660-0026

T-CAS

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Work Order No. 01

REPORT ON
INVESTIGATION OF REQUIREMENTS
FOR
PUTTING FLOATING DRY-DOCK INTO
OPERATION BY
MARITIME ROUTES ADMINISTRATION (RVM),
AT BOMA PORT

ZAIRE TRANSPORT SECTOR LOAN
No. 660-H-011

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PREFACE

The Engineering assignment covered in this report was completed under USAID Contract No. OTR-0000-I-01-1011-00, in support of Zaire Transport Sector Loan 660-4-011.

The task required a Port Engineer to travel to the Port Boma site in Zaire and evaluate a floating dry dock, constructed and delivered to that location under direction of the Maritime Routes Admininstration (RVM--Regie des Vois Maritimes).

Two Contractors were involved in the initial design and procurement specification for the dry dock: Crandall Dry Dock Engineering, Inc., and ABSTECH.

The objective of this Task was to determine the most effective means of putting the floating dry dock into operation. This involved three separate areas of study:

- Examine existing documentation--design, planning, furnishing and testing--to assess current conditions.
- Evaluate additional requirements through on-site inspection of floating dry dock.
- Analyze proposals for putting dry dock into operation and determine whether they were satisfactory and complete in all detail.

The Engineer was also tasked with assisting RVM as needed in letting contracts for the additional services, should conditions be affirmative for this step.

CONTENTS

SUMMARY

The T-CAS Port Engineer, Mr. Gopal Pillai, visited the USAID office in Kinshasa and the floating dry dock at Port Boma, Zaire during the period of 18 March to 2 April 1981. Records were examined, the actual dry dock condition was assessed, and the proposals for making it operational were evaluated.

The items of work remaining to be done were found to be:

a. Supply and installation of mooring system.

b. Connecting the existing power source to dry dock.

c. Repairing of the power distribution system inside the floating dry dock including making the three cross over pipe conduits water tight.

d. Repairing of leaking safety decks.

e. Providing the voltage regulated 220 VDC generator.

f. Repairing of Worthington deep well pumps.

g. Protection to flapper valves from external damage.

h. Provision of a gangway for easy access to the dock.

Various proposals, as submitted by two companies, (Chanimetal and Misener Industries, Inc.) deal with different, but not all, areas of these items of work. They are discussed in detail in the text of this report, along with the areas of the work to be handled by RVM directly. A combination of proposed solutions is recommended which does not lend itself to a summary.

Summary (Continued)

However, it is strongly recommended, based on liaison deficiencies which become evident in retrospect and which resulted in the delays thus far, that a competent Port Engineer be appointed by USAID at Boma to supervise the work and coordinate all efforts. The Port Engineer should have strong electrical background since the major repairs to be carried out on the dock are mainly electrical in nature.

SECTION 1

STUDY PERSPECTIVE

1.1 Scope of Work

The purpose of this study is to suggest the most effective means of putting the floating dry dock constructed and delivered to Boma Port into operation. This involved the study of various procurement and work plans prepared by local contractors and the RVM and scrutinizing the cost estimates submitted by them. It was also necessary to determine whether the works suggested by the contractors and RVM dealt with all aspects of remaining works to be done to make the dock operational.

The only valid quotation which was available for scrutiny was from a proposed subcontractor, Chanimetal. This quote covered only the works to be done in connection with the mooring arrangements. One other quotation, which was available in the files was from Misener Industries dated 21 December 1977, but this quotation may not be valid anymore, being more than 2-1/2 years old. The latter covered most of the other works to be done except the mooring system.

1.2 History of the Project

In March 1973, Crandall Dry Dock Engineering, Inc., Cambridge, Mass, completed a feasibility study for the reconditioning and extension of the existing dry dock at Boma. The detailed drawings and general specification for renovation of the old dry dock also called for construction of a new section to extend the dock by approximately 17 meters. These documents were completed by Crandall in August 1973, and were reviewed by ABSTECH during March 1974. ABSTECH finalized the Invitation For Bid (IFB) on January 1975 which was later revised because of poor response. As per the revised IFB, the project was divided into the three phases described next.

Phase I consisted of the construction in the United States of the new section of floating dry dock which is of all steel welded construction approximately 17 meters long by 24 meters wide and the furnishing of certain miscellaneous access platforms, equipments and materials to Regie des Vois Maritimes (RVM), Boma, Zaire. Phase I also included provision of two on-site technical personnel to perform supervisory services for RVM for connection of the new and existing section of the Dry Dock, necessary electrical connections and preparation for operation of all main and auxiliary systems and services.

Phase II consisted of the transportation of the section from Tampa, Florida to Boma, Zaire.

Phase III consisted of the structural connection of the new section of the floating dry dock at Boma and the neces-

sary electrical connections and preparation for operation of all main and auxiliary systems and services.

All the above three phases were contracted for separately. A contract for Phase I was entered into between RVM and Misener Industries Inc., Tampa, Florida, on November 1975 for a total value of $850,820. The new section was towed from Tampa, Florida to Boma, Zaire and arrived in Boma on 23 September 1976. The connection of the new dock section and all necesary electrical connections were completed on 17 October 1976. The extended dock was tested for operation on that date but failed to pass all the tests. Some of the defects have since been repaired but many items are still outstanding. The details of work still to be done are discussed in paragraphs 1.3.

Even though each phase was contracted for separately, there was no provision for a performance testing of the new dock section at Tampa, Florida, before shipment/towing. This was all the more necessary, because of the very limited facilities available at Boma, Zaire, for any repair works. Had the testing been performed and witnessed at Tampa, Florida, many of the defects could have been detected and rectified before the new section was dispatched to Zaire. ABSTECH should have included this performance testing at Tampa, Florida as part of the Phase I contract.

Since November 1976, several attempts were made to make the dry dock operational. Various proposals have been received from MII and Chanimetal as well as RVM, for making the dock operational. These are evaluated in detail in this report and form the basis of the conclusions and recommendations presented.

1.3 Summary Items of Work/Tasks Yet To Be Done

On going through the several volumes of records available in the USAID office and after discussions with representatives of Chanimetal and RVM and an inspection of the dry dock at Boma, it was found that the following items of works must be completed before the dock can be made completely operational.

These items of work are:

(a) Supply and installation of mooring system.

(b) Connecting the existing power source to dry dock.

(c) Repairing of the power distribution system inside the floating dry dock including making the three cross over pipe conduits water tight.

(d) Repairing of leaking safety decks.

(e) Providing the voltage regulated 220 V DC generator.

(f) Repairing of Worthington deep well pumps.

(g) Protection to flapper valves from external damage.

(h) Provision of a gangway for easy access to the dock.

1.4 Scope of Report

As stated, various proposals have been received from Chanimetal and Misener Industries, Inc. for rectification of the deficiencies enumerated in paragraph 1.3. RVM also has planned for repairs of some of the defects mentioned in the list. These proposals are discussed in specific detail along with the description of the defects, probable causes, methods of rectification and analyses of rates in Sections 2 through 9 of this report. However, the sections are organized to reflect the work items delineated in paragraph 1.3, and the discussion in each instance is from the point of view of the work to be accomplished.

Section 10 provides consolidated cost estimates of the work required, and Section 11 presents the conclusions and recommendations.

S E C T I O N 2

SUPPLY AND INSTALLATION OF MOORING SYSTEM

2.1 Background Information

The preparation of detailed drawings and specifications for extending the existing dock by 17 meters were completed by Crandall on August 1973 and these were reviewed by ABSTECH during March 1974. ABSTECH finalized the IFB on January 1975 which was later revised because of poor response. Even though Crandall's proposals increased the capacity of the existing dry dock, they did not bother to check the adequacy or condition of the existing mooring system. ABSTECH also did not bring up this issue during their review of Crandall's drawings and specifications. At the time of joining of the new seciton to the existing section during September/October 1976, it became apparent that the existing mooring arangements were totally inadequate. Thereupon, a series of correspondence ensued betwen ABSTECH, MISENER, RVM and USAID which culminated in a redesign of the mooring system using new steel chains and concrete anchors as per ABSTECH dwg No. WTS-703-1 Rev O, issued in May 1980.

2.2 Scope of Work

The scope of work under this item/task may be divided into two distinct parts--one to be performed by Chanimetal and the other to be performed by RVM. The details of works to be done by each party are as follows:

2.2.1 Work to be Done by Chanimetal. The work to be done by Chanimetal under this section shall be according to ABSTECH plan No. WTS-703-1-REV. of May 1980. It shall include but not be limited to the following:

a. Supply and installation of 7 each, 110-m long, 50-mm stud link chain--ABS Grade 1 (normal strength) or equivalent.

b. Supply and installation of 4 chain stoppers--"Ulster" type with hinged pawl. One pair shall be fitted face to face, for two-way chain engagement at each location shown in dwg No. WTS-703-1. The stoppers are for chain size 50-56 mm and details as shown in dwg No. WTS-703-1.

c. Supply and installation of two supports for the stoppers

d. Lowering of the concrete "deadmen" of size 3 m x 1.5 m x 1.0 m into the river, suspended from two barges specially arranged for the purpose and depositing the deadmen in the river. The two barges for carrying the deadmen to specified locations will be supplied by RVM. Special arrangements on the two barges for suspending the deadmen will be organized by Chanimetal with the assistance of RVM personnel. Towing of the barges to specified locations will be RVM responsiblity.

e. Supply and installation of 7 buoys, 500 mm diameter and 800 mm high along with 10 mm diameter chain 15-m long for marking of deadmen.

2.2.2 Work to be done by RVM

a. RVM shall cast 7 mooring blocks of size 3.0 m x 1.5 m x 1.0 m (deadmen) with concrete and steel scrap so as to have a specific gravity of 2.75.

NOTE Embedded items for attachment of steel chains will be supplied by Chanimetal.

b. RVM shall provide a derrick of suitable capacity for lowering the mooring blocks into river, two barges for carrying the mooring blocks, necessary assistance for making special arrangements for suspending the mooring blocks and towing as necessary by tugs to locations specified by Chanimetal.

2.3 Analysis of Rates.

Chanimetal has quoted the following rates for completeing the supply and installation of the mooring system:

7 ea. chains, 50 mm dia and 110 meters long	3,100,000FB	187,825Z
4 stoppers with supports	280,000FB	48,090Z
7 buoys with chains		16,110Z
200 meters of cable, 12 mm dia	10,000FB	630Z

Making preliminary preparation, transporting the 7 mooring blocks and placing in position (one team of 1 European supervisor and 7 Zairains for 21 days):

1 European @3700 Z/day -		3700.00Z
6 Zairians @535Z/day -		3330.00Z
Total/day		7030.00Z
Tax 5%		351.52Z
Total cost for the team/day		7381.52Z
Estimated time for completing the job		21 days
Cost for installation of deadmen	21X7381.52Z =	155,010Z

In a quotation submitted by ABSTECH on September 29, 1978, the cost of one chain of similar specification from U.S. source was $17,347 and for 7 chains $121,429. The price quoted by Chanimetal is only 3,100,000 FB (U.S. $93,940). This compares very favorably with the cost quoted by ABSTECH especially since the quotation from ABSTECH was prepared 2-1/2 years ago.

Regarding the rates for European supervisor of 3700 Z/day and Zairian 535 Z/day, these may be justified considering the very specialized nature of the job.

But the time estimated of 21 days is on the high side, and every effort should be made to reduce the time involved so that a saving may be effected.

2.4 Special Points To Be Considered

a. The mooring blocks shall be cast in such a location that lowering of the blocks into the river can be done with minimum effort.

b. All embedded hardware shall be supplied to RVM before casting of these blocks and these must be positioned in the blocks as shown in the plan.

c. When the installation of the mooring system is completed, the proper performance of the mooring system shall be demonstrated by moving the floating dock laterally. It is recommended that the floating dry dock be fixed in position approximately 50 meters from the wharf where there is sufficient depth of water. Power feeding becomes unnecessarily complex when the dock is required to operate in two different locations in the river.

d. Sufficient care shall be taken while moving the dock laterally so that the power feeder cable, from shore to dock will not be excessively strained.

2.5 Recommended Actions

a. A meeting shall be convened between RVM, Chanimetal and USAID and an agreement shall be arrived at regarding apportioning of the work involved, per paragraphs 2.2.1 and 2.2.2.

b. A contract shall be entered into with Chanimetal for completing the works specified in paragraph 2.2.1 at rates specified in paragraph 2.3. A clause shall be included in the contract limiting to 21 days the total number of days for making preliminary preparation, transportation and placing in position the 7 mooring blocks. Any undue delay in finalizing this contract is likely to increase the cost of supply of chains.

c. USAID shall appoint a competent engineer at Boma to coordinate the efforts of the various parties starting with the casting of the mooring blocks. He shall have a strong electrical engineering background so that he can continue at Boma until the dock is made completely operational. The rationale for this is discussed later.

2.6 Alternate solution. Chanimetal has presented an alternate solution for transporting and placing of the mooring blocks using a floating derrick owned by SNEL/CIS, which is stationed in Matadi. Assuming that the work will take about 7 days to complete, Chanimetal has quoted a total price of 2,124,415 FB and 195,995 Z. The daily rate of the floating derrick works out to be 303,488 BF and 28,000 Z. Even though the total expense could be reduced in using this method, through the reduction of the number of days from 7 to 4, this still works out to be more expensive than the first option.

The daily rate of the floating derrick of 303,488 FB, and 28,000 Z is considered reasonable based on enquiries made at the Gulf Oil installation at Banana. McDermott (with representatives in Moanda) has 3 floating derricks of 600T, 200T and 100T capacity in this general area and the daily rate is considered to be much higher than the price quoted by Chanimetal. This method of using the floating derrick in placing the mooring blocks may be retained as an alternative option.

SECTION 3

CONNECTING EXISTING POWER SOURCE TO DRY DOCK

3.1 Background Information.

The existing power feed to the dry dock is reported to be non-operational because of shorted cables in the duct leading from the substation to the quayside. Three 500 MCM conductors were supplied with the dry dock for connection to the on-shore power feed. One 500 MCM cable became taut during tests in 1976 causing the insulation to rupture and short circuit the feed at the feed-through conduit installed on the dock. Before repairs and modifications to the dock can commence, a reliable, safe power feed must be provided.

The exisitng RVM substation transformer, feeding the port compound is rated at 250 KVA, power factor 0.8. The secondary provides 380 volts, 3 phase, 3 wire service and is believed to be delta wound.

There have been several estimates of total demand and required substation capacity to properly serve the on-shore and off-shore facilities. Based upon the total demand load of the works, the floating dry dock and the dredges, the substation capacity is inadequate. These estimates, however, are based upon total load and do not take into account demand factors. An example of demand factors and kilowatt loads estimated for the dry dock is shown in Table 1. Each operational phase of the docking sequence requires specific equipments to be energized. For estimating purposes lights, air conditioners, ventilation fans and fire pump are considered to be continously energized.

Based on the above, the total demand during repair of dredges would be approximately 164 kilowatts. Under these conditions the existing substation could supply the floating dry dock plus a sizable portion of the on-shore facilities power demand.

3.2 Scope of Work.

The scope of work under this item/task may be divided into two distinct parts--one to be performed by the Contractor and the other to be performed by RVM. The details of the work to be done by each party are as follows:

3.2.1 Work To Be Done By The Contractor. The work to be done by the Contractor shall consist of the design, supply, installation and testing of a new power feeding system connecting the existing substation to the dry dock. The low voltage feeder shall replace the existing cable run. The feeder shall be direct-buried or run-in conduit from the substation to the quaiside. At this point the feeder shall rise vertically to a sup-

Table 1 - ESTIMATE OF ELECTRICAL POWER DEMAND

Floating Dry Dock - Boma

Operational Function	Demand Factor/Kilowatts							
	Dewatering Pumps	Capstan Motors	Motorized Crane	Ventilation Fans, Lighting, Air Conditioning	Welding Machine-Old Section	Fire Pump	Ship Under Repair	TOTAL KILOWATTS
Sinking Dock	0.5/40	0/0	0/0	1.0/12	0/0	1.0/24	0/0	76
Docking Ship	0.5/40	1.0/27	0/0	1.0/12	0/0	1.0/24	0/0	103
Raising Dock	1.0/78	0/0	0/0	1.0/12	0/0	1.0/24	0/0	114
Repair Cycle	0/0	0/0	1.0/42	1.0/12	1.0/17	1.0/24	0.25/69	164
Sinking Dock	0.5/40	0/0	0/0	1.0/12	0/0	1.0/24	0/0	76
Undocking Ship	0.5/40	1.0/27	0/0	1.0/12	0/0	1.0/24	0/0	103
Raising Dock	1.0/78	0/0	0/0	1.0/12	0/0	1.0/24	0/0	114

port mast (to be provided by RVM) of sufficient height to provide obstruction free suspension to a second support mast or dry dock entry conduit. The intermediate support requirement is dependent upon the unsupported span limitation of the feeder cable selected by the designer. The suspended cable shall be suitably sized and protected for this service and shall be rated waterproof. An alternate routing method is to provide submarine cable from quayside to a support mast suitably driven/erected near the dry dock. The submarine cable must be trenched or anchored so as to prevent shifting due to river currents. An aerial span of approximately 50 m will be required between the mast and dry dock. The design shall take into account the approximately 7 meters rise of the dock during docking operations.

The design of the feeder system shall include cable sizing and specifications, protection equipment at the substation and compatible connection to the dry dock service entry. The load capacity shall include provision for docked ship power as well as new and old dry dock loads. It shall be the responsibility of the contractor to ensure that the design satisfactorily provides for solid grounding, short circuit protection and fault current detection. Voltage drop under full load shall be within acceptable design limits to ensure start-up of all motors, motor-generators and auxiliary electrical systems. Operating voltage supplied to the dry dock shall be within the specified tolerance of the operating equipment.

The design and installation shall be performed strictly in accordance with the applicable sections of the National Electrical Code, NFPA No. 70 (latest edition), and IEEE Standard No. 45, Electrical Installations on Shipboard. Cable installation shall meet the applicable requirements of the National Electrical Safety Code, ANSI C2 (latest edition). The applicable sections of C2 shall be followed for all works associated with the feeder installation. The completed system design shall be signed and approved by a currently registered professional engineer. The design shall be submitted to RVM for approval prior to installation.

3.2.2 Works To Be Done By RVM

a. If an aerial suspension method from shore to dock is chosen, RVM shall install a supporting mast on the quaiside. The height of the mast shall be at least 5 meters above ground level and shall consist of an 'H' beam of approximate size 250 mm x 200 mm x 12 mm or equal, erected on a concrete base 600 mm x 600 mm x 900 mm deep.

b. RVM shall perform the trenching and backfilling operation for the installation of the underground cables from the

existing substation to the mast on the quai-side. If the underwater route is chosen, RVM shall suitably trench or anchor the submarine cable.

3.3 Analysis of Rates

Based upon budgetary quotations for material FOB U.S. sources, the following estimates are made for material only:

Item	U.S. Dollars
Buried cable, 3 conductor, 500 MCM	$ 5,000
Aerial cable, 3 conductor, 500 MCM	10,000
Circuit breakers, 2 each	4,000
Lightning arrestors, both ends	500
Mechanical hardware and misc.	2,500
Conduit and fittings	1,500
	$23,500

The cost for renewing the existing power supply quoted by Misener Industries in their letter to RVM of 21 December 1977 was $15,000. Assuming 40% increase in material and labor over this period, it would appear that their price is low. Their quotation must be revalidated.

The quotation received from Chanimetal, dated 31 March 1981 contains equipment not priced in the U.S. budgetary, namely drums for cable take up. The price for cable, breakers and accessories quoted to them by Siemens is comparable to the U.S. prices. Chanimetal labor rates have been evaluated previously.

3.4 Special Points To Be Considered

Misener Industries, Inc., in their letter dated 21 December 1971 offered to do the installation of the power feeder from the existing substation to the floating dry dock at a total cost of $15,000. This quotation may now be invalid. Since Misener must be contacted for the other items of work, it is recommended that this item of work be included in their total package.

3.5 Recommended Actions

a. Once a contract for the installation of the mooring system is concluded with Chanimetal and an estimated date of completion is known, Misener Industries shall be contacted to provide a fresh quotation for this item of work to be done along with other items of work specified in paragraphs 4.2, 5.2, 6.2 and 7.2 discussed in the next sections.

b. A contract with Chanimetal for doing this item of work shall be entered into, only if the response from Misener is very unfavorable.

c. The USAID representative shall be available at Boma during the full duration of the job, primarily to coordinate the efforts of the various parties.

S E C T I O N 4

REPAIRING POWER DISTRIBUTION SYSTEM

4.1 Background Information

As described the repairing of the power distribution system inside the floating dry dock also includes making the three crossover electrical conduits watertight.

Three pipe conduits were installed to carry electrical wiring from one side of the dock to the other through the ballast compartments. According to Misener and ABSTECH, these conduits were proven watertight after installation. However, during the sinking of the dock, one conduit leaked badly enough to eventually overflow onto the safety deck. Misener has attributed this leakage to the flexing and vibration of the dry dock section during sea tow.

During testing, twelve step-down transformers overloaded and failed, causing severe burning of the insulation and arcing to the mounting panel. In some cases, the fuse holder located adjacent to the transformer was badly charred. The cause of failure is unknown. The primary tap conections are suspect, as well as secondary control circuit wiring. Ten of the transformers provide power to controls of the following equipments:

a.	Dewatering pump #1	Port and Starboard
b.	Dewatering pump #2	Port and Starboard
c.	Vent Fans	Port and Starboard Wing Walls
d.	Vent fan for existing dock	Starboard
e.	Capstans	Port and Starboard
f.	AC/DC Motor Generator Set	

In addition, there is one each transformer associated with the ground detector light and power-on indicator light of the motor control center.

Except for the ground detector circuit and power-on circuit, each transformer is fused in the secondary. Normal practice requires primary fusing particularly where the input circuit breaker is rated for the higher capacity three phase load. Nomenclature for each transformer is unknown. However one unit is identified as SB Hevi-Duty Electric, 380/220V, KVA 0.050, 2817240T00. Others include 0.100 KVA rating. Fuse blocks associated with each unit should be replaced and rewired. Short circuit protection and ground fault detection must be demonstrated to the Customer Engineer by the Contractor.

4.2 Scope of Work

The scope of work under this item/task consists of:

a. Disconnecting the electrical cables and removing them in their entirety from the crossover conduits between the wingwalls of the new dry dock section.

b. Surveying and testing the conduit to determine the damage sustained.

c. Making the necessary repairs to the existing conduit crossovers.

d. Retesting the conduit to prove water-tightness.

e. Connecting the existing electrical cables as per approved plans.

f. Replacing each defective control circuit transformer and fuse block. Determine correct fuse rating and provide primary protection; trace control circuits to verify wiring and loads, and provide operational tests to demonstrate correct functioning of the electrical system. Operational tests are to include individual demonstration of each control circuit function and simultaneous test of all functions. Ground faults will be simulated at the direction of the Customer Engineer. Electrical hook-up facility for the ship under repair shall be provided.

g. Upon completion of electrical repair and satisfactory demonstration of electrical equipment and control circuits, Misener shall prepare an accurate as-built single line wiring diagram with a complete bill of materials. The bill of materials shall list installed items identified by manufacturers and manufacturers part numbers. A complete wiring diagram shall be supplied including panel schedules, conductor sizing, color coding and terminal designations. Single line and wiring diagrams shall be verified to customer discretion prior to acceptance.

4.2.1 Responsibilities of RVM

RVM will assist Misener personnel in the following:

a. Testing, repair and cable removal.

b. Any other assistance found necessary for completing the job to the extent possible within RVM resources.

4.3 Analysis of Rates

Misener Industries, Inc., quoted in their letter of 21 December 1977 a sum of $2000.00 for completing this job. This rate was approved by ABSTECH in their telegram dated 24 September 1977. This quotation is probably invalid and a requote should be obtained from Misener Industries, Inc.

4.4 Special Points To Be Considered

a. Mr. R.E. Goerlich, Jr., Executive Vice President, in inspection report of September 26, 1978 has agreed to undertake the works described in this section.

b. Inspection of this conduit by Miseners' representatives on 24-26 September 1978 could not ascertain the cause of this reported leakage.

c. RVM has agreed to assist Misener personnel in testing, repairs and cable removal as required in accomplishing this task.

4.5 Recommended Actions

a. Once a contract for the installation of the mooring system is concluded with Chanimetal and an estimated date of completion is known, Misener Industries shall be contacted to provide fresh quotation for this item of work to be done along with other items of work specified in paragraphs 3.2, 5.2, 6.2 and 7.2.

b. RVM should be informed of their responsibilities as detailed in paragraph 4.2.1 for completing this item of work.

c. USAID representative shall be available at Boma during the entire duration of the job, primarily to coordinate the efforts of the various parties.

S E C T I O N 5

REPAIRING LEAKING SAFETY DECKS

5.1 Background Information.

While sinking the extended floating dry dock for the first time on 7 October 1976, numerous leaks were found in the safety deck where deepwell pump motors and gravity and overboard valve rod stuffing boxes were bolted to the deck. According to Misener, the bolted deck connections on the interior safety deck apparently worked loose during the sea tow from Tampa to Boma, Zaire. Even though Misener claims in their letter of June 30, 1977 that these connections were proven in good order during the testing of the new floating dry dock section prior to delivery at Tampa, no test documents are available to substantiate this claim. There is also no record available to show that ABSTECH has witnessed any such tests. Visual examination of the connections has shown that these bolted connections were effected with throughbolts, in lieu of studs or tapped bolts lodging in suitable deck doublers in accordance with good marine practice. The deep well pump head casting is quite solid and provided with four bolt holes which would adequately provide tightness if bolted to a suitable doubling ring of about 3/4" thick, welded to the deck and provided with tapped holes to receive studs or tap bolts not extending through the safety deck. The valve spindle stuffing boxes are also fitted directly to the unpaired deck plating. The observations and recomendations were very thoroughly discussed in ABSTECH report No. 76-194-NY, dated 24 November 1976. Misener in their letter dated 21 December 1977 quoted an amount ot $5,000.00 for repairing the leaking safety decks.

5.2 Scope of Work

The scope of work under this item/task consists of:

a. Removal of ballast pump motors and reach rod deck stands.

b. Fabrication of minimum 3/4" plate base doublers with tapped holes for 3/4" studs for each ballast pump motor and reach rod deck stand.

c. Installation of doublers.

d. Reinstallation of motors and stands.

e. Testing to prove modifications in good order by flooding of the ballast compartments and sinking the dock to the maximum design depth.

5.2.1 Responsibilites of RVM

a. RVM will remove reach rods, install doubler plates (upon receipt from MII) and reinstall reach rods. Installation of doubler plates and reinstallation of reach rods will be done under MII supervision.

b. RVM will remove pumps, install doubler plates (upon receipt from MII) and reinstall pumps after repairs to pumps are made by pump manufacturer. Installation of doubler plates and reinstallation of pumps will be done under MII supervision.

c. RVM will assist Misener personnel in arranging for the testing by flooding of the ballast compartments and sinking the dock to the maximum design depth.

5.3 Analysis of Rates

Misener Industries, Inc., quoted in their letter of 21 December 1977 a sum of $5000.00 for completing this item of work. This rate was approved by ABSTECH in their telegram dated 24 September 1977. But this quotation may not be valid anymore, and a fresh quotation may have to be obtained from Misener Industries.

5.4 Special Points To Be Considered

a. Mr. R.E. Goelrich, Jr., Executive Vice President of Miserner, in his inspection report of September 26, 1978 has agreed to undertake the works described in this section.

5.5 Recommended Action

a. Once a contract for the supply and installation of the mooring system is concluded with Chanimetal and an estimated date of completion is known, Misener Industries shall be contacted to provide a fresh quotation for this item of work to be done along with other items of work specified in paragraphs 3.2, 4.2, 6.2 and 7.2.

b. RVM should be informed of his responsibilites as detailed in paragraph 5.2.1 for completing this item of work.

c. USAID representative shall be available at Boma during the entire duration of the job, primarily to coordinate the efforts of the various parties.

S E C T I O N 6

PROVIDING VOLTAGE REGULATED 220 VDC GENERATOR

6.1 Background Information

One motor driven generator has been installed on the safety deck supplying 220 VDC to:

a. Three motorized crane motors

b. Two Capstan Motors and

c. Five pump motors

This generator is a North West, Shuntwound, 50 KW, 1.15 SF, 220 Volt D.C., 227 Amperes, 1450 RPM, Shunt Field resistance 45/60, Model 400-100-009A, FA 2.6, Serial No. 30365 HD. The generator is driven by a Gould Century, part 6-331135-01, Frame 365 TS, type SC 110A, 75 HP, 50 Hz, 1470 RPM motor.

A shuntwound generator, as supplied by Misener, characteristically will not maintain output voltage regulation under varying load. In this case, the generator is to supply power to a dock crane, two capstans and a fire pump, all of which are subjected to varying loads.

According to Misener in a letter dated 30 June 1977, RVM's representative had accepted this generator prior to delivery at Tampa. But no record is available in the files to substantiate this claim.

Even though Section 8, para 8.7 of the Technical Specification prepared by Crandall did not specify the motor generator windings, paragraph 8.15 of the same specification indicated that the motor generator set was to power the crane and capstan on the existing dock. These variable loads are best handled by a compound wound generator.

Misener, in a letter dated 21 December 1977, has suggested installing an automatic voltage regulator to recify this defect. Misener has quoted an amount of $4000.00 for supplying and installing an automatic voltage regulator and proving modifications in good working order.

6.2 Scope of Work

The scope work under this item/task consists of:

a. Supply, installation, test and guarantee the performance of an automatic voltage

regulator (compatible with the Northwest Generator) providing ± 1/2 % regulations, no-load to full load.

The contractor shall provide regulator specification and performance guarantee with his quotation. The contractor shall demonstrate performance after installation, supplying load simultaneously to three crane motors, two capstan motors, and one fire pump motor. Output voltage from no-load to full-load shall be measured and recorded.

The unit supplied shall be certified by the manufacturer as suitable for continuous operation in the tropics in an ambient temperature of 55°C. Temperature rise under full-load shall be specified.

6.2.1 RVM's Responsibilities

Name plate data for the three motorized crane motors, two capstan motors and fire pump motor will be provided by RVM if required.

6.3 Analysis of Rates

Misener Industries, Inc., quoted in their letter of 21 December 1977 an amount of $4,000.00 for completing this item of work. This rate was approved by ABSTECH in their telegram dated 24 September 1977. This quotation is probably invalid and a requote will be required from Misener Industries.

6.4 Special Points To Be Considered

a. Paragraph 8.15 of the Technical Specification indicated that the motor generator set was to power the crane and capstans on the existing dock. These variable loads are best handled by a compound wound generator. But Misener, in the absence of any specific requirement in para 8.7 which specified the generator, chose a shuntwound generator.

b. The contractor to complete this item of work shall guarantee the proper performance of the generator once the automatic voltage regulator is supplied and installed.

6.5 Recommended Actions

a. Once a contract for the supply and installation of the mooring system is concluded with Chanimetal and an estimated date of completion is known,

Misener shall be contacted to provide a fresh quotation for this item of work to be done along with other items of work specified in paragraphs 3.2, 4.2, 5.2 and 7.2.

b. The USAID representative shall be available at Boma during the entire duration of the job, primarily to coordinate the efforts of the various parties and witness the tests performed by Misener.

SECTION 7

REPAIRING WORTHINGTON DEEPWELL PUMPS

7.1 Background Information

The new section of the floating dry dock was provided with four Worthington deep-well pumps. Paragraph 4.2.1 of the Technical Specification by Crandall specified Model 10 HH 90 Worthington Pumps. The contract drawing also indicates the pump with an 8-inch deep pipe column, with shaft of open water lubricated design. As per the drawing, the shaft leaves the pump casing through a stuffing box and flanged reducer and extends to the drive motor at the safety deck. The contractor, Misener, has furnished a straight "T" connection with a full 8-inch opening and an 8-inch pipe extending to the safety deck, as a housing for the pump shaft and steady bearings.

Drawing No. S 1315-8 recommends that the pump shaft be supported at intermediate points as specified by the pump manufacturer. It could not be determined whether or not any such supports have been provided since the pump shaft has been housed in an 8-inch diameter pipe extending to the safety deck.

As described in detail in ABSTECH Report No. 76-194-NY, dated 24 November 1976, during testing of the dock in October 1976, the mechanical ends of all four pumps were found binding to the extent that the coupled driving motors could not be turned by hand. When started, the pumps vibrated heavily and the motor of the starboard forward pump kicked out on overload immediately after starting.

Considerable efforts were made to free the pumps. The motor of the starboard unit was removed and it was noticed, upon dismantling of the thrust bearing assembly, that the pump shaft, normally concentric to the hollow motor shaft, was at least 3/16-inch out of center at the top of the motor. Since all pump parts and the electric motor casing and shafting are normally machined true and should consequently line up perfectly, the cause of misalignment could not be ascertained without dismantling the entire pump unit. All four pumps could finally be freed to the extent where they could be rotated by hand.

When subsequently started, the pumps kicked off with considerable vibration which subsided after approximately one minute of operation under pumping load. However the starboard forward unit could not be operated vibration free.

During deballasting of the dock, both starboard deep-well pump motors kicked out in consequence of overheating, although when stopped, the pumps were found to be reasonably easy to rotate by hand. Also, all pumps would, at various times dur-

ing deballasting, commence to vibrate and they had to be stopped and restarted, some repeatedly, to overcome vibration.

Misener, in their letter dated 30 June 1977, stated that the pump installation was accepted by RVM's representative prior to delivery at Tampa. No record is available in the files to substantiate this claim. According to Misener the misalignment of the pump shafts occured during sea tow from Tampa to Boma, Zaire, and this in turn, has caused damage to the bearings when operated.

Misener quoted in their letter dated 21 December 1977, an amount of $9000 to effect repairs to the pump and to prove that repairs are in good order.

7.2 Scope of Work

The scope of work under this item/task consists of:

a. Opening and inspecting the pumps and shafting.

b. Replacing the water lubricated bearings with oil lubricated bearings.

c. Reassembling the pumps and shafts.

d. Providing intermediate supports for the pump shaft as necessary to reduce vibration.

e. Completing installation as per Crandalls' drawing which shows the shaft leaving the pump casing through a stuffing box and flanged reducer and extending to the drive motor at the safety deck.

f. Proving that the repairs provided are in good order.

7.2.1 RVM's Responsibilities

RVM's responsibilites include:

a. Removal of pumps for repair by MII personnel.

b. Assist MII personnel in reinstalling the pumps after necessary repair.

7.3. Analysis of Rates

Misener Industries, Inc., quoted in a letter, dated 21 December 1977, an amount of $9000 for the works mentioned in paragraph 7.2. ABSTECH in their telegram dated 24 September 1977 has justified a rate of $8000 for completing this item of work. This quotation is probably invalid and a requote should be obtained from Misener Industries.

7.4 Special Points to be Considered

a. Mr. R.E. Goerlich in his inspection report dated 25 September 1978 has offered to make the repairs on the pumps under the supervision of a Worthington Pump representative.

b. There has been no mention about the intermediate supports for the pump shaft to reduce the vibration. This will have to be provided as found necessary in consultation with the Worthington Pump service representative.

c. The contractor, after completing this item of work, shall demonstrate the proper performance of the pumps by performing the sinking and deballasting operations for the dock.

7.5 Recommended Actions

a. Once a contract for the supply and installation of the mooring system is concluded with Chanimetal and an estimated date of completion is known, Misener Industries shall be contacted to provide a fresh quotation for this item of work to be done along with other items of work specified in paragraphs 3.2, 4.2, 5.2, and 6.2

b. A Worthington Pump Service representative shall be made available by MII as promised in Mr. R.E. Goerlich's inspection report, dated 26 September 1978.

c. The USAID representative shall be present at Boma during the entire duration of the job, primarily to coordinate the efforts of the various parties and witness the tests performed by Misener.

S E C T I O N 8

PROTECTION TO FLAPPER VALVES FROM EXTERNAL DAMAGE

8.1 Background Information

The flapper valves on the pump discharges were damaged during handling of the dry dock section. In his letter dated 23 February 1978, RVM has agreed to do the flapper valve repair. During our visit to the dry dock on 24 March 1981, Cit. Tshimpi has stated that this has been done. Protective guards are required to be fabricated and installed on each of the four flapper valves.

8.2 Recommended Actions

RVM shall be asked to fabricate and install protective guards on each of the four flapper valves.

S E C T I O N 9

PROVISION OF GANGWAY

9.1 Background Information

For easy access to the operating dry dock (as projected) an addition to the gangway is required.

The present access to the dry dock is by means of a gangway built on pontoons consisting of empty barrels at the water level. The present location of the dry dock is about 30 meters away from the quay. The dock will be moved another 20 meters to its new location when the new mooring system is installed. The gangway will then have to be extended to the new location of the dry dock.

9.2 Recommended Action

RVM shall be asked to improve the present access and extend the same to the new location of the dry dock which will be approximately 50 meters away from the quay.

SECTION 10

CONSOLIDATED ESTIMATED COSTS

In the absence of current quotations covering all items of work to be done in making the dock operational, it is difficult to arrive at any accurate consolidated cost figure.

Chanimetal quotations cover cost for supply and installation of mooring systems and cost of electrical equipments for electrical repairs. Chanimetal did not quote a price for installation and repair of the electrical system since the quantity of work involved in the repair could not be ascertained.

Misener, in a quotation dated 21 December 1977 quoted repairs of all defects including the supply of materials. Their prices have been updated assuming a 40% escalation in labor and materials.

With the consolidated cost estimate given below, costs for portions of work to be completed by RVM have been ignored since these are different areas of funding.

The explicit costs projected that will result in an operational dry dock are:

	U.S.$	Z
a. Supply of chains, stoppers and buoys (3,390,000FB - $1=30 FB) (Chanimetal)	113,000	252,655
b. Installation of mooring system (Chanimetal)		155,010
c. Connecting the existing power source to the dry dock (Misener-$15,000 X 1.4)	21,000	
d. Repairing the electrical distribution system (Misener-$2,000 X 1.4)	2,800	
e. Repairing of leaking safety decks (Misener-$5,000 X 1.4)	7,000	
f. Providing a voltage regulated 220V DC Generator (Misener-$4,000 X 1.4)	5,600	
g. Repairing of Worthington Deepwell pumps (Misener - $9,000 X 1.4)	12.600	
h. Providing technical assistance during the repairing operation (10 days) (Misener-$19,000 X 1.4)	26,600	
TOTALS	188,600	407,665Z

As stated, the total cost shown does not include the cost of items of work to be done by RVM; and these works have been described in various paragraphs of Sections 2 through 9.

SECTION 11

CONCLUSIONS AND RECOMMENDATIONS

In a detailed analysis of the project performance during the last 5 years, several deficiencies come to light which include the lack of a detailed specification for the equipment to be installed in the dock and performance testing of the completed dock. Of the several omissions, the following two items deserve special mention.

a. Design of a new mooring system: Crandall Dry Dock Engineering, Inc. made a detailed analysis of the existing dock before preparing the design drawings and technical specifications for the new extension. Even though they were well aware of the increased capacity of the dry dock, they never bothered to examine the adequacy of the 50 year old mooring system. Neither did ABSTECH include this item when they finalized the IFB documents and also the contract documents.

   The inadequacy of the mooring system could have been easily foreseen by the planners, had they investigated it. This omission was one of the primary delaying factors in completing this project.

b. Performance testing and acceptance was also overlooked. In the modified IFB, the project was divided into 3 phases. For all contractual purposes, each phase was being treated separately. The major work under Phase I consisted of the construction and delivery of the new dry dock section FOB Tampa, Florida. None of the contract terms and conditions specified a performance testing program for the completed extension of the dry dock section in Florida.

   This test program before transporting the dry dock from Tampa, Florida to Boma, Zaire, was all the more necessary since:

   - The responsibility of the dock contractor, viz. Misener, was very limited, once the dock was taken over by the transporting company for towing to Boma, Zaire, in spite of the warranty clause in para 9, Section 11 of the contract documents.

- There was the possibility that the new dry dock extension would be damaged during the tow from Tampa to Boma.

- The facilities available for any eventual repair at Boma, Zaire, were very limited.

The inspection clauses under paragraph 7, Section 1 and paragraph 6.6, Section II of the SOW were totally inadequate to check the correct performance of the new extension of the dry dock and all installed equipments.

Even though ABSTECH was obligated to supply a set of approved layout and detail drawings, the set available in the USAID Office does not contain any approval signature of ABSTECH engineering authorities.

The absence of a USAID representative at Boma during the jointing exercise resulted in a lack of coordination between various parties, and also resulted in conflicting accounts of the performance of the dock and installed equipment during the testing conducted in October 1976.

All the above, coupled with many other instances of omission/neglect by the concerned parties, which are quite evident when viewed in retrospect, resulted in the inordinate delay in completing this project.

In addition to specific recommendations, which have been described in connection with the specific tasks discussed in Sections 2 through, 9 it is highly recommended that, during the rehabilitation phase of this project which shall start with the casting of the mooring blocks, a competent engineer shall be appointed by USAID at Boma. This Engineer will supervise the work and coordinate the efforts of the various parties involved. He shall have a strong electrical engineering background so that he can continue at Boma during the latter part of the repair works which are mainly electrical in nature.