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October 24, 1985

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Subject: Cape Verde Desalination
and Power (SAL) Project
W.O. 4850 - BRISC #589
Final Report - Rev. 8/31/85

Reference: BRISC Letter #571, dated 9/21/84
BRISC Letter #587, dated 4/22/85

Agency for International Development
AFR/DR/SWAP - Room 2733A
New State Building
Washington, DC 20523

Attention: Mr. G. Cashion

Dear Mr. Cashion:

Attached are four (4) copies of the Project Evaluation Final Report for your reference and use. This issue is the same as draft report submitted in April, 1985 with the following revised and updated pages:

Table of Contents - added sheet for Appendices (sheet ii)
Note (sheet iii)
Pages 1-1 through 4
Page 2-1
Page 3-2
Pages 4-2 through 6, 4-12 and 4-13
Page 5-2
New Appendix E, containing 5 sheets of statistical data providing water and power production/consumption furnished by GOCV

Updated site data received in July, 1985 has also been included in the above revised pages.

As we discussed over the telephone some time ago, the project's most urgent need is some new permeators. Actually, we provided in the report the identification of 10 worst performing membranes to be replaced at the earliest possible time. We also had provided you with a telex quotation from Polymetrics for furnishing new permeators. We do not have a copy of Polymetrics report on their plant fix during February-March, 1985. However, we understand that they do not intend to furnish any replacement permeators as a part of their guarantee. We feel that any guarantee claim by GOCV may be challenged by the vendor due to operational anomalies (against limits set by the Operating Manuals) such as high delta-p across the membrane and reuse of disposable cartridges in filters. This could lead to a long drawn argument and loss of time and effort. What is important right now is to order some new permeators for the plant to improve performance and economics.

Burns and Roe Industrial Services Corporation
700 Kinderkamack Road ■ Oradell, New Jersey 07649 ■ Telephone: NJ (201) 265-2000 NY (212) 563-7700
Telex: 13-0353

BRISC

Mr. G. Cashion
Agency for International Development

October 24, 1985
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I do not intend to repeat the other recommendations in the report. However, as you indicated, if new funding is adequate an on-shore intake pit could be built to resolve permanently the pump suction problem due to winter storms.

Our contract performance period ended on March 31, 1985 (PACD). You also advised that our proposal dated May 18, 1985 for additional services was not approved. In case you reconsider the situation and have FY 86 funding, we will be glad to assist AID/GOCV in implementing any or all of the recommended actions for improving the project performance.

In case you have any questions, please let us know.

Very truly yours,

Amit Chattopadhyay

Amit Chattopadhyay, P.E.
Project Manager

AC:cdn
Attachments
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CAPE VERDE

DESALINATION AND POWER

(SAL) PROJECT

CONTRACT NO. AID/afr-c-1531

PROJECT EVALUATION

FINAL REPORT

(REPORT NO. 37)

MARCH 29, 1985

Rev. Aug. 31, 1985

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APPENDIX D - SELECTED REFERENCE DOCUMENTS

APPENDIX E - STATISTICS OF WATER & POWER PRODUCTION/ CONSUMPTION (1983 & 1984)

Added 8/31/85

NOTE

The project evaluation report was originally scheduled to be issued eight months after plant initial operation in March 1983. However, in order to coincide with the 1-year "deferred performance test" of the desalination equipment the report was rescheduled to March, 1984.

In the meantime, desalination equipment problems started affecting the water production in early 1984 and an interim test and inspection was made in May, 1984. A claim was made to the equipment supplier, Polymetrics, and the performance test was further postponed subject to the Vendor's correction of the situation. Polymetrics after spending over eight months in obtaining new parts, performed field change work and membrane cleaning in February, 1985.

The performance test was made on March 5, 1985 and subsequently this final evaluation report was prepared. Additional operational data received from field beyond the March 31, 1985, date (PACD) have been included to the extent relevant to this report.

1.0 OVERALL REVIEW

1.0 OVERALL REVIEW

Through the close cooperation and financing by the Agency for international Development (AID) and the Government of Cape Verde (GOCV), the Sal Island Desalination and Power Project was completed.

The project had been anxiously awaited by the population of Sal. The island's fear of water shortage, rationing and at times fearing complete absence of potable water production has ended by the successful completion of this project. The immediate impact was the closing down of the obsolete steam evaporation desalination plant in Santa Maria, and the plant at Espargos which produced potable water for the airport. Over 500 households are connected to the water mains and over 800 connections were made providing electric power. Moreover, numerous applications for new connections have been received. People who are now served with piped-in fresh water and house electric connections are the primary beneficaries of the project. Moreover, potable water is trucked to the communities and made available to the households on a daily basis. This is one of the most effective people to people programs between the U.S.A. and the Republic of Cape Verde.

Improvement of water and power supply for the Amilcar Cabral Airport has already benefited the most important industry on the island. This airport is now able to accept increasing number of landings per week. The foreign exchange earned by the airport activity is vital for the entire republic.

Extensive town street lighting has been provided and existing ones modernized.

Other government facilities and industry and commerce in Palmeira and Espargos/Preguica area account for additional scores of water and power connections, helping boost the economic activities on the island.

Overall improvement in the standard of living and economy on the island has been achieved.

GOCV formed an independent water and power authority named Electricidade e Agua do Cabo Verde (ELECTRA), with a delegation on Sal Island which is responsible for the operation of the plant.

Important Project Information:

A. Plant Capacities:

Desalination Plant	-	550 m^3/d (average), 660 m^3/d (installed)
Desalination System	-	Reverse Osmosis (R.O.)
Diesel-generators	-	2x500 kW

Communities directly served by the project - Palmeira, Espargos/Preguica, Airport

Water is supplied by truck to other communities.

B. Financial Data:

US AID funding	-	$7,790,000
GOCV "in-kind" contribution	-	$1,635,793
GOCV Contribution of land and existing facilities, valued at	-	$1,070,000
Total Project Cost		$10,495.793

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C. Project Completion Dates:

Desalinated water production started:	March 18, 1983
Supply of water by tank trucks started:	March 28, 1983
Commerical sale of electrial power (to Shell) started:	March 31, 1983

Problems and Recommendations

There are several problem areas in the project which require urgent action. The most important action item is to install a number of new permeators in the desalination plant in order to bring the overall product recovery to the desired range. Present recovery rate has dropped to approximately 55% of the design value (with poorer water quality than design) resulting a very high cost of water production. The problem was first analyzed during May-June, 1984 and the vendor was notified of the problems. To remedy, Polymetrics installed some replacement stainless steel parts and attempted a thorough cleaning of the R.O. membranes in February/March, 1985. However, the performance of the desalination equipment remained significantly below the design values, as shown below:

	Design	Actual (March, 1985)
Quantity	660 m^3/d	380 m^3/d average
Quantity	600 ppm	925 ppm average

An attempt should also be made for possible guarantee claim for replacement of permeators per GOCV contract with the supplier.

Some areas of the water storage tanks are showing corrosion. This also requires urgent action. Due to the corrosive nature of the ocean-front atmosphere, rusting will be progressive unless a

corrective measure is taken. Services of a paint expert, preferably from the tank manufacturer (Butler) is recommended to implement a paint repair schedule.

The water surge in the natural intake well which causes suction failure of intake pumps has been a problem during the stormy winter months. Although in the 1983-1984 season this problem caused a minor downtime, in the 1984-1985 season the problem routinely caused plant shutdown for about two days every week for several weeks. The effort of Electra in installing one suction pipe to lower sea level (-8 m) will alleviate this problem. Moreover, the present consideration by GOCV for application of a submersible pump to provide priming water during winter storms will be an added advantage. Contruction of an on-shore well should be considered after 1985-1986 season if the other two measures mentioned above become inadequate to maintain water and power production.

Among other problems, the stainless steel flexible connections at high pressure pump discharge which showed repeated leaks and failures should be changed to rigid spools made of 316LSS material. The flexible joint at the energy recovery turbine, however, can not be similarly substituted due to the movement required for belt-tightening. Polymetrics should be requested to furnish the replacement pieces.

It is also recommended that sufficient spare parts and operating chemicals are in stock well ahead of time to asure their availability at all times. This will also help avoiding costly air-freight charges.

Finally, the quality of operation and maintenance (O&M) must be maintained at all times. In this regard Electra may consider contracting external expertise in some areas of O&M, if needed. Replacement of a trained employee should be done with a similarly trained person. Moreover, Electra's chief water chemist from Mindelo should make periodic visits to Sal plant to verify adequacy of various analysis and dosages required at the desalination plant.

2.0 PROJECT BACKGROUND

2.0 PROJECT BACKGROUND

This project was initiated by a feasibility study prepared by a technical and economic team sent to Sal by AID in March 1977.

The study (Project Paper) recommended complete systems of potable water production, delivery and distribution; power generation, transmission and distribution to all the five (5) communities on Sal Island consisting of the Airport, Espargos, Preguica, Santa Maria and Pedra de Lume. It also recommended the installation of sewerage for Espargos, Preguica and Santa Maria for collecting, treating and storing the fresh wastewater for agricultural uses. Included also were 20 housing units for the plant operators.

In July, 1979 AID awarded the A/E contract to Burns and Roe Industrial Services Corporation (BRISC).

Project Phasing Concept

In November, 1979 BRISC completed the project conceptual design of all systems recommended in the project paper. BRISC also prepared a cost estimate which showed the original authorized funding was insufficient for carrying out the total program as originally recommended.

In order not to postpone projcet implementation, AID and GOCV decided to undertake the construction in two phases. Phase I would be to build the basic systems with the presently available funding.

Phase II would be to complete the remaining program when additional funds would become available.

Figure-I shows the map of Sal Island indicating the communities directly served by Phase I Scope.

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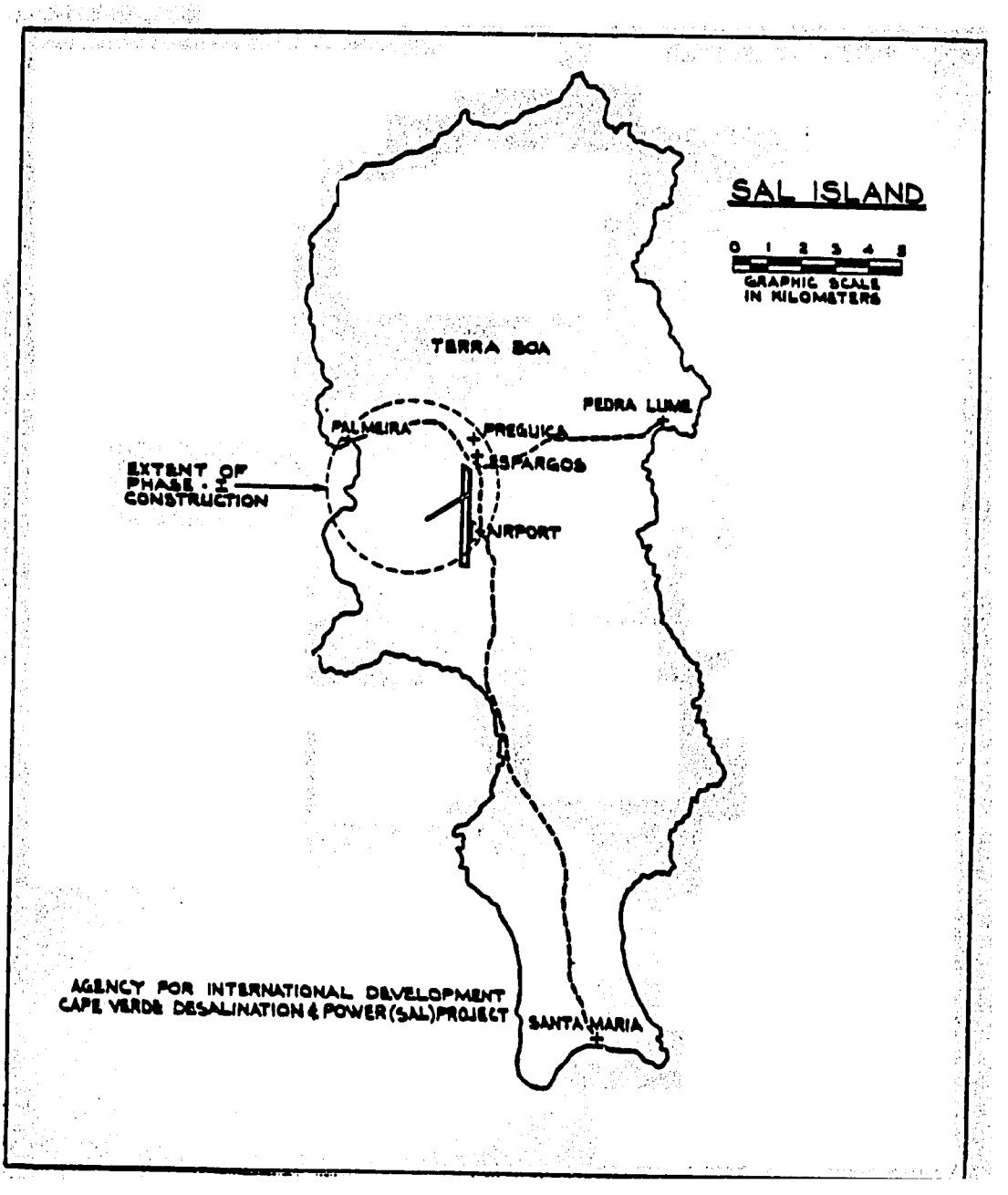

Figure - I
Sal Island

(also shown are major communities and roadways)

Project Financing

Total project cost for Phase-I was approximately $10.5 million with AID and GOCV participation as follows:

AID Contribution

Total AID funding for the project was $7,790,000, and consisted of the following grants:

FY 78	6,290,000
FY 81	900,000
FY 82	600,000
Total	$7,790,000

GOCV Contribution (in equivalent U.S. dollars)

Shipping	$1,153,208
Local Materials	23,145
Local Labor	86,098
Buildings rehabilitation for housing and field offices	207,000
Miscellaneous	166,342
Total "in-kind"	$1,635,793
Land and existing facilities	$1,070,000

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Contractors

There were four U.S. contractors participating in the project:

1) Architect/Engineer Services - Burns and Roe Industrial Services, Corp. (BRISC) Oradell, New Jersey

2) Desalination Equipment - Polymetries, Inc. San Jose, California

3) Power Generation Equipment* - Maison International Norwood, New Jersey

4) Construction and Installation and balance of plant equipment - Ruhlin/Wallace, a joint venture of Ruhlin Company of Columbus, Ohio and Carl P. Wallace of Dallas, Texas.

*Diesel engine manufacturer - Cummins

Schedules

A/E Contract was awarded in July, 1979. Conceptual design and cost estimates were completed toward the end 1979. Several months of time was elapsed for arranging increased AID, and GOCV financing, project phasing concept development and revising project economic analysis. Figure II shows the overall project schedule for the Phase I scope. Design was restarted in April, 1980 and pre-purchase equipment contracts were awarded in the third quarter of 1981. Construction contract was awarded in January, 1982. Construction was completed and water/power production started by end-March, 1983. BRISC operation and training supervisor continued his stay at site during eight months of operation

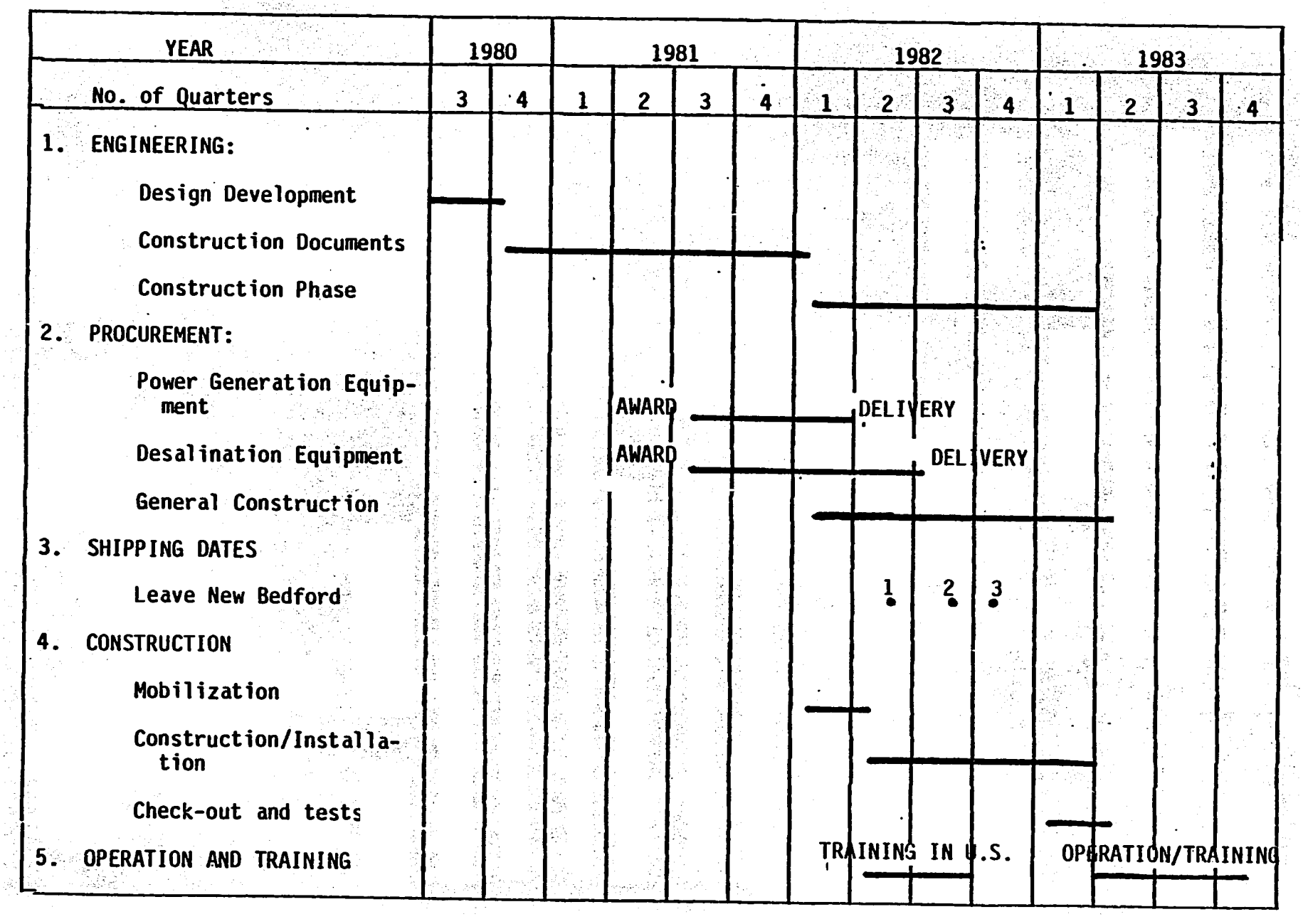

FIGURE II Overall Project Schedule

3.0 DESIGN SUMMARY

3.1 Phase I Construction Scope

3.2 System Capacities

3.3 Water and Power Transmission

3.4 Town Distribution Systems

3.0 DESIGN SUMMARY

A schematic representation of the project is provided in Figure-III.

3.1 Phase I Contruction Scope

Phase I involved the construction and installation of a desalination and power generation plant in Palmeira to produce 660 m3 per day of potable water with provision for future expansion to 900 m3 per day. The potable water is stored in a steel tank of 2000 m3 at the Palmeira plant site. The water is pumped and delivered to a 980 m3 tank located at 74 m elevation on Morro Curral. The water is conducted by distribution mains and submains to users in Espargos, Preguica and the airport. A 100 m^3 overhead water storage tank is provided at the airport. Provision is made to extend the distribution systems to Pedra de Lume and Santa Maria in Phase II. The Palmeira water distribution system was included in Phase I.

Installed power generation in Phase I consisted of 2-500 kw diesel generators with provision for doubling the generating capacity in the future to meet the demand for 15 years of industrial and population growth. The generated power is transmitted to substations in Espargos and the airport by 11 km of direct buried 13.8 kV power cables. From the various substations the electric power is distributed to Espargos/Preguica and the airport with new poles added where required; additional street lighting was also installed. Provisions were made to extend the power transmission and distribution to Pedra de Lume and Santa Maria in Phase II. An administration building is

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constructed at the Palmmeira plant site. Construction of workers' homes and sewerage and wastewater treatment systems were excluded from Phase-I.

3.2 System Capacities

3.2.1 Desalination Plant

The desalination plant output capacity was based on an average daily production of 550 m^3/d. Assuming an availabilty factor 83%, the installed plant capacity was specified at 550 ÷ 0.83 or 660 m^3/d. Three-shift operation of the plant is required.

The plant consists of a full pretreatment system followed by three (3) parallel trains of Reverse Osmosis (R.O.) systems of 220 m^3/d capacity each.

It was projected that after about 5 years of operation another 220 m^3/d R.O. system capacity will be required to be added to meet the increased demand.

3.2.2 Power Generation

Based on an initial peak demand projection of 884 kW, two (2) 500 kW diesel-generators were specified for Phase I construction. Obviously this leaves no spare generator during the peak load hours.

3.2.3 Storage Capacities

The main storage tank at the Palmeira plant site is 2000m^3 capacity. This provides over 72 hours of full rated plant

production or approximately a week's water demand at the actual present rate of 290 m^3/d.

The 980 m^3 storage tank on top of Morro Curral provides gravity distribution to the population of Espargos/Preguica. The airport has been provided with its own 100 m^3 overhead tank.

3.3 Water and Power Transmission

3.3.1 Potable Water Transmission

Main transmission line from Palmeira 2000m^3 storage tank to the Espargos/Preguica 980 m^3 storage tank, and upto Airport - 6" underground pipeline. Pumping capacity is 75 m^3/h. The system is suitable for providing water upto 20 years of demand growth.

3.3.2 Electrical Power Transmission

Main transmission line from the substation at Palmeira plant site is 15 kV 3/C#1 Aluminum Cable, suitable of carrying upto 2000 kW of load to Espargos/Preguica communities.

3.4 Town Distribution Systems

3.4.1 Potable Water Disbribution

a) Palmeira

i) Water supply to the plant site
ii) Tank truck fill station
iii) Town street underground 4" mains and 2" submains
iv) 3/4" laterals and curb stops for house connections
v) Overhead tank was excluded from Phase-I.

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b) Espargos/Preguica (including part of Hortela)

i) Town street underground 4" mains and 2" submains
ii) 3/4" laterals and curb stops for house connections
iii) Overhead storage tank, 980 m^3

c) Airport -

i) Supply piping underground 4" main and 2" submains
ii) 3/4" laterals and curb stops
iii) Overhead storage tank, 100 m^3

Electric Power Distribution

a) Palmeira

i) Power supply for plant equipment and plant lighting
ii) House connections with meter
iii) Town street lighting

b) Espargos/Preguica (including part of Hortela)

i) House connections with meter
ii) Town street lighting

c) Airport

i) Interconnection with airport generating station
ii) Connections with meter to the airport and commerical facilities
iii) Street lighting

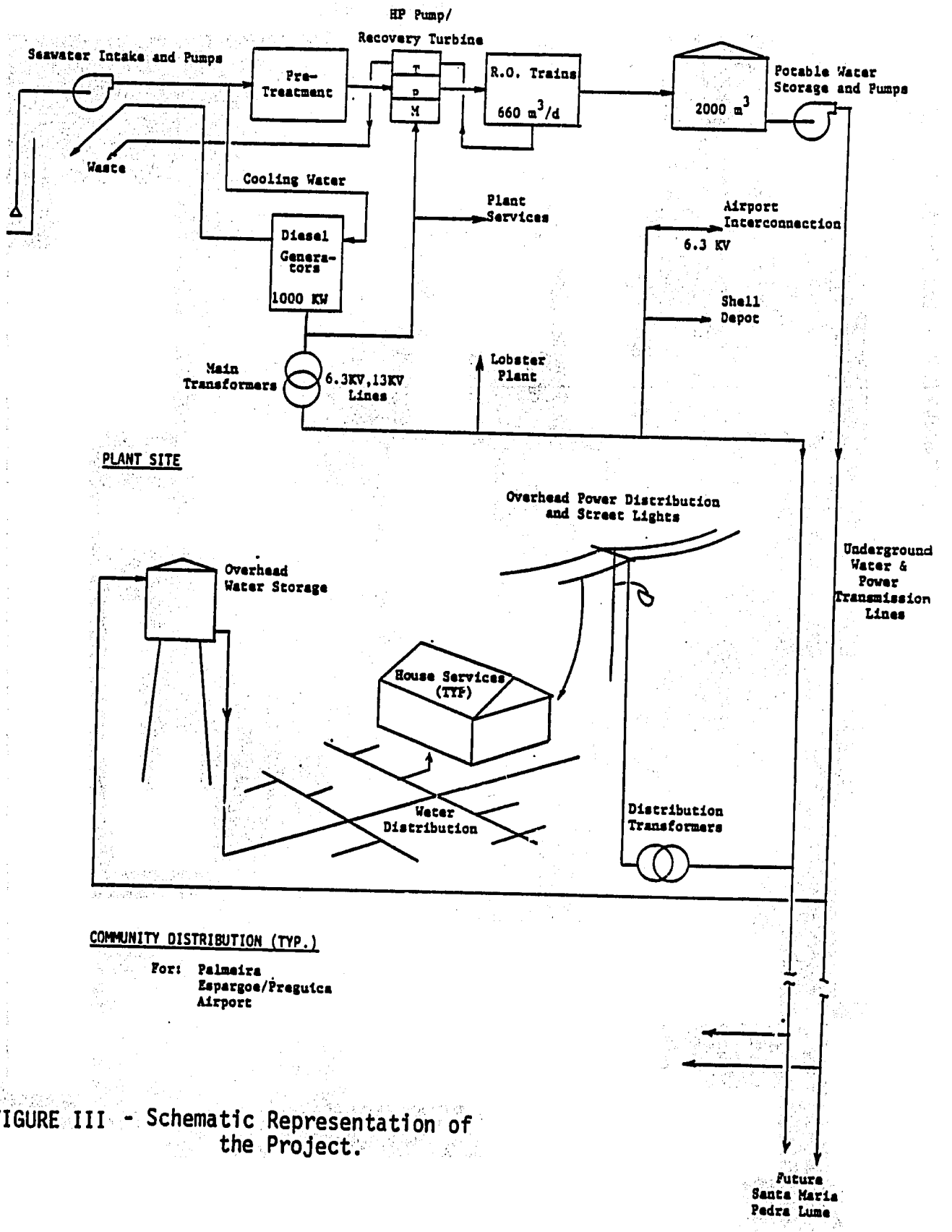

FIGURE III - Schematic Representation of the Project.

4.0 EVALUATION OF PLANT SYSTEMS

4.1 Overall Design

4.2 Equipment

4.3 Performance

4.4 Production Costs/Revenues

4.5 Operation and Maintenance

4.0 EVALUATION OF PLANT SYSTEMS

4.1 Overall Design

4.1.1 Project Concept and Achievement

The chronic water shortage on Sal Island could only be resolved by providing an adequate size seawater desalination plant.

Original investigation and field research for building a desalination and power plant with distribution systems on Sal Island were carried out by a technical team sponsored by AID. This investigation was conducted in March, 1977 and recommended implementation based on its technoeconomic viability. This was presented in the AID "Project Paper".

BRISC studies concurred with and followed the overall AID concept. Some of the design parameters were revised based on up-to-date field data gathered during early design stage.

The project was implemented as Phase-I, which included the water and power plant and limited the distribution water and power to the major population centers and the airport.

The project as designed and constructed achieved the goal of supplying water and electricity to two-thirds of the Sal Islanders as well as to the airport, which is vital to the economy of the entire republic. Moreover, abundance of drinking water is expected to restore public health and together with the availibility of electric energy, the island's economic growth is underway. This results in the fulfillment of the goal of improvement in standard of living of the Sal Islanders.

The following are several examples of commerical and industrial facilities being planned or are in construction stages on Sal based on the improved availability of water and power:

1) SALMAR (the Lobster Plant) completed the expansion of its facilities to include freezing, ice making and fresh food storage (for local consumption). It has installed storage capacities of 640 tons each for fish, lobster and food. It has capacity for making 10 tons of flake ice for selling to fishing boats to take to sea for preserving the fish to bring back to port. The fishing fleet will be increased from the present three ship fleet to sixteen of smaller sizes. In the initial period before the completion of the Palmeira pier construction it is anticipated that SALMAR will attain 30 to 50 percent production capacity. The initial power consumption of this plant will be 240 kVA and will ultimately reach 400 kVA.

2) The Palmeira port construction was started in October, 1984 and to be completed soon. The pier can berth ships up to 300 tons. Sal Island will export frozen fish and lobster by ship directly to Europe and likewise import its needed products.

3) The airport commissioned Italian architects to make plans for expanding the modernizing its facilities, the terminal buildings, to include a modern 75 room hotel at the airport

4) A new hotel in Santa Maria is now under construction. The hotel (95 rooms) wil be owned by a joint-venture (private and government) company called Hotelmar to be financed by a French source. The same French source will probably finance

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the water and electricity transmission lines from the airport to Santa Maria. The present Hotel Morabeza at Santa Maria completed a major expansion of its dining rooms and has an addition of 80 rooms under construction.

4.1.2 Plant Capacities

The demand for water and electricity on the island is steadily increasing. Prior to construction of this project the total water available was 170 m^3/d (including brackish water, unsuitable for drinking). Now the average demand has grown to 290 m^3/d. This is somewhat lower than the projections made in 1979. The following table provides the comparison:

(only 5 years shown)

Years of Operation	Water Demand Originally projected m^3/d	Actual Water Demand m^3/d
1	396	170
2	435	290
3	468	-
4	501	-
5	534	-

It is obvious that the water plant sizing has been adequate. The timing of future addition should be adjusted to reflect actual growth pattern.

Electra is providing house connections on demand basis. A total of 527 connections have been provided so far:

Government Facilities	37
Industry and Commerce	27
Private Homes	463

Demand for electricity is also steadily increasing. The two(2) 500 KW each diesel generators must both run at times to meet the peak demand. Moreover, the existing generators at the airport plant also operate as needed. It must be noted that at this time the electric power demand in Santa Maria and Pedra de Lume are met by their local generators and are excluded from this project. Forecasted and actual demand data are provided below:

(only 5 years shown)

Years of Operation	Power Demand Originally projected(1) Year total/Peak	Actual Power Production(2) Year total/Peak
	MWh/kW	MWh/kW
1	3765/800	2356/(3)
2	3938/832	(4) 2941/(3)
3	4112/869	-
4	4285/906	-
5	4459/945	-

Note:

(1) (Phase I only)

(2) Excludes Airport Generators

(3) Data Unavailable

(4) Estimated by Interpolation of Data for First 9 Months

The generating capacity as installed is adequate to meet present demand. However, because of current high peak demand and to alleviate burden on the airport generators, the third 500 kW (spare) diesel enerator should be installed soon.

A total of 832 connections have so far been provided for the electricity consumers:

Government Facilities	17
Industry and Commerce	9
Private Homes	806

The goal of providing house connections to 1000 homes (80% of the island total households) has not yet been fully materialized. However, new connections are being added on a continuous basis.

4.1.3 Desalination Process

During the conceptual stage a process selection study was conducted. The study indicated a clear economic advantage of the Revese Osmosis (R.O.) System over the vapor systems for seawater desalination on Sal. Consequently, an R.O. system, together with energy recovery from the high pressure reject concentrate, was adopted for design. The drive power for the high pressure pumps is obtained from the diesel-electric plant.

It is important that only trained operators operate the R.O. plant and in strict accordance with the manufacturer's operation manual.

4.1.4 Materials Selection

Handling of seawater required special attention to the materials selection for corrosion consideration.

Major selections were as follows:

Low Pressure Systems	- FRP and PVC piping
High Pressure Systems	- 316L SS piping
Process Vessels	- Rubber lined steel, FRP
Low Pressure Valves	- PVC, bronze or rubberlined steel
Intake pumps	- All bronze
Process pumps	- 316L

Due to budget restrictions, exotic alloy materials were not specified. However, all the specified items are of good engineering selection considered adequate for the intended use.

For potable water system, main delivery and distribution lines were of PVC material with ductile iron fittings. Valves cast iron except for 2 inch and below which were either PVC or bronze.

Underground fuel oil line was steel with factory coated outerlining.

4.1.5 Problem Areas

One area of design which is creating problem is at the intake. During stormy winter months the surge action at the intake well becomes so great at times that the suction is lost. The horizontal centrifugal intake pumps become airbound due to passage of air through the suction pipe and fail to reprime. Due to lack of feed water the desalination plant and the diesel generators must be shut down until the pumps are reprimed.

During the 1983-1984 winter season the lost availibility was relatively minor. However, during the 1984-1985 winter season

the stormy weather continued for several weeks causing almost two days of shutdown every week during that period. In this case site water storage tank could not provide adequate surge capacity due to simultaneous low water production rate (see paragraph 4.2.1).

See Section 5 for discussion on remedial actions.

As a background information it may be recalled that to avoid an expensive on-shore intake suction pit installation, BRISC intake design considered using a existing natural well instead. The natural well, based on original measurements*, would have provided 7 ft. 9 in. submergence at low water, which was considered adequate to provide margin for wave or surge action. However, due to the site conditions developed during construction, the elevation of suction pipe foot valve was installed 3 ft. higher than that shown on the design drawings. This aggravated the suction problem during the rough weather.

*Note:
Measurements were taken by a local diver hired by GOCV. Refer to Report No. 14 dated October, 1980. During construction some of the measured data were found to be inaccurate.

4.2 Equipment

A plant equipment list is provided in Appendix-A for ready reference.

4.2.1 Desalination Equipment

This equipment was supplied by Polymetrics which utilized R.O. membranes manufactured by DuPont. Major components of this system are:

-Raw Water Storage Tank
-Booster Pumps
-Two stage media filtration
-Backwash system with pumps
-Micron filtering
-H.P. pumps
-R.O. System
-Membrane cleaning system with pumps
-Energy Recovery Turbines
-Chemicals Feed Systems
-Control Panel

The equipment is not performing well due to degradation of R.O. membranes in all three trains. The problem started with the iron fouling due the corrosion products from the accumulators at the H.P. pump. The supplier was advised of the problem since the early 1984. Polymetrics acknowledged the problem with the accumulator material (was originally supplied with carbon steel body with hypalon coating) and new 316L SS accumulators were installed in February, 1985. At the same time Polymetrics also attempted to rejuvenate the membranes by special chemical cleaning. Performance test conducted in early March, 1985 showed some improvement but still falls far short of the guarantee conditions. A chronology of events is provided in Appendix-B. Also refer to Paragraph 4.3.1 of discussion on performance.

Another problem was with the leaky high pressure flexible joints. Several new joints were supplied by Polymetrics. These replacement parts were required to undergo better quality assurance than the original ones. H.P. pumps discharge joints can be changed to rigid pieces. However, those at the energy recovery turbine can not be replaced with rigid ones as explained below.

One equipment design error which was uncovered during start-up is the position of the slack side of the power transfer belt between the recovery turbine and the H.P. pump. Only way the belt tighting is accomplished is by periodically (2-3 times a year) adjusting the recovery turbine positioning bolts. This requires use of vendor supplied spacer plates and for minor positioning adjustments the flexible joints remain useful.

4.2.2 Power Generation Equipment

For the last one year the two 500kW each diesel-generators (no spares) have been performing satisfactorily. However, generator shutdowns have occurred during winter storms caused by occasional lack of seawater cooling intake problems.

Thediesel engines are manufactured by Cummins and the generators by Kato. PACS Industries supplied the switchgears.

4.2.3 Balance of Plant Components

Balance of plant equipment was supplied by Ruhlin/Wallace who was also the general installation and construction contractor.

a) Seawater Supply System
   3 horizontal centrifugal type seawater pumps provide supply water to the desalination plant and cooling water to the diesel engines (using heat exchangers). Each pump is rated 114 m^3/h, and was manufactured by Goulds. The pumps are of all bronze construction with SS shaft as specified. The impellers have been reported to have undergone visible metal loss. Some corrosion of bronze is expected in seawater service.

This probably have been aggravated by cavitation (during big surges) and/or by suspened rock particles. Periodic inspection and repair should be performed, if necessary. Impeller replacement may be required after approximately 3 years of operation.

The shafts were originally supplied in carbon steel material by an oversight by the Contractor. The carbon steel shafts failed in mid-1984 but subsequently have been replaced by the Contractor by 316 SS material at no charge. No further problem is reported in this regard.

b) Potable Water Delivery and Distribution System

There are two 75 m^3/h each potable water delivery pumps (one spare) supplying water from the 2000 m^3 site storage tank to 980 m^3 Morro Curral overhead tank and to 100 m^3 airport overhead tank. The pumping system is operating satisfactorily. The level controls at the overhead tanks have been left out of operation and the daily filling is accomplished by predetermined (by experience) timing of pumps operation.

House connections are continuously being added. Moreover water is trucked to other communities by tank-truck. The water distribution system is operating satisfactorily.

Corrosion and local paint failure in some internal and external areas of the water tanks have occured. The tanks are of steel, bolted type, manufactured by

Butler and were supplied factory-coated. Electra has coated the affected areas with primer. However, a sand-blasting and recoating of affected areas are necessary to control progressive corrosion. A recoating program should be adopted using manufacterer's expertise. (This was recommended by BRISC Report No. 35 dated August 31, 1984).

Brown water has been reported which is most likely caused by ferrous corrosion products in the water system. Maintaining proper PH and controlling water salinity should resolve this problem. Moreover, painting of corroded part of the tanks is urgently required.

c) Power Transmission and Distribution Systems

These system consists principally of the following:

i) 2000 kVA, 400v/13.8-7.9 kV transformer
ii) 2000 kVA, 400v/6.3 kV transformer
iii) 1500 kVA 6.3 kV/13.8 kV transformer
iv) 1500 kVA 13.8 kV/6.3 kV transformer
v) Motor Control Centers
vi) Vacuum Switches and Fault Interruptors
vii) Voltage Regulator
viii) 112.5 kVA Substation, 2 75 kVA Substations
ix) Underground transmission line
x) Overhead town distribution lines
xi) Street lighting
xii) House connections

The system is working satisfactorily including interconnection with the airport generating plant. House connections are being continuously added.

One problem was reported for the underground power cable feeding the intake pumphouse from the plant building. Apparently some portions of the trench, during installation, was not properly sand bedded and the cable was damaged by the presence of sharp rocks. This fault by the Contractor originally went undetected by the BRISC and Electra supervisors. The problem is now being corrected by Electra personnel.

d) Miscellaneous Systems

All other systems, including plant compressed air, fuel oil and other plant facilities have been performing satisfactorily. Administration building spaces and layout have proved to be excellent.

4.3 Performance

4.3.1 Desalination Plant

The performance of the desalination plant must be improved. The latest series of tests conducted in March, 1985 by Polymetrics in the presence of BRISC representative shows the following overall performance:

Product Quantity	360 to 400 m^3/d, say average 380 m^3/d
Product Quality	900 to 950 ppm, say average 925 ppm

(No. of operable permeators - 30)

The above data fall drastically inferior to the design and guaranteed values of 660 m^3/d and 600 mg/l (1.5% salt passage). Thirty-three(33) Permeators were originally supplied.

A guarantee claim to the supplier to correct the situation should be considered.

Due to low productivity, the costs of feedwater pumping power (less energy recovery) and chemical cleaning per unit volume of product have been running very high. Furthermore, since a year ago the frequency of chemical cleaning has been required to be 3 to 4 times more often than originally specified by the vendor.

The following relevant information is presented based on the site visit by BRISC engineer during the period March 2 through March 8, 1985:

A) Extensive cleaning and PT-A and Pt-B treatment was performed by Polymetrics between February 27 and March 5, 1985.

B) Tables 1, 2 and 3 provide the performance data collected on February 27 and March 5, 1985 and for R.O. trains A, B and C respectively.

C) Silt density index (SDI) of the feed water was within the range 2.5 to 3.0

D) Polymetrics representative reported the following feed/reject characteristics correlation:

Chlorides	feed	21270 ppm
Chlorides	brine	24106 ppm
Conductivity	feed	48000 umhos
Conductivity	brine	55000 umhos

TRAIN A PERFORMANCE

TABLE 1

Date		27 February 1985			5 March 1985		
Time		400			1100		
Temp		3.8			22.5		
Prod. Flow	l/min	97			114		
No. of Perm		11			12		
Feed Flow	l/min	540			550		
Feed Press	bar	68			70		
Prod. Press	bar	1.0			1.0		
Prod. Cond.	umhos	1700			1350		
Suction Press	bar	3.7			3.4		
Pos.	Ser. No.	Flow	Cond	ΔP	Flow	Cond	ΔP
1	8108501	12.36	1400	1.5	13.84	700	1.05
2	8200076	7.82	1600	1.0	7.82	1000	0.65
3	8108992	8.71	1400	0.6	9.31	900	0.45
4	8200088	8.18	1600	0.65	7.71	850	0.50
5	8110313	8.85	1600	1.2	9.15	1200	0.85
6	8201206	9.82	3700	1.1	10.59	3100	0.85
7	8200082	8.18	1200	0.7	9.15	750	0.50
8	8200056	8.06	1250	1.05	8.57	1000	0.70
9	8201209	-	-	-	9.64	3300	0.85
10	8109439	8.57	1000	1.3	8.44	600	0.90
11	8109473	8.57	1250	0.75	8.85	900	0.50
12	8201653	9.64	2200	-	10.19	1200	1.20
Total		98.76			113.26		

TRAIN B PERFORMANCE

TABLE 2

Date		27 February 1985			5 March 1985		
Temp °C		23.8			22.5		
Prod. Flow	l/min	60			76		
No. of Perm	-	9			9		
Feed Flow	l/min	540			550		
Feed Press	bar	60			64		
Prod. Press	bar	1			1		
Prod. Cond.	umhos	3100			2200		
Suction Press	bar	307			3.4		
Pos.	Ser. No.	Flow	Cond	ΔP	Flow	Cond	ΔP
1	-						
2	-						
3	8109558	7.82	200	1.25	8.85	700	0.95
4	8110205	7.4	3700	1.45	9.64	2000	0.95
5	8109718	7.5	2200	1.50	8.05	1200	1.15
6	8108262	11.25	2400	1.40	8.85	1900	0.93
7	8110389	7.71	2550	1.35	8.06	850	1.05
8	-						
9	8109608	7.6	2300	0.85	9.82	2000	1.35
10	8200520	9.0	3300	0.85	8.18	1500	0.70
11	8201295	7.5	3500	1.35	9.15	4000	1.15
12	8201191	7.4	4000	1.25	7.94	2250	0.85
Total		73.2			78.5		

TRAIN C PERFORMANCE

TABLE 3

Date		5 March 1985
Temp	°C	22.5
Prod Flow	l/min	85
No. of Perm	-	9
Feed Flow	l/min	540
Feed Press	bar	65
Prod Press	bar	1
Prod Cond	umhos	28.50
Suct Press	bar	3.4

Pos.	Serial No.	Flow	Cond	ΔP
1	8108781	9.31	1350	1.15
2	8108982	9.64	3000	1.15
3	-			
4	-			
5	8201182	11.74	4000	1.3
6	8110953	9.15	2800	0.8
7	8110385	8.31	2200	1.9
8	8110383	13.17	4000	1.1
9	-	-		
10	8109530	8.57	2950	-
11	8201238	8.57	2850	1.7
12	8200083	8.31	1900	-
Total		89.5		

E) Polymetrics representative inspected the fiber bundles of approximately 20 permeators between February 15 and February 28, 1985. He found that in all instances the Reemay had burst and that severe channeling was evident. He also noted the presence of substantial amounts of a brown/black muddy substance.

F) During BRISC presence on March 4, another permeator was inspected. This permeator, No. 8201269, had also ruptured Reemay and a good amount of black muddy material in it. Permeator No. 8108501 was also opened. This is still a relatively good performer at 12.5 1/min and 1400 umhos. In this permeator at least the outer wrap of Reemay was still intact and only a few black streaks were noted in the fiber bundle. The inner core of the fiber bundle could not be inspected because this would have meant breaking the Reemay.

G) Rupturing of Reemay will occur when the ΔP exceeds 2.5 -3 bars. Excessive ΔP's may have been caused by the iron from the accumulator or by suspended material in the seawater feed or a combination of the first two factors. Because many of the Reemay ruptures probably occurred already before May 1984, (for performance data see BRISC report No. 34 dated June 15, 1984) it is impossible to establish which of the above factors is to blame for the ruptured Reemay. With the Reemay ruptured in so many permeators and severe channeling in the fiber bundle it is no surprise that the performance of the plant is poor.

H) There are 6 permeators with cracked potheads.

I) The plant is now capable of producing only approximately 55% of the rated capacity with a Salt content 50-60% too high. A real crisis is avoided due to the fact that the actual demand is still low and does not exceed 290 m^3/day.

J) Power Consumption Data

On March 5, 1985 the electric power consumption was measured as 12 kWH/m^3. This data is compared with the design and past performance values as follows:

Study Jan. '80 (i)	Vendor Proj. June '81	Jan. '84 (ii)	May '84 (iii)	March '85 (ii)
6.9	5.6	6.0	7.6	12.0

(above data in kWH/m^3)
(i) only this data includes pumping cost
(ii) data provided by Electra
(iii) data from BRISC Report No. 34

K) Cartridge Filters

Apparently, Electra has been using 10 microns cartridge filters for some time. Polymetric representative stated all other plants that he knows of are using at least 5 microns and in most cases 1 micron filter. Based upon his advise Electra has switched to using 1 micron filter.

4.3.2 Power Generation Plant

Overall performance of the diesel generators have been satisfactory. Several plant shut-down had occurred due to lack of cooling sea water during stormy periods and intake pump suction problems.

The fuel consumption data are provided below:

Design	Actual
0.241 kg/kWH	_____Kg/kWH

4.3.3 Balance of Plant

No major problems in maintaining performance of the balance of plant systems have been reported except for the occasional seawater supply which has been discussed in Paragraph 4.1.5. Also refer to Paragraph 4.2.3 for a discussion on the equipment performance.

4.4 Production Costs/Revenues

Overall costs have been reported to be falling short of revenues by a big margin.

The following information has been gathered during the BRISC engineer's trip to the site during the early March, 1985:

A) Water -

Water costs are now estimated by Electra to be in the range 550-600 ECV (Cape Verdean Escudos) /m^3. At the present exchange rate of 94 ECV/1 US$, this translates to

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$5.85 to $6.38 per m^3 (average is $6.10/$m^3$ or $23/1000 gallons).

The above cost includes depreciation. Value of depreciation used by Electra is not known at this time. However, based on the last economic analysis a cost of $3.04/$m^3$* should have been projected.

First quarter 1980 projected cost was $2.25/$m^3$. A ratio f Consumer Price Index (U.S.) of 1.35 has been applied or first quarter 1985 cost.

It must be pointed out that the economic analysis used the projected water demand (at the second year) as 436 m^3/d whereas the actual demand is around 290 m^3/d. This makes the plant fixed costs portion 50% higher than projected.

The energy cost per unit product has also risen due to fall in the plant productivity to 55% level. The chemicals cost has risen not only due to lower productivity, but also partly due to more frequent chemical cleaning required for the membranes to maintain the WP.

The following price structure is now being used on Sal:

<u>Residential</u>

between 1 to 5m^3/month - 80 EVC/m^3
(Average 33 to 165 l/d) - ($0.85/$m^3$)

above $5m^3$/month	- 120 ECV/m^3
above 165 l/d	- ($1.28/$m^3$)

Industrial

all consumptions	- 130 ECV/m^3 ($1.38/$m^3$)

The selling rates are sustantially lower than the $3.04 /$m^3$ projected price (CPI adjusted) established during project planning stage.

B) Power -

Electricity cost is reported by Electra as 17 ECV/kWH or 18 cents/kWH, including depreciation. Value of depreciation used bv Electra is not known at this time.

The following price structure is now being used on Sal:

40 kWH/month and under	- 12.50 ECV/kWH (13.3 Cents/kWH)
over 40 kWH/month	- 15.00 ECV/kWH (16.0 Cents/kWH)

The production cost is from the original projected selling price of 21.2 Cents/kwH. However, the CPI adjusted value of the projected selling price should now be 28.6 Cents/kWH.

The present actual selling price is substantially lower than the projected selling price.

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C) Overall Costs -

The various costs and demand data as projected during the economic analysis (February, 1985) is presented in Appendix-C for ready reference.

4.5 Operation and Maintenance (O&M)

Since the start up and initial operation in end-March 1983 BRISC field supervisor continued to provide O&M supervision, training and guidance for a period of approximately seven(7) months. Since October 1983, and upon completion of BRISC site activities,

Electra personnel has been operating and maintaining the plant. The plant was originally staffed with qualified and trained personnel who also participated in the project during the construction phase.

The significant activities toward the O&M goal has been the following:

i) Selection of candidates by GOCV and BRISC review and concurrence.

ii) Preparation by BRISC of a training plan, approved by GOCV and AID.

iii) Implementation of the training program in the U.S.

iv) Providing manufacturers' instruction manuals. Desalination plant O&M manual has been provided in Portugese language. Spanish language materials have been supplied as available on other items.

v) Participation of the trainees during the equipment installation at site.

vi) BRISC overall O&M manual has been supplied. This has been translated by GOCV.

vii) Operational training under BRISC field supervisor.

The quality of Electra's O&M activity has been generally good. Unfortunately two trained employees left Electra. Furthermore, Mr. M. Ramos, who was the original project manager from GOCV, is now located on another island.

There have been some instances of relaxing operational limits set by manufactures. Also, lack of adequate stock of spare parts and dosage chemicals may have created operating problems.

Housekeeping is generally good but there is room for improvement. Electra needs their own ordering system for parts. BRISC has thus far assisted them in purchasing and airfreighting parts in many cases.

It must be pointed out that due to high cost of airshipment the overall parts cost becomes excessive. Electra requires preplanning in order to utilize surface shipment, when possible.

Periodic membrane replacement is also required to maintain R.O. System productivity. A replacement rate of 15 to 25% of membranes per year of operation may be expected. In the economic analysis (Feb. 1980) a value of $50,000 or more per year was assumed as membrane replacement cost (refer to Appendix - C, sheet B-7).

It is important that the new employees replacing the original trained personnel have appropriate training. It is doubtful that such training system is in effect at site.

5.0 RECOMMENDATIONS

5.0 RECOMMENDATIONS

5.1 Desalination Plant

A) Membranes

By far the most important action item is to improve the R.O. performance. Installation of new membranes and retiring the poorest performing ones should be planned. Listed below are the 10 worst performing membrane modules:

Location	Serial No
B11	8201295
C5	8201183
C8	8110383
A9	8201209
C10	8109530
A6	8201206
C2	8108982
C6	8110953
C11	8201238
B12	8201191

Improving the overall product recovery rate will immediately cut the fuel and chemicals portion of unit production cost drastically improving the project economy. The quality of product will also be improved.

B) High Pressure Flexible Connections

Since the newly installed 316L accummulators are expected to provide a reliable service in reducing pulsations and vibrations, the flexible connections should be replaced by rigid SS pipe spool pieces when practical.

The three (3) 3-inch size 24" overall length flex pieces with 600 ANSI flanged ends at the high pressure pump discharge should be replaced by similar size spool pieces made of 316L SS material with minimum pipe thickness of 10S.

The other three (3) 3-inch size 30", overall length flex pieces with 600 ANSI flanged ends at the energy recovery turbine inlet must remain flexible to accommodate for turbine base adjustments. In this case the existing flexible joints (24" long) from the high pressure pump discharge may be used as spares, when each used with a make-up spool piece of nominal 6" length. The make-up spool pieces should be fabricated of 316L SS material.

C) Warranty Claims

Possible warranty claim should be considered by GOCV to the equipment supplier, Polymetrics for all the existing deficiencies, including:

- Permeator replacement
- Rigid spool pieces
- Malfunctioning parts not yet corrected.

In this regard the following documents are attached for quick reference (Appendix D)

- Polymetrics Membrane Warranty (for other warranties refer to the Contract)

- Copy of AID (Praia) letter dated 5/29/84 to American Home Assurance

- Copy of BRISC letter dated 6/20/84 to Polymetrics

- Copy of BRISC letter dated 5/7/84 to American International Companies with copiers of previous BRISC letters and telexes to Polymetrics.

- Copy of original DuPont membrane test data.

- BRISC Report No. 34 dated June 15, 1984 is also an important reference (not attached).

5.2 Intake Suction

The present implentation of installing by Electra one 8-inch flexible line extending to a deeper ocean level will definitely improve operational reliability during winter sea storms. In an unlikely case of increased cavitation, the problem can be minimized by slightly throttling the pump discharge valve.

Electra also made a good decision in planning to buy a full capacity submersible pump from Germany.

BRISC believes that the above two measures will be sufficient to meet the winter disruptions. The present natural intake well should be continued to be used.

An on-shore construction of a pit, although most reliable is very expensive and consequently was excluded from the design as a cost saving measure.

5.3 Tanks Corrosion

A cleaning and repainting program to repair the affected areas as well as to avoid new rust-spots should be adopted. An inspection and recommendation by a painting expert, perferably from the manufacturer (Butler) should be utilized for this purpose. This was also recommended in BRISC Report No. 35 dated August 31, 1984.

5.4 Damage to Pipe and Cable

Electra is repairing the affected parts and the trench between the pl[illegible] building and the intake pump house is being sand-bedded prior [illegible] re-installation of the same. Electra action has been very appropriate in this regard.

5.5 Brown Water

Repair of the tanks corrosion, correction of product water PH and reduction of water salinity should resolve this problem. When new permeators are installed, the overall quality of the potable water will be improved.

5.6 Operation and Maintenance (O&M)

To maintain the quality of O&M, all new personnel hired must be qualified and trained for the job. This is also true when a substitute operator takes over during the vacation of an experienced operator. If necessary, a training supervisor from the U.S. should be contracted for this purpose.

All manufacturers' instructions must be adhered to at all times. Strictest control of R.O. feedwater quality, adequate chemical dosage, required cleaning and cartridge replacements must be maintained. Cartridges should not be backwashed for reuse.

Managing spare parts purchase and stocking is also important. To avoid costly air freights, preplanning is essential in this regard. The same holds true for the consumables, including chemicals.

Due to higher frequency of surface transportation between Europe and Cape Verde, Electra should plan to buy spare parts from European countries, whenever possible.

BRISC records indicate that there is a surplus uncommitted fund of at least $38,000 from the AID project fund. The money will be useful in procurement of additional services in helping Electra in the O&M area. Part of the fund may also be used for purchase of spare parts.

5.7 Overall Economics

The following major points are worthwhile to note for improvement on the overall economics:

A) Installation of new permeators will improve product recovery and quality. Unit production costs will be drastically reduced.

B) Review the sales rate structure and upgrade rates to increase revenue.

C) The power recovery trubine should be in use at all times.

D) Maintain diesel-generators to keep at their best efficiencies.

E) The program for installing a 4-inch line to Santa Maria should be given a priority. The expanding hotel business and other residental/commercial activities growing at this southern town will result in a significant increase in demand. At this time the sales quantities are significantly lower than projected.

APPENDIX - A

EQUIPMENT LIST

CAPE VERDE DESALINATION AND POWER (SAL) PROJECT

BRISC W.O. 4850

PROJECTO DE DESSALINIZACAO E ENERGIA DA ILHA DO SAL - REPUBLICA DO CABO VERDE

EQUIPMENT LIST - LISTA DOS EQUIPAMENTOS; PHASE-I; SHEET 1 OF 8 ; FOLHA 1 DE 8

Rev.: Feb. 3, 1983
By: A.C. Date: June 28, 1982

Line No. / No. Linha	Equipment Name / Nome de Equipamento	Identification No. / Equipment Rating or Size / Dados de Equipamento	Part of Skid or Part of System / Parte de Skid ou Parte de Sistema	Supplier / Fornecedor	Manufacturer Model No. / Fabricante No. Modelo	Drawing No. / No. Desenho	Drive Motor Data / Dados do Motor Dirigente	Operating Consumables / Consumiveis: Lubricant / Lubrificante	Operating Consumables / Consumiveis: Others / Outros	Other Name(s) of the Equipment / Outro(s) Nome(s) do Equipamento	Remarks / Comentario
1	2	3	4	5	6	7	8	9	10	11	12
1	BOOST PUMPS BOMBAS DE TRANSFERENCIA	205 A, B, C EACH/CADA 170 GPM/172 FT 38.6M^3/H; 52.4M	PRE-TREATMENT SYSTEM SISTEMA DE PRE-TRATAMENTO	POLYMETRICS	WORTHINGTON D1022,3x2x8 7.4"D. IMP.	003M051	15HP, 380V 3ϕ/50 HZ TEFC		-		
2	COAGULANT SYSTEM SKID SISTEMA DE INJ. COAGULANTE	7.6 m/min.	PRE-TREATMENT SYSTEM SISTEMA DE PRE-TRATAMENTO	POLYMETRICS	POLYMETRICS	003M058	-	-	POLY-ELECTRO-LYTA		MAGNAFLOE 573-C 2900 KG/YR
3	COAGULANT TANK TANQUE DE COAGULANTE	217 70 GALLONS 265 LITROS	COAGULANT SYSTEM SKID SISTEMA DE INJ. DE COAGUL.	POLYMETRICS	?	-	MIXER 1/4 HP 220V/1ϕ/50 HZ TEFC				
4	COAGULANT INJECTION PUMPS BOMBAS DE INJECCAO DE COAGULANTE	214 A, B 2.33 GPH MAX.	COAGULANT SYSTEM SKID SISTEMA DE INJ. DE COAGUL.	POLYMETRICS	MILTON ROY 5R112-117 (FRAME-"A")		1/4 HP 220V/1ϕ/50 HZ				
5	ROUGHING FILTERS FILTROS PRIMARIOS	232 A, B, C, D 90" x 60" SIDE 229cm x 152cm H	PRE-TREATMENT SYSTEM SISTEMA DE PRE-TRATAMENTO	POLYMETRICS	POLYMETRICS	003M080	-	-	FILL REPLACEMENT TROCAR ENCHIMENTO		100 PSI ASME CODE, RUBBER-LINED 7 KG/cm^2 CODIGO ASME C/REVEST. DE BORRACHA
6	BACKWASH PUMPS BAMBAS DE LAVAGEM	262 A, B SEE COMMENTS VER COMENTARIO	BACKWASH SYSTEM SISTEMA DE LAVAGEM	POLYMETRICS	WORTHINGTON D-1022, 6x4x8 6.8"D. IMP.	003M052	25 HP, 3000 RPM 380V/3ϕ/50 HZ TEFC, 1.15 S.F. S.E, 220V/1ϕ AQUECEDOR			BOMBAS DE CONTRA LAVAGEM	800 GPM/35 PSI & 500 GPM/50 PSI EACH 182m^3/H; 2.46 KG/cm^2 114m^3/H; 3.5 KG/cm^2 CADA
7	BACKWASH TANK TANQUE DE LAVAGEM	255 10' ; 14'h	BACKWASH SYSTEM SISTEMA DE LAVAGEM	POLYMETRICS		003M055	-	-	-	TANQUE DE CONTRA LAVAGEM	
8	AIR BLOWER SOPRADOR	248 177 CFM, 8 PSI 2650 RPM	AIR BLOWER SKID SISTEMA DE SOPRAGEM	POLYMETRICS	ROOTS BLOWER 3505 J	KING-KNIGHT A-3637-M1	15 HP, 3000 RPM 380V/3ϕ/50 Hz TEFC: c/AQUECEDOR			AIR SCOUR BLOWER	

CAPE VERDE DESALINATION AND POWER (SAL) PROJECT

BRISC W.O. 4850

PROJECTO DE DESSALINIZACAO E ENERGIA DA ILHA DO SAL - REPUBLICA DO CABO VERDE

EQUIPMENT LIST - LISTA DOS EQUIPAMENTOS; PHASE-I; SHEET 2 OF 8 ; FOLHA 2 DE 8

Rev.: Feb. 3, 1983
By: A.C. Date: June 28, 1982

Line No. / No. Linha	Equipment Name / Nome de Equipamento	Identification No. / Equipment Rating or Size / Dados de Equipamento	Part of Skid or Part of System / Parte de Skid ou Parte de Sistema	Supplier / Fornecedor	Manufacturer Model No. / Fabricante No. Modelo	Drawing No. / No. Desenho	Drive Motor Data / Dados do Motor Dirigente	Operating Consumables / Consumiveis: Lubricant / Lubrificante	Operating Consumables / Consumiveis: Others / Outros	Other Name(s) of the Equipment / Outro(s) Nome(s) do Equipamento	Remarks / Comentario
1	2	3	4	5	6	7	8	9	10	11	12
1	POLISHING FILTERS FILTROS SECUNDARIOS	274 A, B, C, D 72"ϕ x 60" SIDE 183 cmϕ x 152 cm H	PRE-TREATMENT SYSTEM SISTEMA DE PRE-TRATAMENTO	POLYMETRICS	POLYMETRICS	003M079	-	-	FILL RE-PLACEMENT TROCAR ENCHIMENTOS	FILTROS DE POLIMENTO	100 PSI ASME CODE RUBBER-LINED 7 KG/cm² CO'DIGO ASME C/REVEST. DE BORRACHA
2	HYPOCHLORITE GENERATOR GERADOR DE HIPOCLORITO	315 2 LBS/HR	CHLORINE GENERA-TION SYSTEM SISTEMA DE GERACAO DO CLORO	POLYMETRICS	ENGLEHART 51127	003M053	(NO MOTOR) (NAOTEM MOTOR) 380V/3ϕ/50 HZ		SEAWATER 25 GPM (NORMAL) AGUA DO MAR 5.7M³/H		NOT FOR POTABLE WATER NAO P/AGUA POTAVEL
3	STABILIZER INJECTION SYSTEM SKID SISTEMA DE INJECCAO DE ESTABILIZADOR	- 7.6 mL/min.	PRE-TREATMENT SYSTEM SISTEMA DE PRE-TRATAMENTO	POLYMETRICS	POLYMETRICS -	003M059	-	-	STABILT-ZER 2950 LITROS P/Ano		SEQUESTERING AGENT - POLYSTABILIZER S-5 AGENTE DE SEQUESTRO POLYESTABILIZADOR S-5
4	STABILIZER TANK TANQUE DE ESTABILIZADOR	330 70 GALLONS 265 LITROS	STABILIZER INJECTION SYSTEM SISTEMA DE INJECCAO DO ESTABILIZADOR	POLYMETRICS	?	-	MIXER 1/4 HP 220V/1ϕ/50 HZ TEFC				
5	STABILIZER INJECTION PUMPS BOMBAS DE INJECCAO DE ESTABILIZADOR	327 A, B	STABILIZER INJECTION SYSTEM SISTEMA DE INJECCAO DO ESTABILIZADOR	POLYMETRICS	MILTON ROY 5R112-117 FRAME-"A"		1/4 HP 220V/1ϕ/50 HZ				
6	BISULFITE INJECTION SYSTEM SKID SISTEMA DE INJECCAO DE BISULFITO	- 7.6 mL/min.	PRE-TREATMENT SYSTEM SISTEMA DE PRE-TRATAMENTO	POLYMETRICS	POLYMETRICS	003M060	-	-	SODIUM SULFITE SULFITO DO SODIO		1950 KG/YR 1950 KG/ANO
7	BISULFITE TANK TANQUE DE BISULFITO	347 ?	BISULFITE INJECTION SYSTEM SISTEMA DE INJECCAO DE BISULFITO	POLYMETRICS	?	-	MIXER 1/4 HP 220V/1ϕ/50 HZ TEFC				
8	BISULFITE INJECTION PUMPS BOMBAS DE INJECCAO DE BISULFITO	344 A, B	BISULFITE INJECTION SYSTEM SISTEMA DE INJECCAO DE BISULFITO	POLYMETRICS	MILTON ROY 5R 112-117 FRAME-"A"		1/4 HP 220V/1ϕ/50 HZ				

CAPE VERDE DESALINATION AND POWER (SAL) PROJECT

BRISC W.O. 4850

PROJECTO DE DESSALINIZACAO E ENERGIA DA ILHA DO SAL - REPUBLICA DO CABO VERDE

EQUIPMENT LIST - LISTA DOS EQUIPAMENTOS; PHASE-I; SHEET 3 OF 8 ; FOLHA 3 DE 8

Rev.: Feb. 3, 1983
By: A.C. Date: June 28, 1982

Line No. / No. Linha	Equipment Name / Nome de Equipamento	Identification No. / Equipment Rating or Size / Dados de Equipamento	Part of Skid or Part of System / Parte de Skid ou Parte de Sistema	Supplier / Fornecedor	Manufacturer Model No. / Fabricante No. Modelo	Drawing No. / No. Desenho	Drive Motor Data / Dados do Motor Dirigente	Operating Consumables / Consumiveis: Lubricant / Lubrificante	Operating Consumables / Consumiveis: Others / Outros	Other Name(s) of the Equipment / Outro(s) Nome(s) do Equipamento	Remarks / Comentario
1	2	3	4	5	6	7	8	9	10	11	12
1	CARTRIDGE FILTERS FILTROS DE CARTUCHOS	290 A, B 1 MICRON	PRE-TREATMENT SYSTEM SISTEMA DE PRE-TRATAMENTO	POLYMETRICS	CARBORUNDUM 2809 - CFR58T -10-6FK	003M057	-		CARTRIDGE REPLACEMENT TROCAR CARTUCHOS	MICRON FILTERS	EACH FILTER CONTAINS 19-30" LONG CARTRIDGES, 1μ POLYPROPYLENE CADA FILTRO CONTEM, 1μ POLYPROPILENO 19 - 76.2 cm CARTUCHOS
2	REVERSE OSMOSIS SKID POLIN DE OSMOSE REVERSA	R.O. UNIT A, B, C 220 M^3/D. PRODUCT AGUA DO PRODUCTO	R.O. SYSTEM SISTEMA O.I.	POLYMETRICS	POLYMETRICS -	003M001	-	-	MEMBRANE REPLACEMENT TROCAR MEMBRANAS	R.O. RACK SYSTEM COMBOIO DE MEMBRANAS	11 MODULES PER SKID 11 MODULOS POR CADA POLIN
3	R.O. MEMBRANE MODULES MODULOS DA MEMBRANA O.I.	- 22 M^3/D MIN 1.5% SP MAX	R.O. SKID POLIN DE O.I.	POLYMETRICS	DUPONT 6940-055 B-10		-	-	-	PERMEATOR PERMEADOR	HOLLOW FIBER FIBRA OCA
4	POWER SKIDS POLINS DE ENERGIA	PUMP-TURBINE A, B, C	R.O. SYSTEM SISTEMA O.I.	POLYMETRICS	PROCESS EQUIPMENT CO.	5893-SF	100 HP 1500 RPM 380V/3φ/50 HZ TEFC SV.DT. 1.15 S.F.		-	PUMP-MOTOR-TURBINE SKIDS POLINS DE MOTO-BOMBA-TURBINA	MOTOR HAS 220V/1φ SPACE HEATER MOTOR TEM 220V/1φ AQUECEDOR
5	H.P. PUMPS BOMBAS A.P.	113 A, B, C 162 GPM EA. @ 897 PSIG CADA 36.8 M^3/H;63KG/cm^2	POWER SKID POLIN DE ENERGIA	POLYMETRICS	WHEATLEY QUINTUPLEX HP - 125L 2-1/2"x3-1/2"		SEE LINE 4 VER LINHA 4		-	R.O. PUMPS BOMBAS P/O.I.	
6	ENERGY RECOVERY TURBINE TURBINA P/RECUPERACAO DE ENERGIA	114 A, B, C 47.6 BHP @ 27.5 M^3/hr & 59.8 KG/cm^2	POWER SKID POLIN DE ENERGIA	POLYMETRICS	HAYWARD-TYLER 1x10.58x5/8"ERT	01-200-5/8				POWER RECOVERY TURBINE	PELTON WHEEL RODA PELTON
7	FLUSH TANK	141 A, B, C 210 GALLONS 0.8 M^3	POWER SKID POLIN DE ENERGIA	POLYMETRICS	POLYMETRICS		-	-	-		
8	CLEANING SYSTEM SKID POLIN DE SISTEMA DE LIMPEZA	-	R.O. SYSTEM SISTEMA O.I.	POLYMETRICS	POLYMETRICS	003M056	-		SEE REMARKS VER COMENTARIOS	MEMBRANE CLEANING SYSTEM SISTEMA DE LIMPEZA DE MEMBRANAS	FORMALDEHYDE, CITRIC ACID, AMMONIUM HYDROXIDE TANNIC ACID ENZYME DETERGENT

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BRISC W.O. 4850

PROJECTO DE DESSALINIZACAO E ENERGIA DA ILHA DO SAL - REPUBLICA DO CABO VERDE

EQUIPMENT LIST - LISTA DOS EQUIPAMENTOS; PHASE-I; SHEET 4 OF 8 ; FOLHA 4 DE 8

Rev.: Feb. 3, 1983
Jy: A.C. Date: June 28, 1982

Line No. / No. Linha	Equipment Name / Nome de Equipamento	Identification No. / Equipment Rating or Size / Dados de Equipamento	Part of Skid or Part of System / Parte de Skid ou Parte de Sistema	Supplier / Fornecedor	Manufacturer Model No. / Fabricante No. Modelo	Drawing No. / No. Desenho	Drive Motor Data / Dados do Motor Dirigente	Operating Consumables / Consumiveis: Lubricant / Lubrificante	Operating Consumables / Consumiveis: Others / Outros	Other Name(s) of the Equipment / Outro(s) Nome(s) do Equipamento	Remarks / Comentario
1	2	3	4	5	6	7	8	9	10	11	12
1	CLEANING TANK TANQUE DE LIMPEZA	398 420 GALLONS 1.6 M^3	CLEANING SYSTEM SISTEMA DE LIMPEZA	POLYMETRICS	POLYMETRICS		MIXER 1/2 HP 380V/3ϕ/50 HZ	-	-		
2	CARTRIDGE FILTER - (CLEANING SYSTEM) FILTRO DE CARTUCHOS (SISTEMA DE LIMPEZA)	394 10 MICRON	CLEANING SYSTEM SISTEMA DE LIMPEZA	POLYMETRICS	CARBORUNDUM 6 SF 19-3-4F -K1		-		-	CLEANING FILTER	316 SS ASME 150 PSI 57-10" ELEMENTS 57-25.4 cm. CARTUCHOS 10μ POLYPROPYLENO
3	CLEANING PUMP BOMBA DE LIMPEZA	404 165 GPM/82 FT H 37.5M^3/H, 25M H	CLEANING SYSTEM SISTEMA DE LIMPEZA	POLYMETRICS	WORTHINGTON D0122 3" x 2" x 6 5.65" ϕ IMP.		7.5 HP 380V/3ϕ/50 HZ TEFC				
4	HYPOCHLORITE INJECTION SKID POLIN DE SISTEMA DE INJECCAO DE HIPOCLORITO	10 ml/min.	POST-TREATMENT POS-TRATAMENTO	POLYMETRICS	POLYMETRICS	D03M061		-	CALCIUM HYPOCHLORITE HIPOCLORITO DE CALCIO		174 KG/YR. 174 KG/ANO.
5	HYPOCHLORITE SOLUTION TANK TANQUE DE SISTEMA DE INJECCAO DE HIPOCLORITO	378 70 GALLONS 265 LITROS	HYPOCHLORITE INJECTION SKID POLIN DE SISTEMA DE HIPOCLORITO	POLYMETRICS	POLYMETRICS		MIXER 1/4 HP 220V/1ϕ/50 HZ	-	-		
6	HYPOCHLORITE INJECTION PUMPS BOMBAS DE INJECCAO DE HIPOCLORITO	375 A, B 2.33 GPH MAX 147 ml/min. MAX	HYPOCHLORITE INJECTION SKID POLIN DE SISTEMA DE HIPOCLORITO	POLYMETRICS	MILTON-ROY 5R 112-117 FRAME-"A"		1/4 HP 220V/1ϕ/50 HZ				
7											
8											

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CAPE VERDE DESALINATION AND POWER (SAL) PROJECT

BRISC W.O. 4850

PROJECTO DE DESSALINIZACAO E ENERGIA DA ILHA DO SAL - REPUBLICA DO CABO VERDE

EQUIPMENT LIST - LISTA DOS EQUIPAMENTOS; PHASE-I; SHEET 5 OF 8 ; FOLHA 5 DE 8

By: A.C. Date: Feb. 3, 1983

Line No. / No. Linha	Equipment Name / Nome de Equipamento	Identification No. / Equipment Rating or Size / Dados de Equipamento	Part of Skid or Part of System / Parte do Skid ou Parte de Sistema	Supplier / Fornecedor	Manufacturer Model No. / Fabricante No. Modelo	Drawing No. / No. Desenho	Drive Motor Data / Dados do Motor Dirigente	Operating Consumables / Consumiveis: Lubricant / Lubrificante	Operating Consumables / Consumiveis: Others / Outros	Other Name(s) of the Equipment / Outro(s) Nome(s) do Equipamento	Remarks / Comentario
1	2	3	4	5	6	7	8	9	10	11	12
1	SEA WATER INTAKE PUMPS / BOMBAS DA TOMADA DE AGUA DO MAR	A, B, C / 4x6 - 11H 114 M^3/HR 16M	SEA WATER SUPPLY SYSTEM / SISTEMA DE SUPRIMENTODE AGUA DO MAR	R/W	GOULDS / 3196 - MT					DIESEL GENERATOR COOLING & DESAL. PLANT FEED PUMPS / BOMBAS P/RESFRIAMENTO DAS MAQUINAS DIESEL E ALIMENTACAO P/PL. DESAL	ONE SPARE / UMA BOMBA E SOBRSSALENTE
2	RAW WATER TANK / TANQUE DE AGUA DO MAR	15000 GALS. 57 M^3	SEA WATER SUPPLY SYSTEM / SISTEMA DE SUPRIMENTODE AGUA DO MAR	R/W	- / -					ABOVE GROUND RAW WATER TANK	CONCRETE TANK / TANQUE DO CONCRETO
3	POTABLE WATER STORAGE RESERVOIR / RESERVATORIO DE AGUA POTAVEL	2000 M^3	POTABLE WATER DELIVERY SYSTEM / SISTEMA DE SUPRIMENTO DE AGUA POTAVEL	R/W	BUTLER	82.01.180738		-	-	MAIN STORAGE TANK / RESERVATORIO PRINCIPAL	BOLTED TANK / TANQUE C/PARAFUSOS
4	POTABLE WATER DELIVERY PUMPS / BOMBAS DE SUPRIMENTO DE AGUA POTAVEL	A,B / 75 M^3/H; 117 MHD	POTABLE WATER DELIVERY SYSTEM / SISTEMA DE SUPRIMENTO DE AGUA POTAVEL	R/W	GOULDS / 3755		75 HP			BOMBA DE AGUA POTAVEL	
5	MORRO CURRAL TANK / TANQUE DE AGUA NO MORRO CURRAL	980 M^3	POTABLE WATER DISTRIBUTION SYSTEM / SISTEMA DE DISTRIBUICAO DE AGUA POTAVEL	R/W	BUTLER	82.01.180737					BOLTED TANK / TANQUE C/PARAFUSOS
6	AIRPORT ELEVATED TANK / TANQUE ELEVADO NO AEROPORTO	100 M^3	PORTABLE WATER DISTRIBUTION SYSTEM / SISTEMA DE DISTRIBUICAO DE AGUA POTAVEL	R/W	BUTLER	82.01.180736	-				BOLTED TANK / TANQUE C/PARAFUSOS
7	FUEL OIL STORAGE TANK / TANQUE DE ARMAGEM DE OLEO COMBUSTIVEL	37 M^3	FUEL OIL SYSTEM / SISTEMA DE OLEO COMBUST.	R/W	BUTLER	82.01.180735					BOLTED TANK / TANQUE C/PARAFUSOS
8											

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CAPE VERDE DESALINATION AND POWER (SAL) PROJECT

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PROJECTO DE DESSALINIZACAO E ENERGIA DA ILHA DO SAL - REPUBLICA DO CABO VERDE

EQUIPMENT LIST - LISTA DOS EQUIPAMENTOS; PHASE-I; SHEET 6 OF 8 ; FOLHA 6 DE 8

By: A.C. Date: Feb. 3, 1983

Line No. / No. Linha	Equipment Name / Nome de Equipamento	Identification No. / Equipment Rating or Size / Dados de Equipamento	Part of Skid or Part of System / Parte de Skid ou Parte de Sistema	Supplier / Fornecedor	Manufacturer Model No. / Fabricante No. Modelo	Drawing No. / No. Desenho	Drive Motor Data / Dados do Motor Dirigente	Operating Consumables / Consumiveis: Lubricant / Lubrificante	Operating Consumables / Consumiveis: Others / Outros	Other Name(s) of the Equipment / Outro(s) Nome(s) do Equipamento	Remarks / Comentario
1	2	3	4	5	6	7	8	9	10	11	12
1	INSTRUMENT AIR COMPRESSOR COMPRESSOR DE AR PARA INSTRUMENTOS	18.5 CFM	INSTRUMENT AIR SYSTEM SISTEMA DE AR DE INSTRUMENTO	R/N	INGERSOLL-RAND	H37783	3HP, 380V 3Φ, 50HZ D.D.P.				720 RPM NON-LUBRICATED AIR-COOLED NAO-LUBRIFICADO RESFRIADO POR AR
2	INSTRUMENT AIR RECEIVER TANQUE DE AR P/INSTRUMENTOS	80 GAL	INSTRUMENT AIR SYSTEM SISTEMA DE AR DE INSTRUMENTO	R/N	INGERSOLL-RAND	H37783	-				INTEGRAL WITH COMPRESSOR JUNTO COM COMPRESSOR
3	INSTRUMENT AIR DRYER SECADOR DE AR P/INSTRUMENTOS		INSTRUMENT AIR SYSTEM SISTEMA DE AR DE INSTRUMENTO	R/N	DELTECH C3		1/3 HP				REFRIGERATION TYPE TIPO REFRIGERACAO
4	SERVICE AIR COMPRESSOR COMPRESSOR DE AR DE SERVICO	17.3 CFM			INGERSOLL-RAND 6TM 7D	HA1543	5HP, 380V 3Φ, 50HZ D.D.P.				COMPRESSOR RPM 575
5	SERVICE AIR RECEIVER TANQUE DE AR DE SERVICO	80 GAL				HA1543	-				
6											
7											
8											

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PROJECTO DE DESSALINIZACAO E ENERGIA DA ILHA DO SAL - REPUBLICA DO CABO VERDE

UIPMENT LIST - LISTA DOS EQUIPAMENTOS; PHASE-I; SHEET 7 OF 8 ; FOLHA 7 DE 8

By: A.C. Date: Feb. 3, 1983

Line No. / No. Linha	Equipment Name / Nome de Equipamento	Identification No. / Equipment Rating or Size / Dados de Equipamento	Part of Skid or Part of System / Parte de Skid ou Parte de Sistema	Supplier / Fornecedor	Manufacturer Model No. / Fabricante No. Modelo	Drawing No. / No. Desenho	Drive Motor Data / Dados do Motor Dirigente	Operating Consumables / Consumiveis: Lubricant / Lubrificante	Operating Consumables / Consumiveis: Others / Outros	Other Name(s) of the Equipment / Outro(s) Nome(s) do Equipamento	Remarks / Comentario
1	2	3	4	5	6	7	8	9	10	11	12
1	GENERATOR SWITCHGEAR / QUADRO P/GERADOR	"GS" / 400V, 3ϕ, 50HZ	GENERATOR / GERACAO	MAISON INT.	600V INDOOR SWGR PACS	6058-100 -200 -300 -400 -401	-	-	-	NONE	ONE LINEUP / NA LINHA
2	BUSDUCT / BARRA DUTO	BUS / 400V, 3000A, 3ϕ, 3W	GENERATOR SWGR TO TRANSFORMER / QUADRO AO TRANS-FORMADOR	RUHLIN WALLACE	WESTINGHOUSE "POW-R-WAY"	070-W057-6	-		-	NONE	TWO REQ'D / DOIS
3	TRANSFORMER T-1 / TRANSFORMADOR T-1	T-1 / 2000KVA, 3ϕ, 50HZ, 400V-13.8/7.9KV	POWER PLANT / CENTRAL	RUHLIN WALLACE	RTE POWER TRANSFORMER	SUBMITTAL #070-W057-4	-		-	NONE	
4	TRANSFORMER T-2 / TRANSFORMADOR T-2	T-2 / 2000KVA, 3 , 50HZ, 400V-6.3KV	POWER PLANT / CENTRAL	RUHLIN WALLACE	RTE POWER TRANSFORMER	SUBMITTAL #070-W057-4	-	-	-	NONE	
5	TRANSFORMER T-3 / TRANSFORMADOR T-3	T-3 / 1500KVA, 3 , 50HZ, 6.3KV-13.8KV	DISTRIBUTION / DISTRIBUICAO	RUHLIN WALLACE	RTE POWER TRANSFORMER	KBK P.O. #0833-1	-		-	NONE	
6	TRANSFORMER T-4 / TRANSFORMADOR T-4	T-4 / 1500KVA, 3 , 50HZ, 13.8KV-6.3KV	DISTRIBUTION / DISTRIBUICAO	RUHLIN WALLACE	RTE POWER TRANSFORMER	KBK P.O. #0833-1	-		-	NONE	
7	MOTOR CONTROL CENTER MCC-1 / CENTRO CONTROLE DE MOTORES-1	MCC-1 / 400V, 3 , 50HZ	POWER PLANT / CENTRAL	RUHLIN WALLACE	WESTINGHOUSE 5-STAR	SUBMITTAL #070-W057-6				NONE	
8	MOTOR CONTROL CENTER MCC-2 / CENTRO CONTROLE DE MOTORES-2	MCC-2 / 400V, 3 , 50HZ	DESALINATION / DESSALINIZACAO	POLYMETRICS	WESTINGHOUSE 5-STAR	-	-			NONE	

CAPE VERDE DESALINATION AND POWER (SAL) PROJECT

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PROJECTO DE DESSALINIZACAO E ENERGIA DA ILHA DO SAL - REPUBLICA DO CABO VERDE

EQUIPMENT LIST - LISTA DOS EQUIPAMENTOS; PHASE-I; SHEET 8 OF 8 ; FOLHA 8 DE 8

By: A.C. Date: Feb. 3, 1983

Line No. / No. Linha	Equipment Name / Nome de Equipamento	Identification No. / Equipment Rating or Size / Dados de Equipamento	Part of Skid or Part of System / Parte de Skid ou Parte de Sistema	Supplier / Fornecedor	Manufacturer Model No. / Fabricante No. Modelo	Drawing No. / No. Desenho	Drive Motor Data / Dados do Motor Dirigente	Operating Consumables / Consumiveis: Lubricant / Lubrificante	Operating Consumables / Consumiveis: Others / Outros	Other Name(s) of the Equipment / Outro(s) Nome(s) do Equipamento	Remarks / Comentario
1	2	3	4	5	6	7	8	9	10	11	12
1	VACUUM SWITCH INTERRUPTOR DE VACUO	VS-1, VS-2, VS-3, VS-4, VS-8, VS-11	DISTRIBUTION DISTRIBUICAO	RUHLIN WALLACE	TRAYER TYPE 810A10H	77111 SUBMITTAL #070-W057-1	-	-	-	NONE	
2	VACUUM SWITCH INTERRUPTOR DE VACUO	VS-5, VS-9	DISTRIBUTION DISTRIBUICAO	RUHLIN WALLACE	TRAYER TYPE 810A20H	77112 SUBMITTAL #070-W057-1	-	-	-	NONE	
3	FAULT INTERRUPTORS INTERRUPTOR DE FALTA	VCB-1, VCB-2, VCB-3, VCB-4	DISTRIBUTION DISTRIBUICAO	RUHLIN WALLACE	MC GRAW EDISON TYPE "C" 3 PHASE	SUBMITTAL #070-W057-3	-	-	-	NONE	
4	VOLTAGE REGULATOR REGULADOR DE POTENCIA	VR-1	DISTRIBUTION DISTRIBUICAO	RUHLIN WALLACE	MC GRAW EDISON VR-32	SUBMITTAL #070-W057-2	-	-	-	NONE	
5	SUBSTATION #1 SUBESTACAO #1	112.5KVA SUBSTATION #1	LOCAL UTILIZATION REDE DE UTILIZACAO	RUHLIN WALLACE	RTE-COMPARTMENTAL TYPE PAD MOUNTED XFORM	SUBMITTAL #070-W057-5	-	-	-	NONE	
6	SUBSTATION #3 SUBESTACAO #3	75KVA SUBSTATION #3	LOCAL UTILIZATION REDE DE UTILIZACAO	RUHLIN WALLACE	RTE-COMPARTMENTAL TYPE PAD MOUNTED XFORM	SUBMITTAL #070-W057-5	-	-	-	NONE	
7	SUBSTATION #5 SUBESTACAO #5	75KVA SUBSTATION #5	LOCAL UTILIZATION REDE DE UTILIZACAO	RUHLIN WALLACE	RTE-COMPARTMENTAL TYPE PAD MOUNTED XFORM	SUBMITTAL #070-W057-5	-	-	-	NONE	
8											

APPENDIX - B

CHRONOLOGY OF EVENTS

bd

CHRONOLOGY OF EVENTS

(Desalination Equipment Problems)

- Numerous telexes were sent to Polymetrics during February and March, 1984 stating the progressive corrosion problem with the accumulators housing material.

- A telex was sent to Polymetrics on April 13, 1984, stating the breach of warranty and requesting their urgent corrrective action.

- On May 4, 1984 failed permeators were listed to be replaced and requested Polymetrics to send their inspector to the plant site. Polymetrics did not comply.

- At the request of AID/GOCV, BRISC made an inspection trip to site in May, 1984 and the trip report (Report No. 34) was issued on June 15, 1984. Accumulator corrosion problem was obvious and was severely affecting membrane performance.

- AID/Praia wrote to the bonding company on May 29, 1984 enclosing GOCV communication dated April 4, 1984 requesting holding the bond until Polymetrics corrects the equipment problems. BRISC mailed a copy of Report No. 34 on June 20, 1984.

- On June 20, 1984, Polymetric was again requested to make good on the deficient components. The inspection report was also sent.

- On July 3, 1984, Polymetrics telexed BRISC stating their intention of replacing the accumulators (with 316 SS). They also planned to ship cleaning reagents followed by sending a site representative for parts installation and membrane cleaning.

- Polymetrics - supplied cleaning chemicals arrived on SAL in December, 1984.

- Polymetrics - supplied new accumulators arrived at site in January, 1985.

- Polymetrics field representative remained at site during the second half of February through the first week of March, 1985. New accumulators were installed and membrane cleaning was performed.

- BRISC representative witnessed the performance test on March 5, 1985, The performance results was still significantly below the guaranteed values.

APPENDIX - C

DATA USED FOR ECONOMIC ANALYSIS

Burns and Roe
Industrial Services Corp.

W.O. No. 4850.02 Date Feb 25 '80 Book No. _____ Page No. _____
Drawing No. _____ Calc. No. _____ Sheet A-I of _____
By _____ Checked _____ Approved _____
Title Cost-benefit analysis of "Initial Phase" - Cape Verde Desal./power

WATER & POWER DEMANDS

INSTALLED CAPACITIES

		MAX PRODUCTION/YR @ ~0.83 availdity
Water	660 m³/d	200 000 m3
Power	1500 KW	10 906 MWH X 0.60 (load factor) = 6543 MWH

DEMANDS USED IN CALCULATIONS:

Water : Same as in Conceptual design with limit as above

Power : Same as in conceptual design minus consumptions in Santa Maria and Pedra Lume (this is about 90% of total demand for the whole Island). No. of homes receiving power, prorated.

OPER. YR.	WATER DEMAND 1000 m³	POWER DEMAND-MWH
1	144.5	3765
2	159.0	3938
3	171.0	4112
4	182.9	4285
5	195.1	4459
6	200.8	4632
7	↓	4852
8		5072
9		5291
10		5511
11		5731
12		5829
13		5927
14		6024
15		6122
16		6220
17		6290
18		6360
19		6430
20		6500

Burns and Roe
Industrial Services Corp.

W.O. No. 4850.02 Date Feb 20 '80 Book No. _____ Page No. _____
Drawing No. _____ Calc. No. _____ Sheet A-2 of _____
By A.E. Checked _____ Approved _____
Title Cost-benefit analysis of Initial Phase - Cape Verde Desal/power

OPERATIONS & MAINTNANCE COSTS

SUMMARY SHEET

IN THOUSAND US$

ELAPSED YEARS	OPERATING YEAR	SALARY COST	FUEL COST	MAINTENANCE COST	CHEMICALS COST	OTHER COSTS *	TOTAL O&M
1	—						
2	—						
3	1	133	520	68	6.8	13.6	741
4	2		549	73	7.5	15.0	777
5	3		578	78	8.1	16.1	813
6	4		605	83	8.6	17.3	847
7	5		634	88	9.2	18.4	883
8	6		657	93	9.5	19.4	912
9	7		681			—	916
10	8		701			—	936
11	9		729			—	964
12	10		754			—	989
13	11		778			—	1014
14	12		789			—	1025
15	13		800			—	1035
16	14		811			—	1046
17	15		822			—	1056
18	16		833			—	1068
19	17		841			—	1077
20	18		848			—	1083
21	19		856			—	1091
22	20		864			—	1100

* TRUCKING COST FOR WATER SUPPLY TO OTHER COMMUNITIES

Burns and Roe
Industrial Services Corp.

W.O. No. 4850.02 Date Jan 29 '80 Book No. Page No.
Drawing No. Calc. No. Sheet B-1 of
By A.C. Checked Approved
Title Cost-benefit analysis of abbreviated phase - Cape Verde Desal/Power

I. OPERATION & MAINTENANCE COSTS

1.0 Salary costs.

1.1. Direct Staff - Power & Water. (Ref: PP. pg. 6-70 table 20)

Position	No.	Monthly Sal. ea.* Esc.	US $ @ 36	Annual Payroll
Plant Supr	0			—
Elect Supr.	1	15000	417	5004
Chemist	1	12500	347	4164
Op & Maint Sup.	1	15000	417	5004
Diesel Mechanic	2	11250	312	7488
Shift Supv.	4	11250	312	14976
Fitter/welder	2	8750	243	5832
Instr./Elect. Tech	1	10000	278	3336
Tool Keeper	1	6250	174	2088
Shift operator	4	6250	174	8352
Trade helper	4	4375	122	5856
Secretary	0	—	—	—
Laborer-Janitor	3	3750	104	3744
total	24			65844

* As updated by GOCV

Burns and Roe
Industrial Services Corp.

W.O. No. 4830.02 Date Jan 29 '80 Book No. _____ Page No. _____
Drawing No. _____ Calc. No. _____ Sheet B-2 of _____
By A.E. Checked _____ Approved _____
Title Cost-benefit analysis of Abbreviated Phase - Cape Verde Desal/Power

1.2. Direct Staff - Power Dist/Delivery (Ref: PP pg. 6-71 table 2

Position	No.	Monthly Salary* Esc.	US$ @36	Annual Payroll
Power System Supv.	1	13000	361	4332
Power System Foreman	1	10400	289	3468
Secretary	1/2	5200	144	864
Trade helper	3	4550	126	4536
Total	5 1/2			13200

1.3. Direct Staff - Water Dist./Delivery (Ref: PP pg. 6-71 table 22)

Position	No.	Monthly Salary* Esc.	US$ @36	Annual Payroll
Water Syst. Supv.	1	13000	361	4332
Water Syst. Foreman	1	10400	289	3468
Secretary	1/2	5200	144	864
Trade helper	3	4550	126	4536
Total	5 1/2			13200

* As updated by GCCV

Burns and Roe
Industrial Services Corp.

W.O. No. 4850.02 Date Jan 29 '80 Book No. Page No.
Drawing No. Calc. No. Sheet B-3 of
By A.E. Checked Approved
Title Cost-benefit analysis of Abbreviated phase - Cape Verde Desal/Pow.

1.4 Indirect Staff. (Ref: PP. pg. 6-69 table 19)

Position	No.	Monthly Salary* Esc.	US$ @ 36	Annual Payroll
General Mgr.	1	22500	625	7500
Secretary	1	6000	167	2004
Admin. Mgr.	1	12000	333	3996
Secretary	1	6000	167	2004
Personnel clerk	1	7500	208	2496
Bookkeeper	2	7500	208	4992
Service/Collection clerk	2	6000	167	4008
Motor Pool mechanic	0	—	—	—
Warehouseman	0	—	—	—
Meter Reader	2	5250	146	3504
Trade help	2	5250	146	3504
Janitor/Labourer	2	4500	125	3000
total	15			37008

* As updated by GOCV

Burns and Roe
Industrial Services Corp.

W.O. No. 4850.02 Date Jan 29 '80 Book No. _____ Page No. _____
Drawing No. _____ Calc. No. _____ Sheet B-4 of _____
By JE. Checked _____ Approved _____
Title Cost-benefit analysis of Abbreviated Phase - Cape Verde Desal/Pow

1.5 Total Salary costs, /yr.

Σ 1.1 + 1.2 + 1.3 + 1.4 + reserves (PP. Pg. 6-69)

= 65844 + 13200 + 13200 + 37008 + 3968

= $\boxed{133220}$

2.0 Fuel costs : (Ref: BRISC report No. 4)

: $421 / Metric Ton. Sept '79

Current price (trip Feb '80)

$460 / Metric Ton

use current price

Burns and Roe
Industrial Services Corp.

W.O. No. 4830.02 Date Feb 20, 1980 Book No. _____ Page No. _____
Drawing No. _____ Calc. No. _____ Sheet B-5 of _____
By A.C. Checked _____ Approved _____
Title Cost-benefit analysis of Initial phase - Cape Verde Desal / p

Calculation of Fuel costs

Operating yr.	Calendar yr.	Electricity Sales 10^6 KWH	Line loss %	Line loss KWH $\times 10^6$	Desal. plant + pumping 10^6 KWH	Generation output 10^6 KWH	Fuel per yr. M. Tons (@ 0.237 Kg per KWH)	Cost of Fuel @460 $/MT Thousand US$
		①		②	③	1+2+3		
—	0							
—	1							
—	2							
1	3	3.765	0.27	0.010	0.994	4.769	1130	520
2	4	3.938	0.28	0.011	1.093	5.042	1195	549
3	5	4.112	0.30	0.012	1.176	5.300	1256	578
4	6	4.285	0.32	0.014	1.258	5.557	1317	605
5	7	4.459	0.33	0.015	1.342	5.816	1378	634
6	8	4.632	0.35	0.016	1.381	6.029	1429	657
7	9	4.852	0.37	0.018		6.251	1481	681
8	10	5.072	0.39	0.020		6.432	1524	701
9	11	5.291	0.41	0.022		6.694	1586	729
10	12	5.511	0.43	0.024		6.916	1639	754
11	13	5.731	0.46	0.026		7.138	1692	778
12	14	5.829	0.48	0.028		7.238	1715	789
13	15	5.927	0.51	0.030		7.338	1739	800
14	16	6.024	0.53	0.032		7.437	1763	811
15	17	6.122	0.56	0.034		7.537	1786	822
16	18	6.22	0.59	0.037		7.638	1810	833
17	19	6.29	0.62	0.039		7.710	1827	841
18	20	6.36	0.66	0.042		7.783	1844	848
19	21	6.43	0.69	0.044		7.855	1862	856
20	22	6.50	0.73	0.047		7.928	1879	864

W.O. No. 9850.02 Date Feb 13 '80 Book No. _____ Page No. _____
Drawing No. _____ Calc. No. _____ Sheet B-6 of _____
By AZ. Checked _____ Approved _____
Title Cost-benefit analysis of "Initial Phase" - Cape Verde Desal/Power

3.0. Calculations of chemicals cost.

3.1 Calculation for 1000 m^3 feed water :

H_2SO_4 @ 51 ppm = 51 Kg @ \$0.11/Kg → \$5.61
Cl_2 @ 5 ppm = 5 Kg. @ \$0.30/Kg → \$1.50
$FeSO_4$ @ 4 ppm = 4 Kg. @ \$0.10/Kg → \$0.40
$NaHSO_3$ @ 1 ppm = 1 Kg @ \$0.06/Kg → \$0.06
Lime @ 2 ppm = 2 Kg @ \$0.06/Kg → \$0.12

total wt. 63 price \$7.69
Add shipping @ \$65/Ton = \$4.095 } Total/1000 m^3 11.785

OPER. YR	WATER PROD.	FEED WATER	CHEM. COSTS	
	1000 m^3	1000 m^3	US \$	
1	144.5	578	6811	
2	159.0	636	7495	
3	171.0	684	8061	
4	182.9	731.6	8622	
5	195.1	780.4	9197	
6	200.8	803.2	9466	
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Burns and Roe
Industrial Services Corp.

W.O. No. 9850.02 Date Feb 20 '80 Book No. _____ Page No. _____
Drawing No. _____ Calc. No. _____ Sheet B-7 of _____
By A.E. Checked _____ Approved _____
Title Cost-benefit analysis of Initial phase — Cape Verde — Desal / Power

4. Maintenance / Spare parts:

4.1 Membrane Replacement:

1/3 membrane replaced every year. Say each permeator is capable of producing 3384 gpd
= 12.81 m^3/d

Years of operation	Product water 1000 m^3	Av. No. of Permeators in use	1/3 No. of Permeators	Cost of permeators @ $5000 each (in $000)
1	144.5	31	10	50
2	159	34	11	55
3	171	37	12	60
4	182.9	39	13	65
5	195.1	42	14	70
6	200.8	43	15	75
7	↓	↓	↓	↓
8	↓	↓	↓	↓
↓				
20				

4.2 Maintenance:

1% of Capital cost of equipment / yr.

1% of 1.8 million $ = 18000 $.

4.3 Overhaul of Diesel engines.

25% of Diesel cost at year 10
25% of " " " " 15

25% of 120 000 = 157600 $

Consider this as investment

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APPENDIX - D

SELECTED REFERENCE DOCUMENTS

MEMBRANE WARRANTY

1. General

Polymetrics, Incorporated will provide the following guarantees regarding DuPont Permasep™ permeators:

1) Materials and workmanship of each permeator.

2) Initial performance of each permeator.

3) Long-term performance of the Reverse Osmosis (RO) System employing one or more permeators.

These guarantees are as described below.

2. Guarantee Date

The Guarantee Date is defined as the date of start-up of the System, but in all events the Guarantee Date shall not be later than one (1) year from the date of shipment of the permeators from their original manufacturer.

3. Materials & Workmanship Guarantee

Each permeator is guaranteed to be free of defects in materials and workmanship for a period of twelve (12) months following the Guarantee Date.

The liability of Polymetrics under this guarantee is limited to credit as defined in Paragraph 6 herein for permeators requiring replacement, or is limited to the repair and shipment to Purchaser of permeators requiring repair because of defects in materials and workmanship.

4. Initial Performance Guarantee

Each permeator is guaranteed to meet initial permeate flow rate and salt passage specifications under the standard test conditions for that model permeator, as stated in Paragraph 11 herein. This guarantee extends to the date of plant start-up or to twelve (12) months from the date of shipment of the permeators, whichever occurs first. Permeators failing to meet initial performance specifications upon testing at Purchaser's plant must be reported to Polymetrics within thirty (30) days after first detected deficiency. Polymetrics will credit Purchaser, as provided in Paragraph 6 herein, for permeators not meeting specifications.

1 May 81

5. Long-Term System Performance Guarantee

The System is guaranteed for ~~three (3)~~ FIVE (5) years following the Guarantee Date to meet the design capacity using the initial number of permeators provided with the system at the time of start-up and to provide a salt passage not to exceed:

- one and one-half (1-1/2%) under the standard test conditions for B-10 permeators and methods given in Paragraph 11 herein.

If either the design capacity or product quality of the System is not being achieved within guarantee period, the Purchaser should notify Polymetrics in writing, as soon as practicable, after he concludes that the permeators rather than other external factors are at fault. At the time of notification, the Purchaser should provide sufficient operating data to show that the system was operated in accordance with Paragraph 7 herein.

Following receipt of this data, Polymetrics will expedite the analysis of the system performance.

After verification by Polymetrics that subject permeators are the cause of either design capacity or product quality not being achieved, then Polymetrics shall advise Purchaser whether he should either replace subject permeators with new permeators or install additional new permeators to return the System to design performance. Polymetrics will credit Purchaser, as provided in Paragraph 6 herein, for permeators replaced in or added to the system under this performance guarantee.

6. Permeator Replacement

A. Permeator Credit

The Purchaser's liability for replacement and/or addition rate for B-10 permeators will be no greater than 1% per month, on a cumulative basis, of the number of permeators initially specified by Polymetrics.

Polymetrics will provide, at no charge, all replacements and/or additions required during the first year, and all replacements and/or additions in excess of the guaranteed cumulative maximum number of permeators required after the first year.

Should the Purchaser decide to replace or install additional permeators to return the System to design capacity and product quality, as provided in Paragraph 5

x Telex #1132 DTD 12 MAY 82 FROM POLY BNJ

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herein, credit will be issued to Purchaser's account in accordance with the above terms subsequent to such replacement or addition.

All permeator replacements or additions on a System, as specified in this Paragraph 6, will be guaranteed for materials and workmanship and initial performance for a period of twelve (12) months from their date of shipment and will be assigned the original Guarantee Date of the System for long-term performance, regardless of when they are installed on the System.

B. Freight Credit

In addition to the above credit for the permeator(s), Polymetrics will credit Purchaser's account in an amount equal to "minimum freight" from Purchaser's facility for the return of permeator(s) found to be faulty as provided in Paragraphs 3, 4 and 5 herein, provided Purchaser has compiled with the requirements of Paragraph 10 herein.

7. Conditions of Guarantee

This guarantee by Polymetrics for the System is conditional upon maintaining, at all times, the handling, storage, shipment and operation in accordance with guidelines and conditions stated in the System Operating Manual, which will include maintaining the following conditions:

	B-10
Maximum Silt Density Index (as measured on feed manifold)	3.0
Maximum Residual Free chlorine (ppm) (as measured on feed manifold)	
pH greater than 8	0.00
pH less than 8	0.00
Maximum pH within permeators	9.0
Minimum pH within permeators	5.0
Maximum feed manifold pressure (psig) for Feedwater Temperatures	
Above 40°C	0
35°C to 40°C	0
35°C	800
34°C	800
33°C	850

32°C	890
31°C	920
30°C	940
29°C	960
28°C	980
5 to 27°C	1000
Less than 5°C	0
Maximum shipping/storage temperature (°C)	40
Minimum shipping/storage temperature (°C)	5

The guidelines provided by Polymetrics for control of scaling and fouling must be followed.

Any chemicals or procedures used for feedwater pretreatment, cleaning, sanitizing or flushing operations which are not included in the System Operating Manual must be approved in writing by Polymetrics prior to use.

The use of PT-A and PT-B treatment may be required to meet and maintain performance specified in Paragraphs 4 and 5 herein.

Damage caused by materials not originally reported in the design feedwater analysis, or by detrimental effects caused by changes in feedwater composition are not covered by this guarantee.

Failure which can be attributed to unauthorized modification to the permeator(s) voids this guarantee.

no longer required

To effect the guarantee, the System must be registered within ninety (90) days of the Guarantee Date. Polymetrics provides Registration Forms in the System Operating Manual for this purpose. Immediately upon receipt by Polymetrics of the completed Registration Forms, the guarantee will be effective starting from the Guarantee Date.

In the course of the verification of cause of failure, Polymetrics has the right to provide additional instructions for operation and/or maintenance to remedy the System deficiency or to request that Purchaser return the permeators in question to Polymetrics for inspection. Polymetrics will have the further right, in conjunction with the Purchaser, to make all necessary and reasonable inspections and tests of the system on the Purchaser's premises. This guarantee does not apply to permeators which are inaccessible to Polymetrics for examination. Polymetrics is not responsible for maintaining System operation at any time.

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8. Special Guarantees

When special guarantees on product quality, capacity or operating conditions not covered herein, are provided by Polymetrics, then they will be set out in writing in the proposal or in subsequent Polymetrics communications, and must specifically state that such special guarantees are incorporated as part of this guarantee.

9. Guarantee Services

A. Examination of Returned Permeators

All permeators returned for guarantee claim will be examined by Polymetrics to determine the cause of failure. Polymetrics will be responsible for its examination costs for all such examinations where liability for the permeator failure is Polymetrics' responsibility. The Purchaser will be responsible for costs incurred by Polymetrics in all such examinations where the liability for the failure of the permeator is not Polymetrics' responsibility. Following a mechanical examination by Polymetrics, for which the costs will be limited to $200.00 per permeator, if additional testing is needed to determine failure cause, a cost estimate for such work will be supplied by Polymetrics to the Purchaser for his authorization before the work is undertaken.

B. Field Investigation and Examinations

When it is necessary to make field investigations of Purchaser complaints results in compensation to the Purchaser under this guarantee, Polymetrics will be responsible for its own costs. If the cause for such investigations is due to the Purchaser's improper installation or operation, Purchaser will pay to Polymetrics the then current per diem Technical Service Charge established by Polymetrics, plus all living and traveling expenses for Polymetrics' personnel investigating the problems.

10. Returning Permeators

Permeators must not be returned to Polymetrics until a Returned Merchandise Order (RMO), which is provided by Polymetrics' Technical Service Department, is authorized.

Permeators returned to Polymetrics for guarantee examination must be returned freight prepaid (Purchaser is to pay the freight) with a RMO enclosed and must be suitably sanitized, packaged and handled to protect the permeators from damage.

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11. Standard Test Conditions and Initial Performance Specifications

The standard test conditions and performance specifications are as follows:

	B-10
NaCl Test Solution TDS (mg/l)	30,000
Solution Feed Pressure (psig)	800
Solution Temperature (°C)	25
Conversion (%)	30
Permeate Flow Rate (USgpm)	Last three digits of model number multiplied by 100
Salt Passage (%)	1.5

EMBASSY OF THE
UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT
Praia, Cape Verde

United States Address
Praia (I.D.)
Department of State
Washington, D.C. 20520

International Address
U.S.A.I.D.
C/o American Embassy
B.P. 201
Praia, Cape Verde

May 29, 1984

Polymetrics Contract No. Sal
4850-M-101

Mr. Jeffery A. Draper
Attorney-in-Fact
American Home Assurance Co.
3 Embarcadero Center,
San Francisco, Ca. 94111

Dear Mr. Draper:

In response to your inquiry regarding the status of the performance of Polymetrics, Inc. in carrying out its contract covered by Bond No. 18922 issued by your company, the Government of Cape Verde has sent its remarks dated May 21 and a telex dated April 23, 1984 (see attached).

A field report by Engineer Albino Ko, of AID's consulting engineers, Burns and Roe, now being prepared, should spell out the specific deficiencies of Polymetrics, and identify what remains to be done.

was sent to Mr. Draper on 6/20/84

Sincerely yours,

Frank M. Dimond
Acting AID Rep
USAID/Praia

cc: Ahmet Chattopadyay
Glenn Slocum
Eurico Pascoal Almeida
William J. Gill

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Aos
Correios e Telecomunicações
Mindelo

Telex Nº 105/84
Mindelo, 23/04/84

Agradecemos seja transmitido o seguinte telex p/U.S.A.

TELEX Nº 420627 (ITT) OU 232019 (RCA)
MSG Nº 105/84 , 23 APRIL 1984
TO: AMERICAN HOME ASSURANCE CO.
ATTN: MR. EVERETT O. YOUNG
SUBJ: CONTRACT BOND NO. 18922, OF JULY 31, 1981

DURING THE FIRST YEAR OF OPERATION WE HAVE BEEN EXPERIMENTING SEVERA PROBLEMS WITH THE EQUIPMENTS FURNISHED BY POLYMETRICS, INCORPORATED, WHO WAS SUPPOSED TO MAKE GOOD IN EVERYTHING THAT NEEDED REPAIR OR REPLACEMENT.
HOWEVER, IN SPITE OF O CLAIMS, POLYMETRICS HAS NOT DONE SO YET. FO THIS REASON IF YOU HAVE NOT YET VOIDED THE ABOVE MENTIONED BOND WE BEG YOU TO HOLD IT VALID UNTIL POLYMETRICS INCORPORATED, HAS MADE GOOD ON ITS WORK.
PLEASE USE TELEX NO. 89 PUBL SV CV.
BEST REGARDS
MARTINHO RAMOS
REPRESENTATIVE OF THE GOVERNMENT OF CAPE VERDE

O Director,

ELECTRICIDADE E ÁGUA
Empresa Pública de Electricidade e Água
S. VICENTE · CABO VERDE

81

0 7/29

ELECTRA Empresa Pública de Electricidade e Água, E. P.
Serviços Centrais: Av. Unidade Africana N.º 10. 1.º - C. P. 137 - Telef. 2782
S. VICENTE - CABO VERDE

Exmº Senhor
Frank Dimond
Director
USAID/Embaixada Americana
Praia

MAY 25 RECD

Na referência	Sua comunicação de	Nossa referência	Data
		341/GDG/84	Mindelo, 22/5/84

Assunto:

Junto remetemos, para conhecimento, fotocópia do "Status Inquiry" da AMERICAN INTERNATIONAL COMPANIES sobre a Garantia Nº 18922 dada pela POLYMETRICS.

Apresentamos os melhores cumprimentos e subscrevemo-nos

De V.Excª.
Atentamente
ELECTRA, E.P.
ELECTRA
Empresa Pública de Electricidade e Água
S. VICENTE - CABO VERDE

/Eurico Pascoal Almeida/
Director-Geral

Indicar na resposta a nossa referência

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...surance Company
...Fidelity Company
...me Assurance Company
...State Insurance Company
...National Insurance Company
...urance Company of the State of Pennsylvania
...al Union Fire Insurance Company of Pittsburgh, P...
...Hampshire Insurance Company

American International Companies

3 Embarcadero Center, San Francisco, Ca. 94111

STATUS INQUIRY

To: Owner/Obligee

GOVERNMENT OF REPUBLIC OF CAPE VERDE

Address (number, street, city, state, zip)

C/O ELECTRA, E.P. C.P.137 S.VICENTE

City, State, Zip

REPUBLIC OF CAPE VERDE

Date: MARCH 19, 1984

Our Bond Number: 18922

Reinsured's Number:

...ACTOR	POLYMETRICS, INC.		
...ESS	SAN JOSE, CALIFORNIA		
...RIPTION OF ...ACT	SUPPLY OF A REVERSE OSMOSIS DESALINATION SYSTEM PER CONTRACT NO. SAL-4850-M-101		
...ER	GOVERNMENT OF REPUBLIC OF CAPE VERDE		EFFECTIVE DATE 7/27/81
...TRACT ...E	$1,112,700.00	BOND(S) $ 111,270.00	

WITHOUT PREJUDICING YOUR RIGHT OR AFFECTING OUR LIABILITY UNDER OUR BOND(S) DESCRIBED ABOVE, WE WOULD APPRECIATE SUCH OF THE FOLLOWING INFORMATION AS IS NOW AVAILABLE. PLEASE RETURN THE COMPLETED FORM IN THE ENCLOSED SELF-ADDRESSED STAMPED ENVELOPE, RETAINING A COPY FOR YOUR RECORDS.

VERY TRULY YOURS

AMERICAN HOME ASSURANCE COMPANY

BY: JEFFERY A. DRAPER ATTORNEY-IN-FACT

...ONTRACT COMPLETED, PLEASE STATE:	Approximate Date of Completion or Work (or Final Delivery) 16 APRIL 1983	Approximate Acceptance Date 16 APRIL 1983	Final Contract Price $1 112 700
...ONTRACT UNCOMPLETED, PLEASE STATE:	Approximate Percentage or Dollar Amount of Contract Completed or Delivered		

...YOU KNOW OF ANY UNPAID BILLS FOR LABOR OR MATERIALS: NO

...MARKS: Please refer to attached copy of a telex message ...ent to American House Assurance Co. on 4/23/84

...1/24/84 GOCV Representative DATE

It is understood that the information contained herein is furnished as a matter of courtesy for the confidential use of the surety and is merely an expression of opinion. It is also agreed that in furnishing this information, no guaranty or warranty of accuracy or correctness is made and no responsibility is assumed as a result of reliance by the surety, whether such information is furnished by the owner or by an architect or engineer as the agent of the owner.

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Worldwide Bonding
American International Companies
BOND DEPARTMENT
Three Embarcadero Center
San Francisco, California 94111
TEL: 415/445-2700 TELEX: 340238

Direct Dial: 415/445-2643

March 19, 1984

Mr. William J. Gill, Acting Chief
U.S. INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

RE: POLYMETRICS, INCORPORATED
CAPE VERDE PROJECT
CONTRACT NO. SAL-4850-M-101
OUR BOND NO. 18922

Dear Mr. Gill:

For sometime we have been attempting to determain whether the captioned contract had ever been completed and in conjunction therewith whether whether the terms of the bond furnished by our company had been satisfied.

At your earliest convenience we would appreciate very much your completing the enclosed Status Report with any comments concerning the performance of the contract you would care to make.

Your attention to this matter will be very much appreciated.

Very truly yours,

Jeffery A. Draper
Bond Department

Enc: 1

IN NORTH AMERICA: American Home Assurance Company • Commerce and Industry Insurance Company of Canada • National Union Fire Insurance Company of Pittsburgh, Pa. • The Insurance Company of the State of Pennsylvania OVERSEAS: American International Underwriters

30353 (12/80)

9D

cc: PGO'Keefe-w/a
JPasquarelli'
AChatto-w/a
AKo "
pf "

J. Draper/w.att.
American Home
Assurance

BRISC

Subject: Cape Verde Desalination & Power
(SAL) Project
W. O. 4850 - BRISC #560
Warranty Claim - Desalination Equipment

June 20, 1984

Polymetrics, Inc.
1284 Forgewood Avenue
Sunnyvale, California 94089

Attention: Ms. Sue Whiteside

RE: Our Telex #531, dated February 10, 1984
Our Telex #540, dated March 16, 1984, Item B
Our Telex #545, dated March 28, 1984
Our Telex #551, dated April 13, 1984
Our letter #559, dated June 5, 1984

Dear Ms. Whiteside:

Further to our above referenced Telexes and subsequent telephone conversations, we request your urgent action in replacing all parts including permeators and other plant components as listed in Attachment A to this letter. We have already requested replacement of the pulsation dampeners per our letter #559, dated June 9, 1984, to which we have not received any reply. As we mentioned in that letter, we conducted a site inspection. We are enclosing for your reference one copy of the inspection report providing further details with photographs of the equipment problems.

We cannot over-emphasize the requirement of your expeditious action since the problems with your equipment are continually aggravating and seriously affecting plant production.

Kindly let us know by return mail or Telex the action you are taking regarding the replacement items.

Very truly yours,

Amit Chattopadhyay

Amit Chattopadhyay, P.E.
Project Manager

AC:ac
Attach.
cc: A.Robalo/Electra
M.Ramos/ "
J.Snead/AID, Wash.
G.Slocum/AID, "
D.Bedford/Polymetrics

Burns and Roe Industrial Services Corporation
50 Winters Avenue ▫ Paramus, New Jersey 07652 ▫ Telephone: NJ (201) 265-2000 NY (212) 563-77[illegible]
Telex 13-4223

ATTACHMENT A

1. All the corroded tees and accumulators body of the pulsation dampeners shall be replaced with SS316L or other corrosion resistant materials (such as aluminum-bronze as required for the HP pump liquid end) according to the specification.

2. All corroded brine reject flexible pipes shall be replaced with new ones. (Material and test certification documents are required.

3. The feedwater temperature controller shall be replaced with 50 Hertz rating.

4. All pressure transmitter to shutdown high pressure pump shall be replaced with signal 10 - 12 mA.

5. Due to fouling, low productivity, low product water quality and permeator damage, a total of twenty-six (26) permeators shall be replaced immediately. The following are serial numbers of the permeators to be replaced in each train.

Train	Permeator Rack Nos.	Permeator Serial Nos.
A	1	8200298
	2	8200076
	3	8201136
	4	8200088
	5	8110313
	6	8201206
	7	8201196
	8	8110383
	10	8201295
	11	8201183

Train	Permeator Rack Nos.	Permeator Serial Nos.
B	1	8109205
	2	8109558
	3	8108262
	4	8108992
	6	8109173
	7	8200520
	9	8109718
	11	8200082
	12	8201191
	-	8103759

Train	Permeator Rack Nos.	Permeator Serial Nos.
C	1	8108781
	3	8109431
	6	8110953
	8	8109608
	9	8201269
	12	8200083

c: PGO'Keefe
JPasquarelli
TCKlemm
[redacted]
file

BRISC

Subject: Cape Verde Desalination & Power (SAL) Project
W.O. 4850; BRISC No. 536
Corrections to Desalination Plant Deficiencies Required by Warranty from Polymetrics - Bond No. 18922

May 7, 1984

American International Companies
Bond Department
3, Embarcadero Center
San Franciso, California 94111

Attention: Mr. Jeffrey A. Draper

Dear Mr. Draper:

Confirming our telephone conversation, I am forwarding for your information one (1) copy each of the following documents, the contents of which are self-explanatory:

1. BRISC letter No. 552 dated April 17, 1984, addressed to Polymetrics, with a copy of Telex No. 551 dated April 13, 1984.

2. BRISC Telex No. 535 dated May 4, 1984.

Your attention to this matter will be appreciated.

Very truly yours,

Amit Chattopadhyay

Amit Chattopadhyay, P.E.
Project Manager

AC/sz
Enclosures

cc: A. Robalo
G. Slocum
J. Snead

Burns and Roe Industrial Services Corporation
650 Winters Avenue □ Paramus, New Jersey 07652 □ Telephone: NJ (201) 265-2000 NY (212) 563-7700
Telex: 13-4223

Achievements in Engineering and Construction Since 1932

91

346419

MAY 4, 1984

POLYMETRICS: ATTN: MR. PETER SMITH/D. BEDFORD

SUBJECT: CAPE VERDE DESAL EQUIPMENT
W.O. 4850 - BRISC 535

INFO RECEIVED FROM ELECTRA, SAL:

1) TWO NEW FLEX HOSES WERE REC'D. ELECTRA IS SENDING TWO OLD FLEX PIPES AND FIVE PRESSURE TRANSMITTERS AND RUPTURED DISCS DISCS TO POLY

2) CLEANED TRAIN A WITH CITRIC 4. BIZ DETERGENT AND PTB. RESULTS IN OHMS: 4,250, 750, 1700, 1100, 700, 900, 3000, 1150 - 1000, 3250, 650, DP: 1-1.1, 2-0.7, 11-1.15, 12-1.15.

3) BASED ON HIGH PRODUCT SALINITY IT APPEARS THE FOLLOWING PERMEATORS FAILED, THEIR SERIAL NUMBERS ARE:

TRAIN A: 8200293, 8201136N 8201196, 8201183
TRAIN B: 8109205, 8108262, 8108749, 8110389, 8201191
TRAIN C: 8110953, 8109608, 8200083.

4) PERMEATOR SERIAL NR. 8108749 WAS OPENED FOR CHANGING O-RING, AS A NORMAL MAINTENANCE OPERATION. ELECTRA DIDN'T INCREASE FEED PRESSURE WORKING AT LOW TEMPERATURE BECAUSE THE FLEX HOSES WERE LEAKING AND THEY COULDN'T HOLD HIGHER PRESSURE.

5) TRAIN B IS STILL STORED AWAITING INSPECTION SINCE THE FLEX HOSE AND DISC RUPTURED ON LAST MARCH THAT CAUSED BENDING ON SST FEED LINE AND PROBABLY SOME MORE SERIOUS PROBLEM IS OCCURRING. WE BELIEVE THIS AND OTHER PROBLEMS (CORROSION OF PUMP INLET TEE, PUMP INTERNALS, FLEX HOSES, RUPTURE DISCS AND PERMEATOR DEGRADATION) ARE SUFFICIENT CAUSES REQUIRING POLY INSPECTION AS A PART OF WARRANTY.

AMIT CHATTOPADHYAY
BURNS & ROE

170737 POLYUSA
TAP117 +
BR 650 PARA
.....
1614EDT 005.20

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cc: PGO'Keefe
JPasquarelli
MWCherry
ACFA
[redacted]
file

BRISC

Subject: Cape Verde Desalination and Power (SAL) Project
W.O. No. 4850; BRISC No. 552
Corrections to Desalination Plant Deficiencies
Required by Warranty

April 17, 1984

Polymetrics, Inc.
1005 Timothy Drive
San Jose, California 95133

Attention: Mr. Peter Smith
Manager, Projects

Dear Mr. Smith:

Attached is a confirmation copy of the telex we sent you last Friday, April 13, 1984.

The contents of the telex are self-explanatory. We would like to add that the end-of-one-year "deferred performance test" cannot be conducted until Polymetrics corrects the system to bring it to a full and satisfactory operating condition.

Please advise us at your earliest convenience of your specific action program to remedy all the deficiencies in the desalination system.

Very truly yours,

Amit Chattopadhyay

Amit Chattopadhyay, P.E.
Project Manager

AC/sz
Enclosure: (1)

cc: Mr. D. Bedford - Polymetrics
G. Slocum/J. Snead/F. Dimond - AID, Washington, DC
M. Ramos/A. Robalo - Cape Verde

Burns and Roe Industrial Services Corporation
650 Winters Avenue ■ Paramus, New Jersey 07652 ■ Telephone NJ (201) 265-2000 NY (212) 563-7700
Telex 13-4223

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O
L
POLY SNJ

4/13/83
TLX 346419
ATTN: MR. PETER SMITH/MR. DEAN BEDFORD
CC: AID/WASH. D.C.
ELECTRA/GOCV
W.O. 4850; BRISC NO. 551; CAPE VERDE DESAL PLANT

WE HAVE BEEN ADVISED BY THE GOVT OF CAPE VERDE (GOCV) THAT THE FLEXIBLE CONNECTIONS HAVE NOT PERFORMED TO KEEP THE DESALINATION PLANT IN OPERATION NOR THE MEMBRANE ELEMENTS PROVEN RELIABLE IN MAINTAINING DESALINATED WATER QUALITY. SINCE THE ABOVE DEFICIENCIES, AND SEVERAL OTHER DEFICIENCIES INCLUDING AGGRAVATING CORROSION ON CERTAIN COMPONENTS AND REPEATED FAILURES OF RUPTURE DISCS, ALL OCCURED DURING THE TWELVE MONTHS OF TRIAL OPERATION PERIOD, GOCV REQUESTED US TO NOTIFY YOU THAT THE WARRANTY IS BREACHED AND THEY REQUIRE POLYMETRICS TO REMEDY EVERYTHING WITHIN SIXTY CALENDAR DAYS.

PLS ACKNOWLEDGE AND ADVISE US YOUR ACTION

AMIT CHATTOPADHYAY
BURNS & ROE

E. I. DU PONT DE NE[illegible]RS & COMPANY
INCORPO[illegible]

"PERMASEP" PRODUCTS — ROUTE 896, GLASGOW, DELAWARE 19711

SHEET NO._____ Poly

PACKING LIST

SHIP TO:
Polymetics, Inc.
1005 Timothy Drive
San Jose, Ca. 95133

ORDER NO. [illegible] 2905	DATE
CUSTOMER ORDER NO. [illegible]	DATE
ROUTING	DATE 5/24

PKG. STENCIL 21 32455

MATERIAL 33-MODEL 6840 060N PERMASEP B 10 PERMEATORS, 2 1 Pound & 3-30 Gram Bottles PTB

Permeator No.	Location		GPM	SP	ΔP	Model	Permeator No.	Location		GPM	SP	ΔP	Model
8108262			3.92	1.5	4	6840-060N	8000088			3.88	1.1	3	6840-060N
8749			3.85	1.1	6		9781			4.34	1.5	4	
8781			3.84	1.1	5		500			3.86	0.9	4	
8982			3.85	1.1	3		1186			4.49	1.0	5	
8992			3.92	1.0	3		1188			4.50	1.2	4	
9173			3.91	0.8	3		1191			4.49	1.2	0	
9205			4.35	0.9	3		1196			3.75	1.3	5	
9530			3.88	1.2	4		1206			4.46	0.8	4	
9558			3.88	1.1	3		1238			4.48	1.5	5	
9608			4.55	1.0	5		1269			4.42	1.1	3	
9434			3.88	1.1	3		1295			3.90	1.3	3	
9718			3.85	1.2	3		1653			3.87	0.9	4	
10385			3.85	0.9	3								
10313			3.92	1.3	3								
10953			3.91	1.2	2								
10383			3.75	1.1	4								
10389			3.92	1.3	4								
200056			3.78	0.6	3								
76			3.92	0.7	3								
82			3.91	0.6	3								
83			3.92	1.1	2								

DISTRIBUTION: 1 — PACKING LIST 2 — PACKING LIST 3 — MARKETING DATA 4 — FILE

APPENDIX E

WATER AND POWER PRODUCTION/CONSUMPTION STATISTICS

EMPRESA PÚBLICA DE ELECTRICIDADE E ÁGUA DE CABO VERDE

ELECTRA - DELEGAÇÃO DO SAL

ESTATÍSTICA DE PRODUÇÃO E CONSUMO DE ENERGIA E ÁGUA DURANTE O ANO DE 1984

E N E R G I A

TRIM.	PRODUÇÃO KWH	CONSUMO KWH							
		DOMÉSTICO	ESTADO	INDÚSTRIA	ILUMINAÇÃO PÚBLICA	DESSALINIZAÇÃO	CONSUMO INTERNO	PERDAS NA REDE	OBS:
1º	693 200	130 300	10 000	198 350	40 800	147 060	4 607	162 081	
2º	670 400	130 583	12 500	170 446	40 800	177 981	4 007	134 080	
3º	716 800	171 538	4 042	175 100	40 800	248 700	4 352	143 360	
4º	782 128	169 884	12 010	130 900	40 800	236 096	5 457	18 691	
SOMA:	2.862 528	602 305	38 552	674 796	163 200	809 837	18 423	458 212	

RESUMO PRODUÇÃO PALMEIRA- 2.687 898,6 KWH

STA MARIA- 174 629,4 KWH

Á G U A

TRIM.	PRODUÇÃO M3	CONSUMO M3								
		DOMÉSTICO	ESTADO	INDÚSTRIA	FONTENÁRIO	AUTOTANQUE	CONSUMO	CONSUMO GRATUITO	PERDAS	EXISTENCIA FINAL.
1º	16 340	5 313	105	3 438	446	2.038	254	254	1 900	
2º	19 591	7 226	100	5 095	3 347	1 800	307	234	1 482	0
3º	24 020	9 747	260	5 445	3 572	1 476	322	260	2 138	800
4º	21 080	9 420	421	3 735	1 765	2 975	200	273	2 491	600
SOMA:	81 031	31.706	886	17 703	9 130	8 289	1 083	1 021	8 011	

Delegação da ELECTRA no Sal, 2 de Abril de 1985

O DIRECTOR,

ANTONINO VIEIRA ROBALO

EMPRESA PÚBLICA DE 'RICIDADE E AGUA DE CABO VERDE

ELECTRA - DELEGAÇÃO DO SAL

ESTATISTICA DE PRODUÇÃO E CONSUMO DE ENERGIA E ÁGUA DURANTE O ANO DE 1984

ENERGIA -VALOR EM CONTOS

TRIM.	PRODUÇÃO KWH	CONSUMO								
		DOMESTICO	ESTADO	INDÚSTRIA	ILUMINAÇÃO PÚBLICA	DESSALINIZAÇÃO	CONSUMO INTERNO	PERDAS NA REDE	TOTAL	OBS:
1º		1.243	125	1.686					3.054	
2º		1.771	185	1.976					3.932	
3º		2.231	52	2.034					4.317	
4º		2.500	168	1.830					4.498	
		7.745	530	7.526					15.301	

PRODUÇÃO E CONSUMO DE ÁGUA - VALOR CONTOS

TRIM.	PRODUÇÃO	PARTICULARES	ESTADO	INDÚSTRIA	FONTENÁRIO	AUTOTANQUE	TOTAL	OBS:
1º		520	9	394	446	163	1.532	
2º		716	9	662	435	234	2.056	
3º		962	20	707	464	169	2,322	
4º		1.186	50	485	229	208	2.158	
		3.384	88	2.248	1.574	774	8.068	

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EMPRESA PÚBLICA DE ELECTRICIDADE, ÁGUA DE CABO VERDE, E.P.

ELECTRA - DELEGAÇÃO DO SAL

ESTATÍSTICA DE PRODUÇÃO E CONSUMO DE ENERGIA E ÁGUA DURANTE O ANO DE 1983

ENERGIA

TRIM.	PRODUÇÃO KWH	CONSUMO KWH						
		Doméstico	Estado	Indústria	Iluminação pública	Dessalinização	Consumo interno e perdas na rede	OBS:
1º	55.400	14.700	5.830	5.500	5.670	16.190	8.310	a) Não elevado. Consumo resulta da utilização de energia na teste de arranque da Instalação.
2º	527.848	104.430	85.500	32.733	20.800	144.000 b)	140.385	
3º	479.6.0	84.695	101.904	35.333	20.800	125.500	111.368	
4º	655.820	125.800	153.539	42.937	20.800	163.020	149.724	
SOMA:	1.718.068	329.625	345.973	116.503	68.070	448.710	409.787	

ÁGUA

TRIM.	PRODUÇÃO	CONSUMO M3								
		Particulares	Estado	Indústria	Fontenário	Autotanque	Consumo instal.	Consumo interno	Perdas	Existência
1º	2.458	759	60	75	-	1 150	389	15	-	10
2º	9.470	1.053	1.007	1.198	1.939	889	51	160(m)	103	100
3º	17.019	3.547	2.067	1.893	4.586	1.600	-	450	2.876	500
4º	20.215	5.380	1.675	2.400	4.966	1.610	-	300	2.584	800
SOMA:	49.162	10.759	4.809	5.566	11.491	5.249	440	925	5.563	1.410

Inclui a lavagem das tubagens nas ligações novas.

EMPRESA PÚBLICA DE ELECTRICIDADE E ÁGUA DE CABO VERDE

ELECTRA - DELEGAÇÃO DO SAL

ESTATÍSTICA DE PRODUÇÃO E CONSUMO DE ENERGIA E ÁGUA DURANTE O ANO DE 1983

ENERGIA - VALOR EM CONTOS

TRIM.	PRODUÇÃO	CONSUMO								
		DOMÉSTICO	ESTADO	INDÚSTRIA	ILUMINAÇÃO PÚBLICA	DESSALINIZAÇÃO	CONSUMO INTERNO	PERDAS NA REDE	TOTAL	OBS:
1º		140	54	50					194	
2º		1.201	98	101					2.399	
3º		974	1.405	371					2.750	
4º		1.383	1.535	472					3.390	
SOMA:		3.698	4.192	843					8.733	

ÁGUA - VALOR EM CONTOS

TRIM.	PRODUÇÃO	DOMÉSTICO	ESTADO	INDÚSTRIA	FONTENÁRIO	AUTOTANQUE	TOTAL	OBS:
1º		48	-	-	48		96	
2º		244		43	159	60	506	
3º		190	114	112	286	128	830	
4º		430	134	192	397	128	1.281	
SOMA:		912	248	347	890	316	2.713	

Delegação da ELECTRA- Sal, 2 de Abril de 1985

O DIRECTOR,

/ ANTONINO VIEIRA ROBALO /

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CTEA-DELEGAÇÃO DO SAL

PREVISÃO ANALÍTICA DE CARGA NAS HORAS DE PONTA NO PERÍODO DE 1984-1994 NA ILHA DO SAL, EM KW, E NECESSIDADE EM POTENCIA INSTALADA NA CENTRAL DA PALMEIRA

Ano	Dessalinizador	Espargos	Palmeira	Salmar	Shell	Aeroporto	Bairro Novo e outros	Vila Santa Maria	Hotel Morabeza	Novo Hotel	Pedra Lume	Imprevistos	TOTAL KW	TOTAL KVA	Potencia instalada necessária, KVA
1984	100	150	60	200	300	250	40	50	80	-	50	50	1330	1662	2000
1985	130	180	140	250	300	300	70	55	90	-	50	50	1615	2018	3000
1986	160	200	180	260	300	300	75	60	110	300	50	50	2025	2531	3000
1987	180	220	190	250	350	320	80	65	230	350	60	50	2345	2931	4000
1988	180	240	200	250	350	330	85	70	240	380	60	50	2358	2947	4000
1989	200	250	210	250	400	350	90	80	250	400	60	50	2590	3237	4500
1990	200	270	220	250	400	380	120	85	280	420	65	50	2740	3425	4500
1991	250	280	240	300	400	400	140	90	300	450	70	80	3000	3750	4500
1992	280	300	260	300	450	420	150	100	350	500	70	80	3260	4075	5500
1993	280	320	280	300	500	430	160	110	350	510	80	80	3400	4250	5500
1994	300	340	300	300	500	450	180	120	400	520	80	80	3570	4462	5500

Nota: A potência necessária a instalar é a mínima indicada, sendo necessário haver um grupo de, pelo menos 750 KVA