 14.7 million tons annually from 1976 and thereafter to replace present exports through the two sea-lines to be removed.

Least-Cost Analysis

6.05 Benefits directly attributed to the port cannot be calculated because the port forms an integral part of the overall gas scheme. Under these circumstances, the objectives were to find the least-cost solution for required port facilities and to establish the port as a viable financial entity. Various alternative designs were considered for the port and its major components. For reasons explained below, the proposed project was selected as the best solution.

6.06 Port layout is constrained by the oceanographic environment as well as by operational, navigational, and safety requirements, and it is a function of cost optimization principles. The two most important cost variables, which have an inverse but complex relationship, are those of the main breakwater and dredging including rock removal. As the distance of the main breakwater from the shore increases, construction cost increases and dredging required decreases (offshore layout). Conversely, as the distance of the main breakwater from the shore decreases (that is, if it were built in shallow water), dredging required in the channel and harbor as well as costs for protection and/or maintenance of the channel increase (near-shore layout). If the main breakwater were placed in an intermediate position (middle-distance layout), costs

of the main breakwater and loading piers decrease to less than those associated with offshore layout and dredging costs decrease to less than those associated with near-shore layout.

6.07 Several port layout concepts were analyzed, based on operational requirements, performance characteristics, and capital cost of facilities. Dual-entrance versus single-entrance and effects of removing one or more of the existing sea-lines in the port were taken into account. As an extreme alternative, a layout was also studied in which the main breakwater would be built in 38-40 m of water, thus avoiding the need for dredging. Studies indicated the most economical layout would be middle-distance breakwater layout and dual-entrance.

6.08 Annex 19 gives total cost of breakwaters and dredging for different locations of the main breakwater. It shows that if the distance of the main breakwater from shore were 1,000 m, total cost of breakwaters and dredging would be DA 810 million; if 1,300 m from shore, DA 700 million; and if 1,800 m from shore, DA 960 million. The least cost solution, 1,300 m from shore, was selected for the proposed project.

6.09 Annex 20 gives the analysis of the number of berths required based on the capital and maintenance costs of berths as compared to ships waiting time.

VII. AGREEMENTS REACHED AND RECOMMENDATIONS

7.01 Agreement having been reached on the principal issues discussed in Chapters III, IV and V, and in particular:

(a) technical assistance for improving port management, administration, and operation and training of personnel (para 3.04);

(b) technical assistance for preparing a master plan for port development (para 3.06);

(c) project financing plan (para 4.08);

(d) amount of retroactive financing (para 4.09); and

(e) method of recovery of investment cost through tariffs (para 5.05).

The project is recommended for a Bank loan of US$70 million to the Government for a 25-year term, including four years of grace.

APPRAISAL OF

BETHIOUA PORT PROJECT

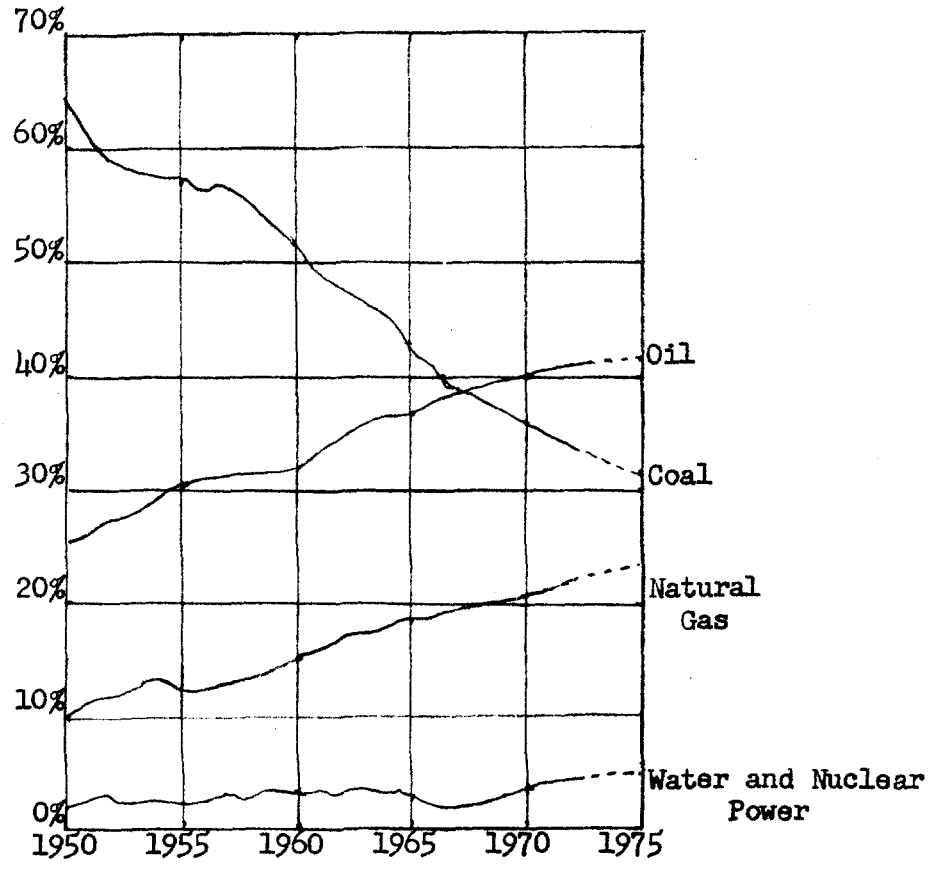
ALGERIA

World Demand for Natural Gas

1. World consumption of primary forms of energy grew at the high annual rate of 5.5% during the 1960's. This reflected strong growth in industrial activity, transport needs (particularly expanding use of automobiles and jet aircraft), energy-intensive innovations, less efficient energy usage, and relatively low energy costs, particularly for oil and (in North America) gas. World energy consumption is foreseen to slow down during the 1970's to about 5% annually and by the second half of the 1970's to about 4.2% annually, reflecting decelerated economic growth in some industrial countries, increased energy costs, constraints on international oil supplies, environmental constraints on development of energy resources, more efficient energy usage, and structural changes in consumption patterns. Three areas--North America, Western Europe and Japan-accounted for 62% of total energy consumption in 1970 and are foreseen to account for 58% by 1980. 1/

1/ Source: IBRD paper "Some Implications of Rising Trend in Petroleum Prices for Developing Countries, 1970-1985", December 20, 1973, pp. 2-3 (under cover of SecM73-769, "Petroleum Prices", December 20, 1973).

2. The following graph gives trends of major sources in world energy consumption, 1950-1975:



Source: Rene Bordet, "LNG Prospects in World Markets", World Petroleum, December 1971. Mr. Bordet is Chairman and General Manager of GAZOCEAN, Paris.

3. World oil demand in 1970 was about 41 million barrels/day (b/d). It is expected to be about 49 million b/d in 1973 and about 70 million b/d in 1980, based on a 5.3% annual growth rate. 1/

4. In 1972 natural gas provided about 20% of world energy requirements. The following table summarizes world reserves of natural gas, by area, 1967-1971:

1/ Ibid.(page 1).

Area	1967	1968	1969	1970	1971
	billion m^3				
North America	9,570	9,485	9,260	9,745	9,465
Central and South America	1,910	1,760	1,925	2,035	2,060
Western Europe	4,710	4,900	4,900	4,920	4,790
Africa	2,765	3,285	3,850	4,500	4,470
Middle East	6,225	9,040	9,260	10,085	10,035
Far East and Pacific	1,095	1,175	1,455	1,670	2,170
USSR and Eastern Europe	8,250	9,550	12,570	12,635	16,350
Total	34,525	39,195	43,220	45,590	49,340

Source: Dr. P.H. Frankel, "World Wide Gas Trade", Petroleum Press Service, August 1972.

5. In 1965, North America had 37.8% of proven natural gas reserves 1/ followed by: the Middle East, 24.3%; the USSR and Eastern Europe, 11.7%; Africa, 8.1%; Western Europe, 7.6%; Central and South America, 7.2%; and the Far East and Pacific, 3.3%. By the beginning of 1972, the USSR and Eastern Europe had taken the lead with 32.6%, followed by: the Middle East, 19.9%; North America, 18.7%; Africa, 11.2%; Western Europe, 9.4%; Central and South America, 4.2%; and the Far East and Pacific, 4.0%. At that date, the total was distributed among countries as follows: the USSR, 31.5%; the USA, 15.6%; Iran, 11.6%; Algeria, 6.1%; and the Netherlands, 4.8%.

6. Natural gas production has risen sharply in recent years, 1/ from 590 billion m^3 in 1962 to 1,260 billion m^3 in 1971. In 1971, the USA was the leading producer, 646 billion m^3, followed by: the USSR, 210 billion m^3; Canada, 84 billion m^3, Venezuela, 53 billion m^3; the Netherlands, 43 billion m^3; and Iran, 35 billion m^3. By 1980, world production or consumption of gas is expected to exceed 3,550 billion m^3 annually.

7. Industrial nations, mainly the USA, Western European nations, and Japan, have the highest demand for natural gas, and this situation is not expected to change. The USA and Western Europe have less than 30% of proven natural gas reserves, but they consume more than 70% of the amount produced annually. Growing interest in reducing pollution gives LNG a new advantage, which is bound to increase, over coal and petroleum. In the future the USA, Western Europe, and Japan will be large importers of natural gas. A brief review of the potential market for natural gas in each of these areas gives a clearer picture of the supply alternatives.

1/ "Problems in the LNG Trade", Petroleum Press Service, November 1973.

8. In the USA, natural gas constitutes the most important source of thermal energy. The natural gas share of the energy market grew from little more than 10% at the close of World War II to nearly 33% in 1970. This growth was at the expense of coal, and was possible largely because the cost of natural gas was low compared to the cost of other fuel. A number of forecasts exist of the future supply and demand for natural gas in the USA. The following table is representative:

Source	1970	1975	1980
	billion m^3		
Domestic			
All but North Slope	617.5	560.3	461.3
North Slope	-	10.5	33.1
Synthetic pipeline gas	-	-	15.6
Foreign			
Canada	23.5	32.5	32.5
Mexico	1.4	1.4	-
Other Countries (Algeria, Venezuela, etc.)	1.1	9.9	73.6
Total gas supply and demand	643.5	614.6	616.1

Source: United States National Petroleum Council Initial Report.

9. In Western Europe, demand for natural gas is expected to increase faster than demand for all types of energy together. Natural gas accounted for 7%, or 85 billion m^3, of the energy market in 1970; it is expected to account for 13%, or 310 billion m^3, by 1980. In 1970, nearly all of the 85 billion m^3 consumed was indigenous, except for 1.5 billion m^3 imported by France and the United Kingdom from Algeria. But during 1970-80, indigenous gas is expected to supply over 90% of requirements, with the remainder imported.

10. Availability of indigenous supplies will be the main factor affecting development of the European natural gas market. To establish a position for natural gas in the European market, it will be substituted for and/or complementary to other forms of energy. This can mainly be done on a price basis--allowing for any premium by virtue of its intrinsic properties. On a price basis, indigenous natural gas competes fully with other fuel in the thermal energy market. Natural gas imported into Europe may not be able to command significant price premiums; however, with a forecast annual consumption of 310 billion m^3 by 1980 and total reserves of 4,790 billion m^3, natural gas imports are expected to increase considerably.

11. In Japan, natural gas is not now a significant fuel, having a share of barely 1% of the primary energy market. Its main uses are non-thermal, including feedstock for manufacturing chemicals (59% of demand in 1970). Thermal uses in 1972 were: town gas blending, 18%; industry, 17%; and electric power generation, less than 1%. In the future, imported natural gas will be entirely for thermal uses, with electric power generation taking nearly 70% and town-gas blending the remainder. The Japanese Natural Gas Association estimates

that in 1980 the share of natural gas in the energy market will be about 7%, or 280 billion m^3. A market of this magnitude will exist, however, only if natural gas remains competitive with alternative fuels--allowing for any premium by virtue of its intrinsic qualities.

12. Countries importing natural gas may be supplied by three methods: pipeline, methanation, or liquefaction. Methanation and liquefaction are the methods to supply the USA. Additional pipelining will be possible in the foreseeable future only from Mexico and Canada, but pipelining from Central and South America cannot be entirely discounted. All or any of these methods may be used to supply Western Europe or Japan (if the proposed Algerian-Italian sea-line under the Mediterranean proves satisfactory).

13. Determination of whether natural gas will move by pipeline, methanation, or liquefaction clearly is based on the cost of gas at the point of use. Much evidence suggests that proven natural gas reserves in Abu Dhabi, Algeria, Australia, Ecuador, Indonesia, Iran, Kuwait, Libya, Nigeria, Qatar, Sarawak, Saudi Arabia, and Venezuela (major sources) are commercially attractive to the USA, Western Europe, and Japan.

APPRAISAL OF

BETHIOUA PORT PROJECT

ALGERIA

Algerian Gas Export Projects

1. Introduction

The development of natural gas liquefaction projects throughout the world is in part a consequence of the rapid growth of the share that natural gas has in the energy balance of industrial countries. At this date there are no less than 39 LNG projects, either developed, developing or under study. Algeria with unique experience in this field is in an ideal position to participate. The recoverable reserves of natural gas in Algeria are now in the order of 4,000 billion m^3. These reserves provide a substantial development base.

2. The Camel Plant

Algeria's first gas liquefaction plant came on stream in 1964 at Arzew, the Bank helped finance its construction with a US$20.5 million loan (Loan 378-AL). The plant, the first LNG plant in the world, is operated by the Companie Algerienne du Methane Liquide (CAMEL). SONATRACH holds a 49% interest in CAMEL. The gas supply for CAMEL comes from the Hassai R'Mel field which is owned by SONATRACH. The CAMEL plant can supply about 1.5 billion m^3 of natural gas 1/ annually and the LNG is sold f.o.b. Arzew under a 15 year contract; two thirds to the British Gas Council and one third to Gaz de France. The LNG taken to the British Gas Council is shipped to Canvey Island (England) by two 27,400 m^3 LNG carriers, "Methane Princess" and "Methane Progress". LNG for Gaz de France is delivered to Le Havre (France) by the 25,500 m^3 "Jules-Verne."

3. The Skikda Plant

Algeria's second gas liquefaction plant is at Skikda. The plant also receives natural gas from the Hassi R'Mel field. The plant is owned by SONALGAZ in which SONATRACH's interest was increased to 100 percent in December 1971. The first three production units have been in operation since early 1973, and each has an annual capacity of LNG output equivalent to 1.3 billion m^3 of natural gas. The gas from these units is shipped to Fos-sur-mer for Gaz de France and to Boston (USA) for Distrigas under 15 and 20 year contracts,

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1/ Each one m^3 of LNG (at -162°C) is equivalent to about 562 m^3 of natural gas at atmospheric pressure and temperature.

respectively. A fourth unit of the same capacity is under construction, under a lump sum turnkey contract for US$50 million equivalent and is scheduled for completion in August 1974. The gas from this unit will be shipped to Barcelona for Gas Natural (Spain) with which SONATRACH signed, in early 1972, a 20 year contract. SONATRACH is negotiating for the construction of the fifth and sixth units to deliver LNG to Eascogas LNC Inc. (USA), with which it signed in May 1972 a 20 year contract. The contract has received conditional approval from the FPC in December 1973.

4. The Bethioua Plant

In October 1969, SONATRACH signed a 25 year contract with El Paso Natural Gas (USA), which calls for the delivery of 10 billion m^3 of natural gas annually to the east coast of the United States. The contract has received approval from the FPC and financing of the investments required has been arranged with the Exim Bank and US Commercial Banks. SONATRACH will develop the field and plant facilities and deliver the liquefield gas and related by-products to the proposed port at Bethioua. This site was selected on the recommendation of Consulting Engineers, Engelbrecht (Federal Republic of Germany) who made a detailed study of ten alternative locations on the Algerian coast. A 40-inch pipeline to carry the gas from Hassi R'Mel to the plant (510 km) has been completed and construction by CHEMICO (USA) of the first LNG plant (US$350 million equivalent) started in July 1973 and is scheduled for completion by mid-1976, when the first shipment of LNG to El Paso is due.

Late in 1972, SONATRACH signed a contract with a European consortium of gas companies, for the supply of 15.5 billion m^3 of natural gas per year over 20 years beginning in 1977, including an option on an additional three billion m^3 annually. This buying group represents French, German, Belgium, Swiss and Austrian interests. It is reported that the contract has received the approval of the respective governments and arrangements for financing the project are apparently complete. To meet LNG deliveries under this contract a second LNG plant will be built at Bethioua. Bids for that plant have been received and are being analyzed by SONATRACH. Total cost is estimated at US$350 to 400 million.

SONATRACH has also signed a second contract with El Paso for the supply of another 10 billion m^3 of natural gas. The first deliveries are envisaged for 1978. Deliveries require the construction of a new pipeline from Hassi R'Mel and a liquefaction plant similar in size to that being constructed to meet requirements under the first El Paso contract. Application was made in the Spring of 1973, for import authorization from the FPC. Hearings started in November, however, because no decision had been taken by the FPC by December 31, 1973, SONATRACH availed itself of its rights in draft contract with El Paso to re-negotiate the terms of the contract. Preliminary conversations have already started.

Finally, in December 1972, SONATRACH signed a heads of agreement with Panhandle Eastern Pipeline Co. (USA), to sell to them 4.5 billion m^3 of natural gas annually over a 20 year period, beginning in 1979. Gas will be shipped to the U.S. Gulf Coast and from there it will be piped via existing lines to existing customers. A contract is reported to have been signed in November 1973, and Panhandle Eastern filed its application for authorization by the FPC. This application is likely to be pending for some months.

5. Other LNG Contracts

Additional contracts have been under discussion. During October 1973, SONATRACH signed an agreement for the delivery of 4.5 billion m^3 of natural gas annually to Gas Natural (Spain) over a 20 year period. In October 1972 an agreement in principle was reached with ENI (Italy) for the delivery of 11 billion m^3 of natural gas annually to Southern Italy over a 25 year period. It is proposed to construct a pipeline from Hassi R'Mel to Cap Bon (Tunisia) and then via submerged sea-lines across the Sicily Channel and Messina Straits to the Italian mainland. A further contract covering 12 billion m^3 annually with a second European Consortium headed by Ruhrgas (Germany) over a 20 year period was also agreed upon in principle in October 1973.

6. Traffic Through the Port of Bethioua

It is anticipated that the port facilities at Bethioua will be used almost exclusively for outbound shipments of crude oil, natural gas and related products. LNG will constitute the major tonnage and is expected in the volumes shown in the following table. Two types of LNG are produced; one type for the European market, a slightly different type for the American market. They use separate loading facilities.

Estimated Natural Gas Shipments - Port of Bethioua
(billion m^3 annually)

Destination	1976	1977	1978	1979 and after
American Market	5	10.0	15.0	20.0
European Market	—	7.5	15.0	20.0
Total	5	17.5	30.0	40.0

In the process of producing natural gas in the Hassi R'Mel field, large volumes of condensate are also produced. SONATRACH expects to pipe these condensates from the field separators to the Port of Bethioua where they will be exported. The following table indicates the condensate volumes that SONATRACH expects to market.

Anticipated Condensate Shipments - Port of Bethioua
(Annual Volumes)

Year	million tons
1976	13.52
1977	14.89
1978	16.03
1979	16.71
1980	15.18
1981	13.88
1982	12.84
1983	11.71
1984	9.85
1985	8.90

There will be generated large quantities of LPG, consisting of propane and butane. The annual forecast traffic of LPG from Bethioua will be as follows:

Anticipated LPG Shipments - Port of Bethioua
(Annual Tonnage)

Year	Tons
1976	100,000
1977	350,000
1978	600,000
1979 and thereafter	800,000

In addition to the LNG, condensates and LPG it is expected that 14.7 million tons of crude oil and 360,000 tons of anhydrous ammonia will be shipped from the Port of Bethioua annually. About 120,000 tons of ammonia will be shipped to other Algerian ports and the balance, as well as the crude oil, will be exported.

7. The Price of LNG

While there have been a number of contracts signed for the export of LNG from Algeria, the prices are generally not revealed. The initial El Paso contract, the Eascogas contract, and the Distrigas contract are public documents and the terms and conditions of sale are known. In December 1973 the Algerian Minister of Industry and Energy, stated 1/, that the recent ENI, Gas Natural and Ruhrgas contracts start with a plant gate price equivalent to US$0.65 per million BTU 2/.

1/ The Oil and Gas Journal, December 17, 1973, "Algeria May Renegotiate LNG Pacts".

2/ Each one million BTU is produced by about 1,000 ft^3 (about 28.2 m^3) of natural gas.

The first El Paso contract is for a period of 25 years. The base sales price is 30.5 cents per million BTU. 80% of this price is firm and beginning with September 15, 1971, 20% of the base price may be escalated by future increases in two selected US Bureau of Labor indices. These indices are the index of wages in the petroleum industry and the United States cost of steel mill products.

The Eascogas contract employs a different pricing formula. Expressed in terms of US cents per million BTU delivered f.o.b. Algerian port, the basic sales price is 45.75 cents. Under the pricing formula, this basic sales price is subject to a definite escalation of 1.5% annually beginning as of 1973. There is also a currency exchange rate formula related to the commercial rate of exchange of the US dollar at a given point of time 1/. The Contract sales price is calculated as of the first business day of each month. In accordance with the pricing formula, the currency exchange formula is applied to the escalated basic sales price as of such date to determine the price of all deliveries taking place during such month. If the application of the currency exchange formula for the determination of the Contract sales price yields a result which is less than 45.75 cents per million BTU, the Contract sales price shall be taken as being equal to 45.75 cents per million BTU. Thus, under Article VIII of the contract, the basic sales price per million BTU is 45.75 cents subject to a 1.5% compounded increase once each year, and to the application of the currency exchange rate formula once each month.

During the past year there have been dramatic increases in the price of world crude oil. The prices of natural gas, which have historically had a tendency to lag behind the BTU equivalent value of oil, are in many instances far out of line with current oil prices. If natural gas usage develops as expected and is increasingly in direct competition with oil (e.g. for electric power generation), then it is reasonable to expect an upward revision of gas wellhead prices to reflect this competitive circumstance. Natural gas sales are usually on a long-term contract because of the costly specialized facilities required, and because both supply sources and demand tend to be far less flexible than in the case of crude oil, the general price trend of gas follows the lead of oil but in a rather deliberate fashion.

1/ This arrangement is similar to that approved for Canadian gas sold by Westcoast Transmission Company Limited to El Paso Natural Gas Company for transmission in the latter's Northwest Division. There, the contract sales price is related to the currency exchange rate of the US dollar in Canada.

8. The Cost of the Facilities

A reasonable estimate of the cost of the facilities to produce, transport and process the natural gas to be exported from Bethioua, can be obtained from existing sources. Bechtel prepared a preliminary engineering and cost study in 1970 for the first El Paso export project. In July 1972, those cost estimates were updated. A firm contract was awarded in 1973 by SONATRACH to CHEMICO for the construction of the first liquefaction plant at Bethioua, at very close to the estimate and the second plant has been tendered at rates which appear to be lower on a unit basis. Using Bechtel's figures for estimating the costs, the following table 1/ gives a summary of the total probable capital investment. Local taxes paid to the Government by SONATRACH which is a public company have been excluded.

Gas Export Project

Total Probable Investment in
Field Facilities, Pipelines, Liquefaction
Plants, and Storage and Loading Facilities
(in Million US$ equivalent)

1.	Field Facilities - Hassi R'Mel		
	Direct Costs	244	
	Other Costs	44	
			288
2.	Pipelines		
	Direct Costs	354	
	Other Costs	52	
			406
3.	Liquefaction Plants, Loading Arms and Storage		1,170
4.	LNG Port Facilities*		50
	Total		1,914
	say		2,000

* This covers SONATRACH and CNAN investments and does not include the proposed Bank project because it is expected to be financially viable.

1/ This economic analysis is based on the use of Bethioua for the export of 40 billion cubic meters of LNG per year for a period of 25 years. The volumes envisaged are: the first El Paso, the second El Paso, the European Consortium and Panhandle Eastern contracts.

The operating costs associated with the initial El Paso contract up to the point of delivery of the product to the ship side, were estimated by Bechtel in 1972, to be US$29.5 million annually. The volume under discussion is four times the amount in the El Paso deal and in the absence of significant economies of scale a figure of US$118 million may be taken as the full stream operating cost for a representative year i.e. 1980. The life of the contracts vary from 20 to 25 years and a depreciation rate of 4% per year produces an annual cost of US$76 million.

Most of the foreign currency to be used in the construction of the facilities is financed by short-term loans and is relatively expensive. For comparative purposes a rate of 9% is taken as the cost of capital, or US$144 million during the year 1980. This figure drops to US$73 million by 1990.

9. Revenues and Returns

The total estimated volume of gas shipments each year is the equivalent of 40 billion m^3. This may be otherwise stated in terms of millions of BTU's as 1,412 trillion BTU. The estimated 1980 operating cost of the total production facility plus depreciation plus the interest on borrowed money (at 9%), amounts to US$338 million. The break-even point before allowing any return for the natural gas is 23.9 cents per million BTU. If the invested capital changed by the amount of the annual depreciation, the break-even cost in 1990 would be 18.9 cents per million BTU's.

The break-even cost estimated of 23.9 and 18.9 cents per million BTU in 1980 and 1990 respectively, does not take into account the revenue credits earned by either the condensate or the LPG. Most of the costs of producing both these products are included in the annual expenses of US$338 million. Such items as the pipelines to carry the condensate from the field or its storage facilities at Bethioua do not appear to be in the cost. The revenue from condensate and LPG could be very substantial. The 1980 production of 16.7 million tons of condensate is the equivalent of 122 million barrels. At a stabilized price of $10 per barrel (based on January 1974 prices of crude oil) this amounts to nearly US$1.22 billion. The annual volume of LPG has been estimated to be 800,000 tons in 1980. It has not been possible to assess a reasonably correct price for that commodity.

10. The Impact on the Algerian Economy

The prices of LNG to be exported from Algeria are generally not revealed. Moreover it is hard to predict future price escalation as well as future contract prices especially since those will reflect the recent increase in crude oil prices. However, based on confirmed gas export base prices f.o.b. Algerian ports (US$0.305 per million BTU for the first El Paso contract and US$0.4575 per million BTU for the Eascogas contract) and those recently revealed by the Government (US$0.65 per million BTU for the ENI, Natural Gas and Ruhrgas contracts), and on the scheme's capital investment and operating expenses, the scheme is undoubtedly beneficial to the Algerian economy. The Government estimates its total earnings from the scheme at US$70 billion over the next 25 years, against total expenditure of US$10 billion during the same

period. The scheme will provide immediate employment to several thousand people in gas exploration, transportation and transformation; in related industrial activities and in port operation. It will also provide needed energy to the importing countries.

ANNEX 3

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Gas-Export Contracts

Buyer	Quantity/ Year (billion m^3)	Delivery Date	Period of Contract	Port of Delivery	Destination
A. Contracts Concluded					
British Gas Council	1.0	1964	15	Arzew	Canvey Island
Gaz de France	0.5	1964	15	Arzew	Le Havre
Gaz de France	1.5 to 3.5	1972/75	15	Skikda	Fos-sur-mer
Distergas (USA)	2.0	1971	20	Skikda	Boston
Gas Natural (Spain)	0.5 to 1.5	1974/79	20	Skikda	Barcelona
Eascogas LNG Inc. (USA)	3.0 to 6.0	1976/79	20	Skikda	US East Coast
El Paso Natural Gas (I)	10.0	1976	25	Bethioua	US East Coast
European Consortium (I)	15.5	1977	20	Bethioua	Austria, Belgium, France, Federal Republic of Germany, and Switzerland
B. Contracts being Negotiated					
El Paso Natural Gas (II)	10.0	1978	25	Bethioua	Being Discussed FPC
Panhandle Eastern Pipeline Co. (USA)	4.5	1979	20	Bethioua	US Gulf of Mexico Coast
Gas Natural (Spain) (II)	4.5	N.A.	20	N.A.	N.A.
ENI (Italy)	11.0	N.A.	25	Via Tunisia	Southern Italy
European Consortium (II)	12.0	N.A.	20	N.A.	N.A.

Source: SONATRACH

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Port Facilities at Algerian Most Important Ports

1. At Algiers

The port has two entrances and is protected by five breakwaters totalling about 5 km long:

- from north-east by a breakwater 1,290 m long;
- from east by a breakwater 1,500 m long;
- from south-east by a breakwater 1,304 m long; and
- from south by a breakwater 1,000 m long.

All breakwaters are of the mound type protected by 50 to 250 t concrete blocks. The port comprises three basins:

- the old port having an entrance 176 m wide and 22 m deep, a water area of 74 hectares (ha), and berths totalling about 3 km long and are 2.5 to 12 m deep;
- the Agha basin 6.5 to 10 m deep having berths totalling about 2.8 km long; and
- the Mustapha basin having an entrance 240 m wide and 16 m deep, a water area of 75 h and berths totalling about 2.7 km long and are 7 to 11 m deep.

The port has 48 berths totalling about 10 km long, of which 37 are for general cargo and 11 for special cargo. Out of the 48 berths, 15 have depths exceeding 9 m.

The port land area is 119 ha and is served by railways 27 km long. There are about 30 transit sheds totalling about 77,000 m^2 in area, 30 refined oil tanks totalling about 160,000 m^3 capacity and eight wine tanks totalling 36,000 m^3 capacity.

The port has several slipways and two dry docks one for ships of up to 136 m long and 8 m draft and the other for ships up to 75 m long and 5 m draft.

The floating equipment available in the port includes five water barges, 10 tug boats 150 to 1,000 hp, five pilot boats, two floating cranes 85 and 400 t capacity, 76 barges 20 to 250 t capacity, one small suction dredger and two hopper barges. Cargo handling equipment includes 60 quay cranes 2 to 12 t capacity, 32 mobile cranes, 52 tractors, 276 trailers and 141 forklift trucks.

2. At Annaba

The port has two basins:

- the small basin having a water area of about 10 ha and berths totalling about 1.3 km long and 8.5 to 10 m deep; and

- the main basin having a water area of about 40 ha and berths totalling about 2 km long and 8.75 to 10 deep.

The port land area is about 107 ha, 50% of which is occupied by the industrial zone. Transit sheds are limited having a total area of 2,100 m^2. There are a grain silo 18,000 t capacity and a wine tank 300 t capacity.

Equipment available in the port include special handling equipment for iron ore, coal and phosphate; two tug boats 700 hp each; two floating cranes 110 and 8 t capacity and 10 mobile cranes 3 to 7 t capacity.

3. At Arzew

The port has an entrance 400 m wide and 20 m deep and is protected by two breakwater 1.2 km and 1.1 km long extended to a depth of about 18 m.

The port land area is limited to 24 ha. Berths are highly specialized and include one pier with two berths for loading LNG, one berth for loading ammonia, two berths for loading crude oil and refined oil 13.5 and 15.5 m deep and four berths for general cargo totalling about 700 m long and are 9 to 10 m deep. There are three mooring stations for loading crude oil. They are situated in 20 to 25 m deep water, 850 m apart and at about 1.5 to 1.8 km distance from the shore. They are connected to the shore by several sea-lines 20 to 40 inches in diameter.

Equipment available in the port include six tug boats 1,500 to 2,500 hp, four floating cranes 10, 50, 100 and 125 t capacity and 12 cranes 2 to 25 t capacity.

4. At Oran

The port is protected by two breakwaters 2.8 and 0.5 km long. The entrance is 190 m wide. The port comprises six basins; 7, 10, 15, 16, 17 and 24 m deep.

The port water area is about 120 ha and its land area is about 71 ha of which about 43 ha are used for storage purposes. The port has 37 berths totalling 5.2 km long of which about 3.5 km having a depth from 9 to 12 m. There are 38 transit sheds totalling about 70,000 m^2 in area, a grain silo of 30,000 t capacity and four wine tanks totalling 534 m^3 capacity.

Equipment available in the port include two tug boats 500 and 750 hp, fuel-oil barge 600 t capacity three floating cranes 30 to 100 t capacity, 29 quay cranes 1.5 to 6 t capacity, 21 mobile cranes 2 to 13.5 t capacity, 28 tractors and 39 forklift trucks 1.5 to 4 t capacity.

5. At Skikda

The port is protected by two breakwaters 1.75 km and 0.6 km long. It comprises two harbors: the old one for general cargo and the new one completed in 1973 for LNG, LPG, ammonia and crude oil exports.

The port comprises eight berths: three for crude oil exports, two for LNG exports, one for LPG export, one for ammonia export and one for general cargo import and export. The port land area is about 42 ha. There are nine transit sheds totalling 7,900 m^2 in area, a grain silo 20,000 m^3 capacity and a wine tank 150 m^3 capacity. Equipment available in the port includes two tug boats, a floating crane 100 t capacity, eight quay cranes, 5 mobile cranes 4 to 10 t capacity, 21 tractors, 84 trailers and 24 forklift trucks 2 to 8 t capacity.

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Traffic Through Main Ports
(Thousand Tons)

Port	1968		1969		1970		1971		1972	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Algiers										
General Cargo	1,645	1,864	1,887	2,072	1,904	809	1,935	629	2,323	676
Petroleum Products	1,844	31	1,877	566	2,295	1,391	842	1,201	85	1,463
Total	3,489	1,895	3,764	2,638	4,199	2,200	2,777	1,830	2,408	2,139
Annaba										
General Cargo	461	391	767	646	1,132	952	1,252	682	1,464	864
Minerals	-	2,703	-	2,202	-	1,379	-	1,602	-	1,770
Total	461	3,094	767	2,848	1,132	2,331	1,252	2,284	1,464	2,634
Arzew										
General Cargo	139	4,415	193	3,339	130	2,406	60	2,034	20	2,038
Petroleum Products	-	14,853	-	18,493	-	16,075	240	18,080	213	19,237
Total	139	19,268	193	21,832	130	18,481	300	20,114	233	21,275
Bejaia										
General Cargo	158	690	286	566	367	622	309	143	340	93
Petroleum Products	-	14,550	-	14,750	-	16,080	90	13,187	85	12,043
Total	158	15,240	286	15,316	367	16,702	399	13,330	425	12,136
Ghazaouet										
General Cargo	14	172	8	221	8	197	7	164	34	162
Mustaganem										
General Cargo	122	318	106	347	174	376	205	188	198	272
Oran										
General Cargo	919	520	905	643	1,075	785	1,124	367	1,318	385
Skikda										
General Cargo	267	103	243	79	323	73	386	79	515	73
Petroleum Products	218	-	242	-	253	-	260	-	268	6,469
Total	485	103	485	79	576	73	646	79	783	6,542
For the above Ports:										
Total General Cargo	3,725	8,473	4,395	7,913	5,113	6,220	5,278	4,286	6,212	4,563
	12,198		12,308		11,333		9,564		10,775	
Total General Cargo and Minerals	3,725	11,176	4,395	10,115	5,113	7,599	5,278	5,888	6,212	6,333
	14,901		14,510		12,1712		11,166		12,545	
Total Petroleum Products	2,062	29,434	2,119	33,809	2,548	33,546	1,432	32,468	651	39,212
	31,496		35,928		36,094		33,900		39,863	
Grand Total	5,787	40,610	6,514	43,924	7,661	41,145	6,710	36,356	6,863	45,545
	46,397		50,438		47,806		45,066		52,408	

Source: The Ministry of Transport and ONP.

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Management Consultants' Services

Provisional Scope of Work

Phase I Problem Identification

(a) Organization Analysis and Evaluation

(i) Office National des Ports (ONP)

(ii) Societe National de Manutention (SONAMA)

(iii) Compagnie Nationale de Navigation (CNAN)

(b) The respective functions and interrelationships of ONP, SONAMA and CNAN; their relationships with port users and the national labor syndicate (BCM)

(c) Focus on

(i) general cargo ports

(ii) existing specialized ports (e.g. Arzew, Skikda)

(iii) the project port, Bethioua

(d) Series of recommendations in broad general plan

Phase II Detailed Programming of Specific Programs

(a) Reorganization plan, to include possible realignment of present entity roles and responsibilities plus labor

(b) financial and cost accounting and statistical systems; financial management; tariff structures and rates; management information systems; capital programming; internal audit

(c) operations planning

(d) data processing systems, including computers

(e) training programs

Phase III Implementation

Note It is envisaged that operating and financial systems and training will be limited to Algiers, in the expectation that the companies themselves will be able to extend the new programs to other ports.

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Expenditures on Port Development Plans 1970-73 and 1974-77
DA Thousand

Port	1970-73[1]	1974-77[2]
Annaba	135,000	35,000
Alger	17,000	25,000
Arzew	10,000	45,000
Bethioua	-	1,200,000
Mostaganem	18,000	20,000
Oran	15,000	35,000
Skikda	277,000	90,000
Tipaza	12,000	-
Fisheries Ports	38,000	30,000
Navigational Aids	20,000	20,000
Studies	-	50,000
Total	542,000	1,550,000

1/ Actual.

2/ As proposed by Directorate for Infrastructure to the Ministry of Planning

Source: Directorate for Infrastructure
May 1974

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Cost Estimate

Project Element	Project Cost DA Million			Project Cost US$ Million			% of Foreign Exchange
	Local	Foreign	Total	Local	Foreign	Total	
A. Civil Works							
1. Construction							
(a) Main Breakwater	131.4	174.3	305.7	32.1	42.6	74.7	57.0
(b) Secondary Breakwaters	85.1	109.7	194.8	20.8	26.8	47.6	56.3
(c) Piers and Berths	63.8	83.6	147.4	15.5	20.5	36.0	56.9
(d) Supporting Facilities[1/]	9.8	13.1	22.9	2.5	3.1	5.6	55.3
(e) Service Port	2.9	4.5	7.4	0.7	1.1	1.8	61.1
(f) Sealine Removal	0.8	0.8	1.6	0.2	0.2	0.4	50.0
Subtotal 1.	293.8	386.0	679.8	71.8	94.3	166.1	56.8
2. Dredging							
(a) Soft Material (6.6 million m^3)	12.3	28.2	40.5	3.0	6.9	9.9	69.7
(b) Hard Material (1.6 million m^3)	45.8	107.7	153.5	11.2	26.3	37.5	70.1
Subtotal 2.	58.1	135.9	194.0	14.2	33.2	47.4	70.0
Subtotal A.	351.9	521.9	873.8	86.0	127.5	213.5	59.7
B. Consulting Services							
1. Project Design	0.9	5.9	6.8	0.2	1.5	1.7	88.2
2. Project Supervision	14.3	18.0	32.3	3.5	4.4	7.9	55.7
3. Training and Studies	4.9	9.0	13.9	1.2	2.2	3.4	64.7
Subtotal B.	20.1	32.9	53.0	4.9	8.1	13.0	62.3
C. Contingency Allowances							
1. Physical (10% of A+B)	37.1	55.2	92.9	9.1	13.6	22.7	59.9
2. Price (19.4% of A+B)	45.9	134.4	180.3	11.2	32.8	44.0	74.5
Subtotal	83.0	190.2	273.2	20.3	46.4	66.7	69.6
Total Project Cost	455.0	745.0	1,200.0	111.2	182.0	293.2	62.0

1/ These include navigation aids, access raod, potable water, sewage treatment, storm drainage, power and lighting, telecommunications, fire protection, deballasting system and Harbor Master building.

Source: Consultant estimate as revised by mission.

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Estimated Project Expenditure

Calendar Year	DA Million			US$ Million		
	Local	Foreign	Total	Local	Foreign	Total
1974	51.4	82.5	133.9	12.5	20.2	32.7
1975	152.3	245.6	397.9	37.0	60.2	97.2
1976	163.0	262.3	425.3	39.6	64.4	104.0
1977	88.3	154.6	242.9	22.1	37.2	59.3
Total	455.0	745.0	1,200.0	111.2	182.0	293.2

Government Financing of Interest During Construction

	DA Million	US$ Million
1974	1.7	0.4
1975	13.2	3.2
1976	28.2	6.9
1977	40.5	9.9
1978	16.5	4.0
Total	100.1	24.4

Source: Consultants' Estimate as revised by mission.

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Design Criteria

A. Characteristics of Ships Using the Port

Ships of different type, size and capacity will be required to handle the port traffic.

1. LNG Carriers

(a) Types, Cost and Size of LNG Carriers

There are presently seven LNG containment systems approved by Lloyd's Register. The most prominent types are the Membrain - integral type (Gas Transport, Technigas, Conch) and the Spherical tanks type - (independent type, Moss Rosenberg). The cost of a 125,000 m^3 LNG tanker of the first type is about US$100 million if constructed in USA and about US$75 million if constructed in Europe as compared to US$90 million and US$70 million, respectively, for the second type.

During the last ten years the size of LNG carriers has risen from 26,000 m^3 to 125,000 m^3. The following table summarizes the present state of the World LNG fleet (19 vessels):

Year	Name of Carrier and Shipyard	Capacity (m^3)	Gross Reg. Tonnage	Length (m)	Beam (m)	Draft (m)	Speed (knots)
1958	Methane-Pioneer (France)	5,100	5,058	103.3	15.2	7.2	9.5*
1964	Methane-Princess & Methane Progress (France)	27,400	21,876	189.3	24.8	7.9	17.2*
1965	Jules Verne (France)	25,500	22,292	201.0	24.7	7.3	17.5*
1969	Polar Alaska & Artic Tokyo (USA)	71,500	44,089	243.3	34.0	10.0	17.0
1969	Esso Brega, Porto Venere, Liguria & Laleta (USA)	40,000	30,455	207.9	29.3	8.7	18.0
1971	Descartes (France)	50,000	32,100	220.0	31.8	9.2	18.0*
1972	Hassi-R'mel (France)	40,000	28,235	191.5	29.2	9.1	17.6*
1972	Gadania, Gadila, Gari & Gaztrana (France)	75,000	N.A.	259.0	35.0	9.5	17.0
1973	Charles Tellier (France)	40,000	28,000	191.5	29.2	9.1	17.6*
1973	Hull No. 176 (Norway)	30,000	N.A.	180.0	29.2	N.A.	19.2
1973	Hull No. 196 (Norway)	87,600	N.A.	249.5	40.0	10.4	19.5

*Algerian route.

(b) LNG Carrier Trends

Exportable gas surpluses in the 1970's and 1980's will exist in North Africa, the Middle East, USSR, Nigeria, Southeast Asia, Southwest Pacific, Venezuela and Trinidad. The main import areas will be USA, Japan and Western Europe. Short-term projections indicate that the total LNG fleet will have a combined capacity of 5.2 million m^3 in 1977, as compared to 936,000 m^3 in 1973; a 5.5-fold increase in only four years.

The following table gives the existing capacity and an estimate of future 1/ orders of LNG carriers up to 1977:

LNG Carrier Capacity (m^3)

	Additional Capacity	Cumulative Capacity Based on Orders	Additional Capacity Based on Options	Total Cumulative Capacity
Existing	-	936,000	-	936,000
1974	484,600	1,420,600	-	1,420,600
1975	510,000	1,930,600	595,000	2,525,600
1976	365,000	2,295,600	1,040,000	3,930,600
1977	207,600	2,503,200	1,100,000	5,238,200
	1,567,200	2,503,200	2,735,000	5,238,200

Of the additional fleet envisaged up to 1977, three vessels are less than 40,000 m^3 capacity, nine are between 40,000 m^3 and 88,000 m^3, 58 are 120,000 m^3 or 125,000 m^3 capacity and five are 165,000 m^3 capacity. Most of the 120,000 m^3 and 125,000 m^3 vessels are expected to be built in France and USA, but some will be built in Norway, Japan and Italy.

Longer term LNG demand forecasts are widely debated and the resulting projections concerning the future LNG fleet can only be approximate between a lower and higher level as indicated below:

1/ Source: Consultants Feasibility Study derived from the "Economist Intelligence Unit Ltd." QER Special No. 12.

Possible Ship Requirements by Mid and Late 1980's /1
(Reference ship: 125,000 m^3 capacity and 18 knots average speed)

Market	Low Estimate	High Estimate
USA	40	100
Japan	25	50
Western Europe	10	20
Total Number	75	170

The following table indicates the main characteristics of the world LNG fleet for those vessels in service or planned:

Capacity (m^3)	Length (m)	Beam (m)	Draft (m)
40,000	191.5	29.2	9.1
75,000 /2	259.0	35.0	9.5
87,600	249.5	40.0	10.4
125,000 /3	285.5	43.7	11.0
200,000 (Planned)	340.0	48.0	13.5

/1 Source: M.W.H. Peebles, LNG 3 Conference and Ocean Industry, November 1972.
/2 Bethioua/Europe (European Consortium Contract).
/3 Bethioua/USA (El Paso Contract).

(c) LNG Carriers Using Bethioua Port

To satisfy the El Paso I contract, nine 125,000 m^3 LNG carriers are being built; three in France, scheduled for completion in 1975; and six in USA, scheduled for completion in 1976. LNG from Bethioua to Europe (European Consortium contract), will be transported by carriers of 75,000 m^3 average capacity. LNG berths at Bethioua are designed to handle this size of vessels, as well as the 200,000 m^3 vessels in future by further (deepening) dredging in front of the berths.

2. Crude Oil Tankers

(a) World Tonnage Forecasts

Oil tanker requirements are forecast to reach 300 million dwt by 1980, as compared to 125 million dwt in 1971; an expansion of 250% in nine years. The annual growth rate is expected to be about 13% until 1975 (needed capacity about 200 million dwt) and then 8% until 1980. Main areas of oil needs will be USA, Japan and Western Europe, and main area of oil surplus will be the Middle East

At the end of 1971, the average ocean-going tanker was rated at 45,800 dwt with a speed of 15.8 knots. However, for future projections, the reference vessel is a 250,000 dwt tanker with an approximately identical speed of 15.5 knots.

(b) Size Trend

For nearly 20 years after World War II, the T-2 oil tanker was the standard for this type of ships. Its basic characteristics are:

Dead Weight (t)	Draft (m)	Length (m)	Beam (m)
16,600	9.15	160	20.7

The average characteristics for tankers under 150,000 dwt are:

Dead Weigth (t)	Draft (m)	Length (m)	Beam (m)
15 to 30,000	9 to 10.0	155 to 175	20 to 26
30 to 50,000	10 to 12.0	175 to 220	26 to 33
50 to 80,000	12 to 14.5	220 to 240	33 to 37
80 to 100,000	14.5 to 15	240 to 250	37 to 42
100 to 140,000	15 to 16.5	250 to 290	42 to 47

Mammoth tankers are over 100,000 dwt began to appear in the mid-1960's. By 1974 there will be 779 tankers of 100,000 dwt or over, of which more than 400 will be over 200,000 dwt. Their average characteristics are:

Dead Weight (t)	Draft (m)	Length (m)	Beam (m)
150,000	16.0	295	48
175,000	17.0	307	50
200,000	17.9	315	52
225,000	18.5	330	54

The two largest tankers in existence are the Nisseki Maru and the recently launched (February 1973), Globtik Tokyo, with the following characteristics:

	Dead Weight (t)	Draft (m)	Length (m)	Beam (m)
Nisseki Maru	372,400	27.2	347.5	61.9
Globtik Tokyo	477,000	28.0	379.5	62.2

The three largest tankers recently ordered, or announced are two 540,000 dwt vessels for Shell from Chantiers de l'Antlantique of Saint Nazire, France (for delivery in 1976), and a 706,000 dwt tanker ordered by Globtik Tankers of London from Ishikawajima-Harima, Japan (for delivery in 1977).

(c) Oil Tankers Using Bethioua Port

The planning of the proposed port requires the removal of two of the three existing sea-lines currently used for loading crude oil. A berth for crude oil will be constructed to replace the lines to be removed (see Map 10875). Based on the envisaged crude oil traffic through the port (14.7 million tons annually), and its destinations, tankers ranging between 50,000 dwt and 250,000 dwt will be used. The berth is designed to handle such range.

3. Condensate Tankers

(a) Size Trend

Condensate tankers come under the general category of oil tankers. Consequently, a large number of those condensate tankers are not accounted for in separate statistics. Some vessels have been converted from oil to condensate and this transformation is relatively easy to accomplish, and could become more frequent, depending on the evolution of energy demands.

(b) Condensate Tankers Using Bethioua Port

Based on the maximum volume of condensate exports (16.7 million t in 1979) and their destinations (USA, Europe, Africa and Asia), the following sizes of tankers are envisaged:

(i) 50,000 dwt tankers for the European and African markets;

(ii) 100,000 dwt tankers for the American and Asian markets, between 1976 and 1980; and

(iii) up to 250,000 dwt tankers for the American and Asian markets after 1980.

Consequently, one of the two condensate berths is designed to handle tankers of 50,000 to 150,000 dwt and the other to handle tankers of 100,000 to 250,000 dwt.

4. LPG and Ammonia Tankers

Based on forecast annual exports of LPG (800,000 t), and Ammonia (360,000 t), the following sizes of tankers will use Bethioua port:

(i) for LPG, tankers ranging between 35,000 m^3 and 70,000 m^3;

(ii) for ammonia headed for Algeria, tankers of 6,000 dwt; and

(iii) for ammonia headed for Europe, Africa and Asia, tankers of 12,000 dwt.

B. Structural Design Criteria and Loads

1. Structural Design Criteria

Maximum wind velocity	83 km/hour (45 knots)
Seismic loading	0.12 g
Maximum Tide range	1.0 m
Approach velocities of ships	0.075 m/sec for 200,000 ton and larger ships 0.10 m/sec for ships between 100,000 and 200,000 tons 0.15 to 0.20 m/sec for ships less than 100,00 tons
Approach angle for ships	5 degrees for ships of 100,000 tons or larger 7 degrees for ships less than 100,000 tons
Maximum horizontal angle of mooring lines (from ship's bow or stern to outer mooring dolphin)	35°
Maximum vertical angle of mooring lines	45°
Ultimate strength of each cable	63 tons

2. Loads

The following loads shall be combined appropriately:

(a) Breakwaters

Wave height	10.3 m (crest to trough) 7.75 m (crest to still water)
Lateral force due to design wave	28 t/m^2 at 0.00 water level
Current forces	negligible

(b) Platforms and Trestles

Live Load (traffic, etc.) = 0.75 t/m^2

Equipment Load (except loading arms) = 0.375 t/m^2

Seismic Load = 0.12 x g
(Transverse or Longitudinal)

Temperature Range = $\pm$ 40°F

Wind Load = 0.10 t/m^2

(c) Berthing Dolphins

Springline Pull = 50 t

Wind Load = 0.10 t/m^2

Seismic = 0.12 x g (Transverse and Longitudinal)

Live Load = 0.25 t/m^2

(d) Mooring Dolphins

Cable Load = Cable strength at 100 t/hook

Seismic Load = 0.12 x g

Live Load = 0.25 t/m^2

C. Safety Considerations

LNG carries with molded hull heights of about 25 m and drafts of about 11 m are quite difficult to manoeuvre under windy conditions and in confined areas. The dual-entrance harbor will permit access from either direction as weather or hazards require. Certain general safety measures should be taken, the most important of these measures are:

(1) Each ship must be manoeuvred into berthing position using tug boats. The ship should be moored in such a way that the bow faces the harbor entrance to facilitate maneuvers in an emergency. Qualified pilots should be employed for this purpose.

(2) In no case should any vessel (tugs or ships) or any hot point (motors or vehicles) come within less than 75 m of any LNG carrier during filling operations because of gas leaks which may occur.

(3) The minimum distance between piers should be 375 m. Berths should be provided with four breasting dolphins and two mooring dolphins. Because the LNG carriers have a very large freeboard, the mooring dolphins should be arranged so that the angle of the mooring cables does not exceed 25 degrees from horizontal.

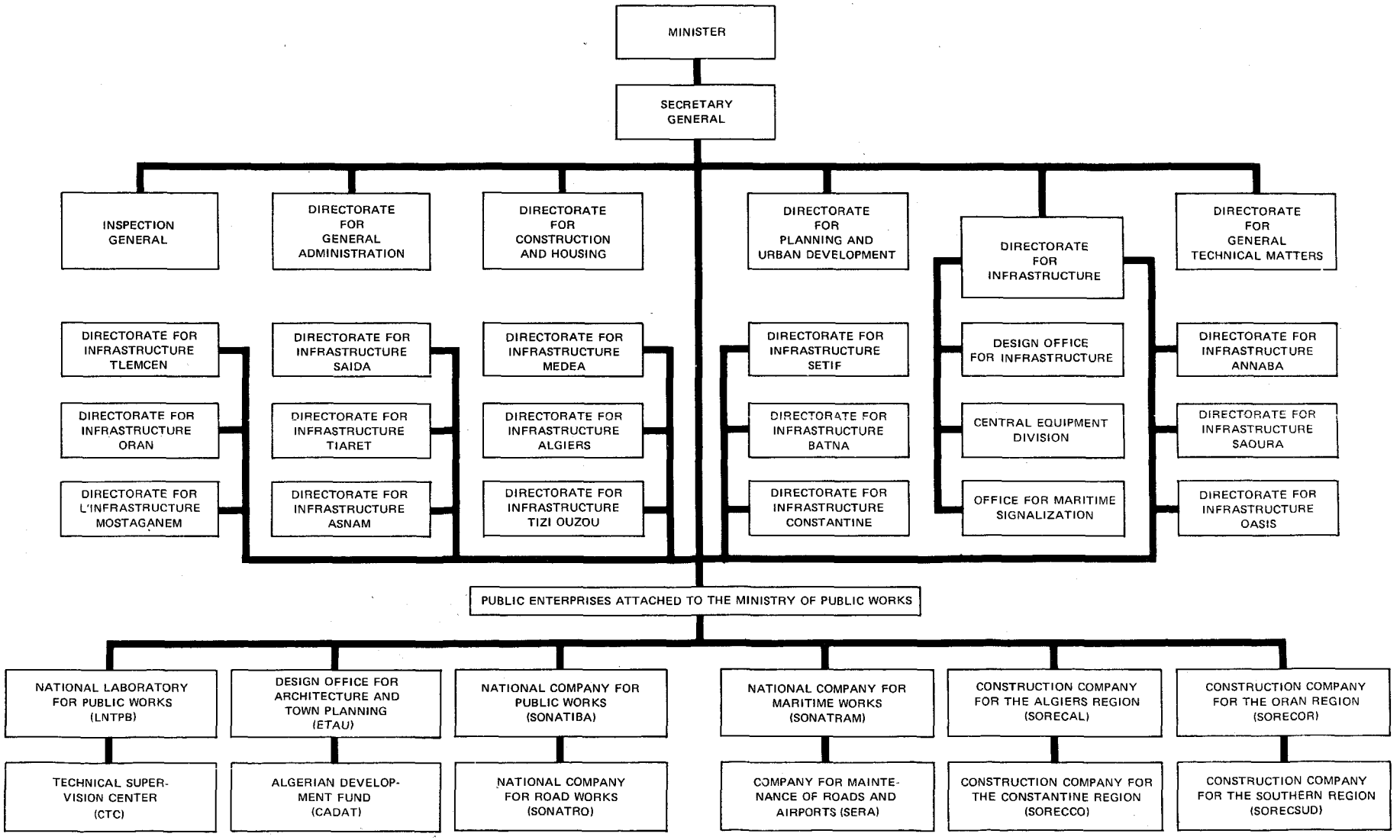
(4) When two LNG carriers are moored simultaneously on either side of the double berth piers, special safety measures must be taken during filling operations. In particular, at no time should one tanker be loaded until filling operations have been completed on the other.

(5) Spillage of cryogenic fluids on structural steel will cause recrystallization and brittleness. If steel piles are to be used, it will be necessary to provide them with a concrete, jacket to cover the splash zone.

(6) Loading platforms, as well as breasting and mooring dolphins, must be capped with concrete because of the sparking potential of mooring lines.

APPRAISAL OF
BETHIOUA PORT PROJECT
ALGERIA

ORGANIZATION OF THE MINISTRY OF PUBLIC WORKS AND CONSTRUCTION



NOTE: ACRONYMS FOR ORGANIZATION NAMES RELATE TO FRENCH TITLES OF ORGANIZATIONS AS USED IN ALGERIA.

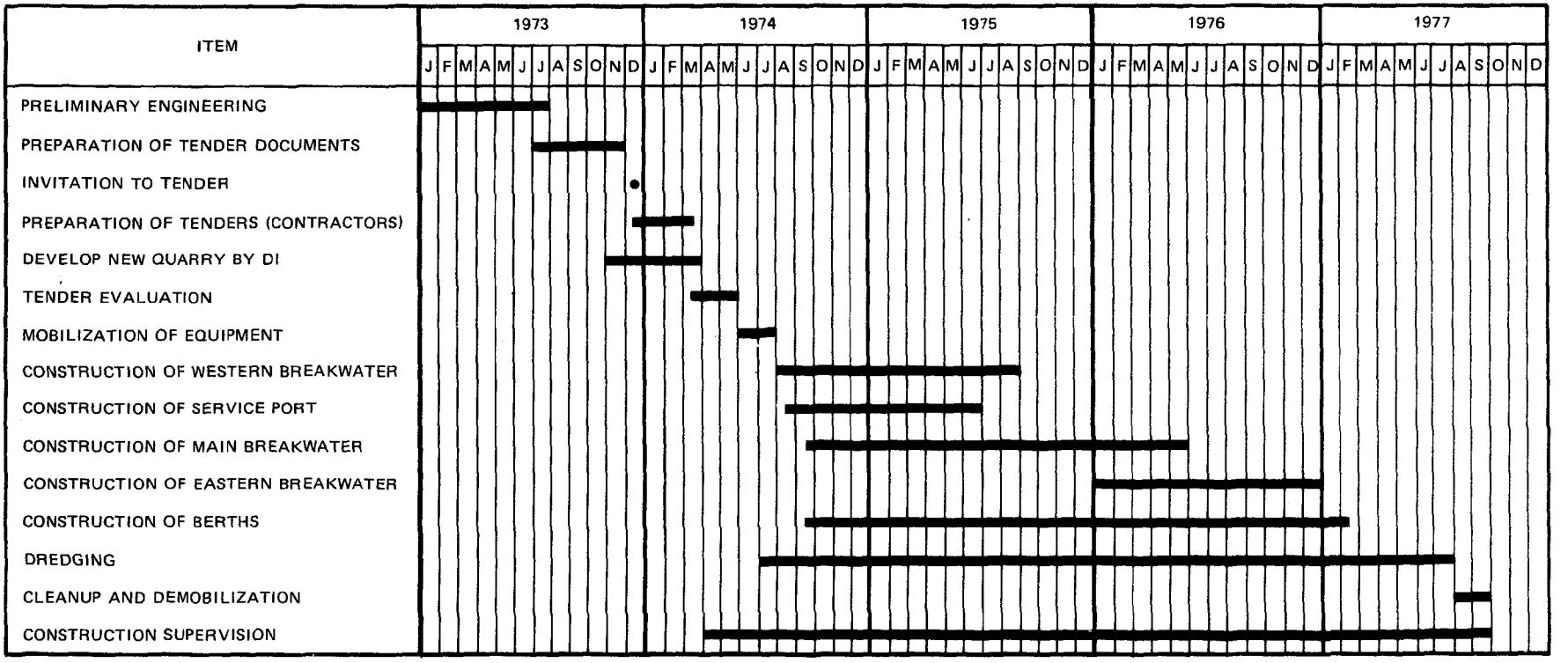
World Bank—7149(2R)

SOURCE: DIRECTORATE FOR INFRASTRUCTURE

May 1974

ANNEX 11

ALGERIA
APPRAISAL OF
BETHIOUA PORT PROJECT
Work Program



Source: Consultants' Estimates as Revised by Mission

World Bank–8355

May 1974

ANNEX 12

APPRAISAL OF

BETHIOUA PORT PROJECT

ALGERIA

Estimated Schedule of Loan Disbursements

IBRD Fiscal Year and Quarter	Cumulative Disbursements at end of Quarter US$' Thousand
1974-1975	
September 30, 1974	1,700
December 31, 1974	4,300
March 31, 1975	7,900
June 30, 1975	12,600
1975-1976	
September 30, 1975	17,800
December 31, 1975	23,700
March 31, 1976	30,900
June 30, 1976	37,700
1976-1977	
September 30, 1976	43,600
December 31, 1976	50,000
March 31, 1977	55,600
June 30, 1977	62,200
1977-1978	
September 30, 1977	66,400
December 31, 1977	68,500
March 31, 1978	70,000

Source: Mission Estimate

May 1974

APPRAISAL OF

BETHIOUA PORT PROJECT

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Principal Tariffs of ONP

	General	Skikda	Assumed for Bethioua
Ship Dues			
Taxe de Peage (Harbor Dues) per ton of cargo	Various AD 0.18 - AD 1.50	AD 1.00	AD 1.00
Droit de Quai (Berthage) per net registered ton of ship			
(a) International Cabotage (e.g. Europe)	AD 0.21	AD 0.21	AD 0.21
(b) Other	AD 0.42	AD 0.42	AD 0.42
Pilotage per net registered ton of ship	AD 0.08 - AD 0.10	AD 0.16	AD 0.16
Amarrage (Berthing) per net registered ton of ship	AD 0.12	AD 0.12	AD 0.12
Cargo Dues			
Droit de Quai (Wharfage) per ton	Category 1 / 2	Payable by SONATRACH under concession agreement	Payable by SONATRACH under concession agreement
(a) International Cabotage loaded	AD 0.10 / AD 0.20		
unloaded	AD 0.29 / AD 0.58		
(b) Other loaded	AD 0.20 / AD 0.40		
unloaded	AD 0.58 / AD 1.15		

ANNEX 14

Source: ONP

May 1974

APPRAISAL OF

BETHIOUA PORT PROJECT

ALGERIA

Government's Financial and Economic Objectives for Public Enterprises and Agencies, including those Responsible for Transport

1. The Government takes a practical approach when determining financial and economic objectives of public enterprises and government agencies, including those responsible for transport. Its policy is to mobilize capital resources so that nationwide planning and financing is facilitated for new productive assets and for replacement and improvement of existing productive assets. Funds are to be generated by the enterprises or agencies through an adequate return on capital invested and capital recovered through depreciation. To ensure that depreciation charged is adequate for purposes of pricing and capital recovery, productive assets have to be assigned rational economic lives and to be valued on a real basis.

2. In practice, fixed assets are in two categories. The first is assets for which historical costs are known, including those transferred from former owners. These are valued by applying Government financial correction indices to historical costs. The second is assets for which historical costs are not known, including infrastructure, which historically have been treated as State assets. These are to be valued on a replacement cost basis according to prescribed formula. Valuations have to be as at December 31, 1971.

3. The Government mobilizes resources by fiscal appropriations, such as income tax (at the rate of 50% of profits), by special contributions to the State budget from revenue, and by the use of capital (depreciation and reserve) funds. The principles have been established, but detailed regulations have yet to be prepared; meanwhile, the principles are being applied on an ad hoc basis. The system is flexible and allows for special treatment in appropriate circumstances.

4. In the case of enterprises having a monopoly position, the special contribution takes the form of a percentage on turnover; in other cases, it is based on the costs of each production unit, taking into account fixed assets employed, turnover, and other elements relating to the specific type of activity. The rates have not yet been established. The contribution is not an operating cost and does not reduce any income tax liability. Payment is made in the year following the year of assessment. As regards capital funds, enterprises and agencies are required to deposit them in a special account at the Treasury, when they are known as "Equipment Bonds". Normally these deposits may not be withdrawn for 5 or 10 years (depending on the option chosen), and carry interest at 5% and 6%, respectively.

5. Funds for new investments are financed from public resources, such as the Treasury, banks, or the Algerian Development Bank. Regulations for financing other capital expenditures, such as replacing, renewing, or improving assets, have not yet been issued, but will probably include exemption (partial or whole) from deposits of reserves, early withdrawal of deposits, and bank financing.

Income Tax

6. Income tax in Algeria is at the rate of 50% of profits. Most categories of ONP's income are described as "taxes" and, because of the principle that a tax cannot be taxed, ONP has assumed that most of its net income is not liable to income tax. This assumption is questionable, since ONP has been created as an industrial and commercial enterprise and its tariffs are payments for facilities provided and services rendered.

APPRAISAL OF

BETHIOUA PORT PROJECT

ALGERIA

Assumptions and Bases used In Financial Evaluation

(i) Interest during construction - Government will pay this interest to May 15, 1978, i.e. six months prior to the date of the first capital repayment of the Bank loan;

(ii) Loan terms - Bank loan - commitment charge 3/4%, interest 7-1/4%, term 25 years including four years of grace; others as given in para. 4.08;

(iii) Operating costs - developed from consultant's estimates;

(iv) Depreciation - investment recovered over 25 years;

(v) Tariffs - direct charges as currently charged at Skikda LNG port, (see Annex 14). Concession payments by SONATRACH for wharfage etc. estimated at 33-1/3% of direct charges;

(vi) Working capital - DA 1.38 million provided by Government;

(vii) Start up - transfers of capital work in progress to fixed assets in use phased according to berth construction phasing and start of exports against various LNG sales contracts;

(viii) Sensitivity Analyses - LNG plants Nos. 3 and 4 and start of product exports delayed by one year. Project completion delayed six months; and

(ix) No provision has been made for any appropriations of profit or application of depreciation funds other than for annuity payments. In particular, no provision made for:

(a) income tax;

(b) special contribution to State budget; and

(c) deposit of depreciation reserves in special Treasury Account or in Equipment Bonds (and therefore no interest income on such deposits).

APPRAISAL OF

BETHIOUA PORT PROJECT

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Financial Evaluation, Methodology

1. This project differs from a normal port project as it concerns a completely new port, designed basically to export a specialized and relatively new bulk product and associated products. Although it has a high capital cost and very long life in engineering terms (para. 2, below), its economic life for the purposes for which it is to be built and for this appraisal, depend on proven recoverable resources of natural gas in Algeria, the growing world demand for this product, and the present facts concerning sales contracts. A normal economic evaluation of the project in isolation from the whole LNG program is not possible. For these reasons, the financial evaluation of the project is in two parts: first, a discounted cash flow analysis for the 25 years covered by the first sales contract (on the assumption that proven recoverable reserves of natural gas would be exhausted by then or soon after), and second, conventional accounting forecasts from 1976, when exports commence, to 1980, the year after that for which full production of the liquefaction plants and maximum exports are planned, and 1981. Sensitivity analyses were carried out for both DCF and accounting evaluations.

2. For accounting purposes, it is considered reasonable to depreciate the project over 25 years (as for the DCF analysis) because of the:

(a) probable exhaustion of natural gas reserves in the relatively near future;

(b) doubtful economic use of the project for other traffic after depletion of the gas reserves;

(c) need of the Government to recover the capital invested within a reasonable time for reinvestment in other development projects; and

(d) inability to repay debt from depreciation on the basis of normal lives (for example: dredging, 20% of total cost, infinite life; breakwaters, 54%, about 100 years; berths, 16%, about 40 years).

APPRAISAL OF

BETHIOUA PORT PROJECT

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Revenue and Cash Flow Forecasts
(DA Million)

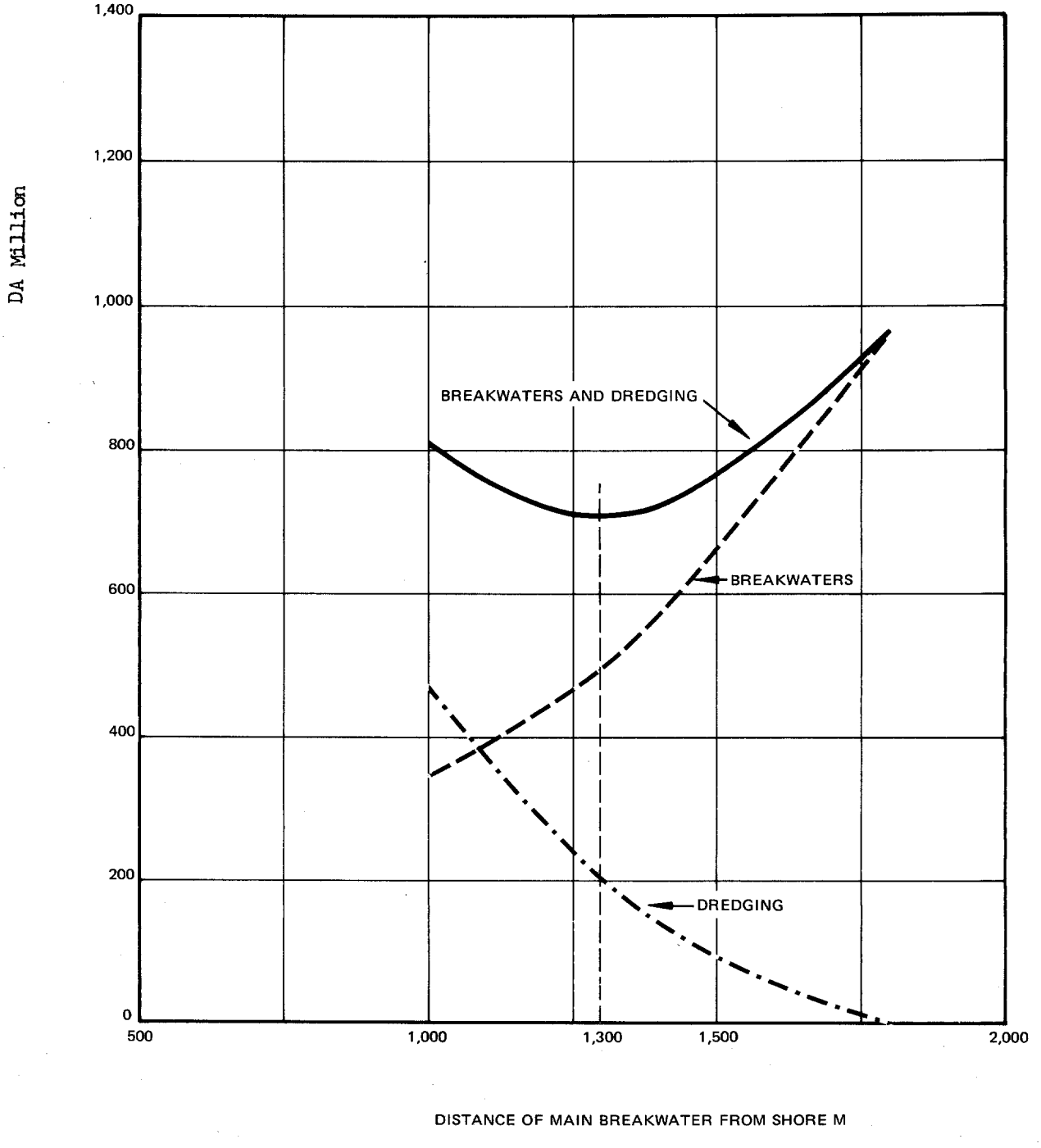
	1976	1977	1978	1979	1980	1981
Operating Revenues						
Direct port charges	37.2	67.2	87.0	102.2	102.5	102.5
Cargo and concession fees	11.2	20.2	26.1	30.7	30.7	30.7
	48.4	87.4	113.1	132.9	133.2	133.2
Operating Expenses						
Labor	4.3	4.3	4.3	4.3	4.3	4.3
Other	1.5	3.0	3.0	3.0	3.0	3.0
	5.8	7.3	7.3	7.3	7.3	7.3
Net Revenues, Before Depreciation	42.6	80.1	105.8	125.6	125.9	125.9
Investment Annuity Payment			113.0	113.0	113.0	113.0
Working Capital	1.4					
Cash Surplus:						
Annual	44.0	80.1	(-7.2)	12.6	12.9	12.9
Cumulative	44.0	124.1	116.9	129.5	142.4	155.3

Source: Bank Staff

May 7, 1974

APPRAISAL OF
BETHIOUA PORT PROJECT
ALGERIA

TOTAL COST OF BREAKWATERS AND DREDGING
FOR DIFFERENT LOCATION OF MAIN BREAKWATER



Source: Consultants' Estimates
as Revised by Mission

World Bank–8396

May 1974

APPRAISAL OF

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ALGERIA

Analysis of Number of Berths

1. Because the cost of building and operating LNG carriers is very high, every hour saved in loading daily output of liquefaction plants is worth many hundreds of dollars. A larger number of berths than the minimum required will reduce the average waiting time for ships to berth. The capital cost of additional berths, however, also is high. Therefore, a detailed analysis was made to determine whether total ship time savings could be realized that would be of greater value than the additional capital cost necessary to achieve them.

2. The 35.64 million m^3 annual output of two LNG plants (daily throughput of 108,000 m^3 for 330 working days) will be transported to both the United States and European markets. LNG carriers will be loaded to 98% of capacity (allowing for loading to 99% and loss of 1% during filling operations). For the United States market, 125,000 m^3 capacity carriers will be used and 291 loads per year will be required. In 330 working days, average time between arrivals will be 27.2 hours. With 22.5 hours at berth, a minimum of two berths will be required. For the European market, 75,000 m^3 average capacity carriers will be used and 485 loads per year will be required. Average time between arrivals will be 16.3 hours. With 20 hours at berth, a minimum of three berths with two loading facilities will be required. However, actual intervals between arrivals will vary considerably from the average due to weather conditions and route structures. Consequently, the number of ships in port at some periods will be above or below average. For periods with above average ships in port, additional facilities will reduce ship time lost due to waiting as well as stress on shore storage facilities.

3. The value per hour of waiting time saved has been computed separately for each market because of the difference in construction and operating costs of LNG carriers. A conservative project lifetime of 25 years has been assumed in the computations.

4. The capital, financing, and operating costs for carriers with capacities of 125,000 m^3 and 75,000 m^3 over a 20-year life were estimated by the Economist Intelligence Unit (EIU) (UK), assuming 340 days of operations per year. For the 125,000 m^3 carrier, EIU estimates hourly cost at DA 7,500 on the basis of capital cost of DA 269.2 million. However, carriers now on order for use to the United States (El Paso Natural Gas Co.) will cost about DA 360 million. At this capital cost plus interest, hourly cost will be DA 8,172. For the 75,000 m^3 carrier, EIU estimates hourly cost at DA 5,400.

5. In defining the general port layout, production rates have been considered only in the final phase since the intermediate phases are too short to affect final determination of the number of berths.

6. A comparison of construction, financing during construction, and present value of 25-year maintenance costs for several options with the value of time saved for each option were analyzed. The project, which has been developed as the final port layout, comprises the optimum number of berths based on the results of the above study (three berths for the United States market and three for the European market).

7. The value of time saved to ship operators enables ultimate purchasers to pay Algeria that much more for LNG f.o.b. port. Thus Algeria can expect to recoup in LNG sales prices any additional port costs involved in the project.

8. A study was also made to assess the optimum number of berths needed for crude oil and condensate exports. The study was based on traffic forecasts (para 6.04 and Annex 2, para 6) and size of tankers (Annex 15, paras (f) and (h)). As a result, construction of three berths for both commodities was recommended.

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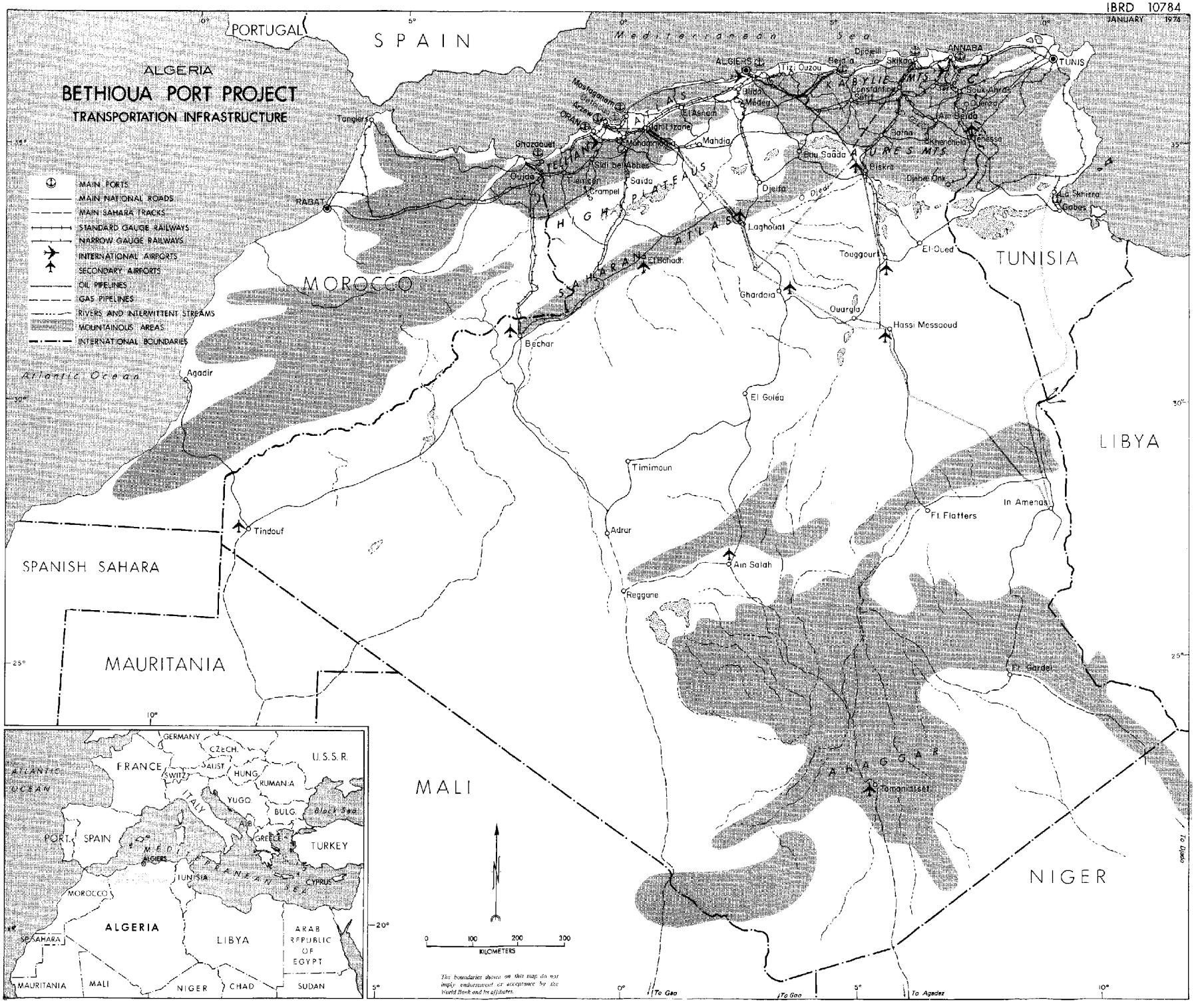
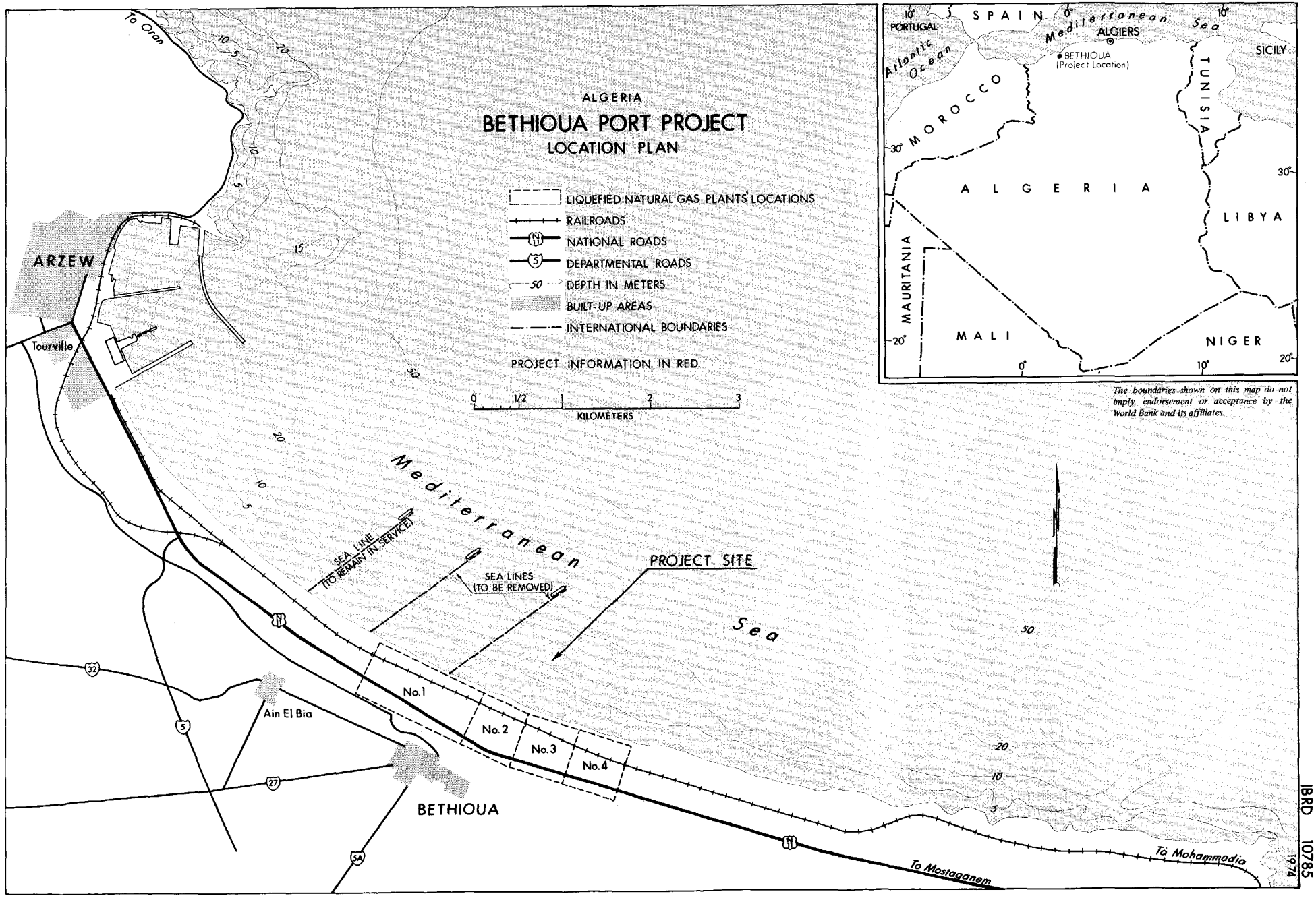
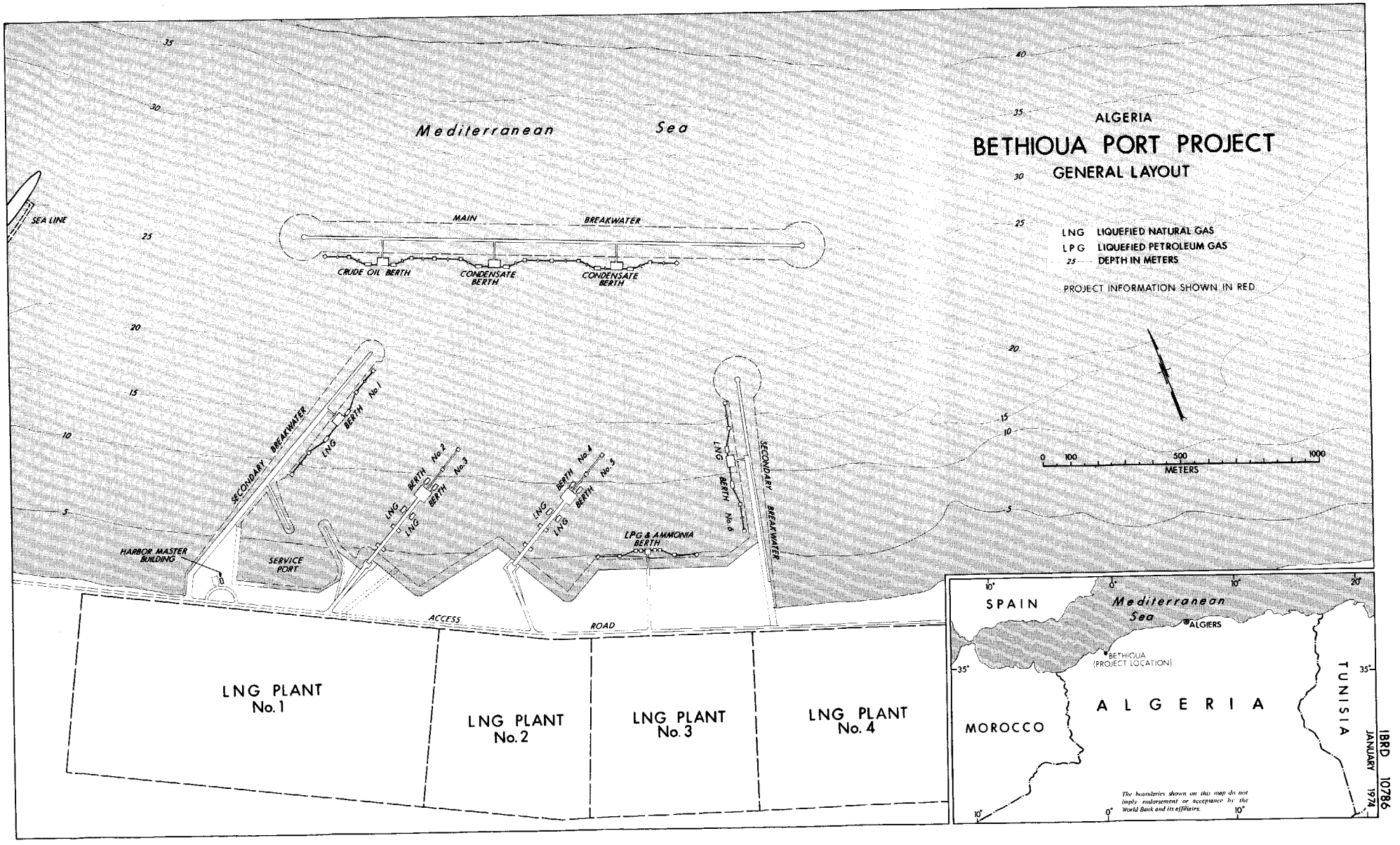
JANUARY 1974




ALGERIA
BETHIOUA PORT PROJECT
LOCATION PLAN
LIQUEFIED NATURAL GAS PLANTS LOCATIONS
RAILROADS
NATIONAL ROADS
DEPARTMENTAL ROADS
DEPTH IN METERS
BUILT-UP AREAS
INTERNATIONAL BOUNDARIES
PROJECT INFORMATION IN RED.
0 1/2 1 2 3
KILOMETERS
To Oran
ARZEW
Tourville
Ain El Bia
BETHIOUA
SEA LINE (TO REMAIN IN SERVICE)
SEA LINES (TO BE REMOVED)
PROJECT SITE
Mediterranean Sea
No.1
No.2
No.3
No.4
To Mostaganem
To Mohammadia
PORTUGAL
SPAIN
Mediterranean Sea
ALGIERS
BETHIOUA (Project Location)
SICILY
Atlantic Ocean
MOROCCO
TUNISIA
ALGERIA
LIBYA
MAURITANIA
MALI
NIGER
The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates.
IBRD 10785
1974



IBRD 10786
JANUARY 1974