OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

RESTRICTED

16589

DP/ID/SER.A/941
24 December 1987
ENGLISH

ASSISTANCE IN PERFORMANCE IMPROVEMENT OF FISH PROCESSING PLANTS

SI/GBS/87/801/11-02

GUINEA BISSAU

Technical report: Review by fish storage technology engineer *

Prepared for the Government of Guinea Bissau
by the United Nations Industrial Development Organization,
acting as Executing Agency for the
United Nations Development Programme

Based on the work of Per Ben I. Nesinum,
expert in fish storage technology

Backstopping Officer: B. Galat, Agro-based Industries Branch

United Nations Industrial Development Organization

Vienna

* This document has been reproduced without formal editing.

V.87-92842

Table of Contents

INTRODUCTION p. 4

CONCLUSIONS AND SUMM[illegible]Y OF RECOMMENDATIONS p. 5

I. SEMAPESCA

A. General Description p. 10

B. Evaluation of the Major Components p. 13

1. The Power Generating Plant p. 13
2. The Central Refrigeration Plant p. 17
3. The Decentralized Refrigeration Unit p. 29
4. Maintenance Section p. 30
5. Processing p. 30
6. Processing Facilities p. 31
7. Handling Facilities p. 31
8. External Service Facilities p. 32

C. Proposal for the Rehabilitation of SEMAPESCA p. 34

1. Condemnable Installations p. 34
2. Reusable Installations p. 34
3. Rehabilitation Programme p. 35
4. Training p. 38
5. Technical Assistance p. 38
6. Maintenance Fund p. 39

II. THE "BOLOLA" PLANT p. 41

A. General Description p. 41

B. Evaluation of the Major Components p. 42

1. Electricity & Fuel p. 42
2. Cold Storage p. 42
3. Compressors p. 43
4. Ice Production p. 43
5. Ice Store p. 43
6. Fish Handling p. 43
7. Cold Storage p. 43
8. Fish Processing p. 43

C. Rehabilitation Programme for BOLOLA p. 44

1. Ice Production Machine and Store Unit p. 44
2. Handling and Storage p. 44
3. Fish Processing p. 44
4. Maintenance, Training and Technical Assist. p. 44
5. External Conditions p. 45

ABSTRACT

IMPROVEMENT OF THE PERFORMANCE OF THE TWO EXISTING FISH PROCESSING PLANTS IN GUINEA BISSAU.

Project Number: SI/GBS/87/801/11-02/J 13103

Objective:
The main objective of the project is to conduct a technical assessment of the scope and range of the rehabilitation programmes needed to make the two plants, SEMAPESCA and BOLOLA, operational again. If feasible the project would assist the process of reducing wastages and possibly generate foreign exchange through exports.

Duration:
The fish storage technology engineer inspected the sites of the plants during one month.

Main Conclusions and Recommendations:
SEMAPESCA (built in 1976) is in a poor shape and only operating partially and on severely reduced capacities.

No maintenance unit is existing and no spare parts are available.

A major rehabilitation programme is needed involving even the recasting of floors and foundations. Part of the machinery and installations are condemnable and would need replacements by new and better designed components of a higher material quality.

Reusable components would need to thorough overhauls before reinstallation.

A maintenance unit should be installed equipped with drills and vice benches and proper tools.

Training and technical assistance would be needed.

BOLOLA (built in 1983) is a much better shape. Only minor repair work and the change of electric control devices would be needed. Both plants suffer from the lack of sufficient supply of the raw material, fish and shrimp (receptions are at a level of 40 - 60 kg. a day).

The fluctuations and variations in the public electricity supply is deemed the major cause of mal-functions and break-downs at the plants. Fuel supply is another major problem.

Rehabilitation of the plants, in fact, should be seen in the context of an improvement of the external service and supply situation.

INTRODUCTION

The operating conditions of the two fish processing and storage facilities of Guinea Bissau is at a deprived status. Technical problems are encountered in the field of deep-freezing essentially due to poor maintenance. The results have been the facing of low levels of output and considerable losses. This despite the assumed presence of a large sea- and freshwater fishery potential.

At the Technical Assistance Seminar (TAS) organized by UNIDO in co-operation with the Ministry of Natural Resources and Industry, Government of Guinea Bissau (held in Bissau on 23 and 24 October 1985), a strong recommendation was made to seek technical assistance from UNIDO for undertaking a study to investigate the possibilities of improving the performance or the existing fish processing plants.

UNIDO requested Rambøll & Hannemann, Consulting Engineers and Planners, Copenhagen, Denmark (the Consultant), to provide a Fish Storage Technology Specialist to conduct the said study over a period of one man-month.

The Consultant visited the two plants in the period 27 July to 27 August 1987. The specialist of the Consultant was:
Mr. Per Ben Nesinum, Fish Storage Technology Specialist

This report presents the findings and recommendations of the Consultant and do not necessarily correspond to the points of view of UNIDO or the Government of Guinea Bissau.

The Consultant would like to extend his acknowledgements to all persons met. The assistance received was in all respects expedite and professional.

CONCLUSIONS AND SUMMARY OF RECOMMENDATIONS

The purpose of the Consultant's inspection visit was to make proposals for urgently needed repair and maintenance work in order to improve the performance of the two fish processing and storage plants: SEMAPESCA and BOLOLA. In addition, the need for any associated training programmes should be outlined.

The Situation at the Plants in General

SEMAPESCA

SEMAPESCA (built in 1976) is in poor operating condition. The actual capacity utilization is far below the designed capacity.

The following machinery and equipment are condemnable:

- the decentralized ice production unit,
- the entire electric system (cables, panels and control devices),
- and the ammonia and lubricating oil pipe system.

Other parts of the machinery and equipment (compressors, separator frame, blast and plate freezers, receiver, evaporators and the central ice production unit) are reuseable but in a condition where major overhauls would be needed. Furthermore, floors and foundations are in a poor condition.

Handling and storage equipment is insufficient both in terms of quality and quantity.

Processing is done by hand and is limited to sorting. Only 40 -60 kg. raw material were received daily.

Maintenance facilities, spare part stocks and trained personnel are lacking. In fact, all repair and maintenance jobs are carried out with only one hammer and a few spanners.

The causes that has led to this situation are:

- Poor engineering design, craftsmanship and use of low quality materials
- Misuse and mismanagement of the facilities
- Difficulties in accessing spare parts and trained personnel
- Fluctuations and variations in public power supply in the range of plus/minus 20%
- Severe shortages of fuel supply for the electricity generating diesel plant on site
- Shortage of refrigerant

Recommendations for SEMAPESCA

Condemnable installations should be replaced by new ones of an appropriate design and high quality materials. Special emphasis should be given to an improved design of the piping system making use of the option of passing the pipes through chilled/cold rooms to avail of temperature levels.

Reusable machines and equipment would need a major overhaul before reinstallation and only when floors and foundations has been repaired

Handling and storage equipment should be provided (trays, frames and plastic corner cube boxes).

Processing equipment should be installed designed for the local conditions, i.e. based on manual processing.

A maintenance workshop equipped with a pillar drill, a bench with a vice, and commonly used hand tools (hammers, screwdrivers, spanners and error detection instruments) should be installed. A stock of commonly used spare parts and a spare part inventory and control system should be provided.

Training programmes should be designed for essentially on-the-job training within the areas of food technology, storage and maintenance operations.

Technical assistance in terms of a food processing specialist and a cold storage engineer should be provided for a period of two years following completion of the rehabilitation work. (For the salient points of recommendation refer to section 3.4)

BOLOLA

BOLOLA (built in 1983) is in a better shape and is appropriately designed. Also craftsmanship and choice of materials appears to respect sound standards and practices.

The two cooling towers are not operable. The motors are burned out.

Certain basic parts of the electrical system, as control devices and pump motors are destructed.

The roof of the ice store and the ice outlet box are severely corroded.

Handling in strictly manual and quantities handled are in the same range as for SEMAPESCA.

No processing in terms of transformation of raw material into market ready product take place. No processing facilities nor equipment are found on site though floor space is available.

No maintenance facilities nor spare part stock is available.

The causes having created this situation are the same as for SEMAPESCA (refer above).

Recommendations for BOLOLA

Burned out motors and electric control devices should be replaced.

The roof of the ice store should be recasted and reinforced. The ice outlet box should be replaced.

Otherwise repair work is on a minor scale involving limited casting work, insulation and painting.

Handling and storage equipment should be provided matching the expected raw material situation.

Processing equipment should be considered however, the design should as appropriate reflect the expected load of raw materials and the type to be received in the future.

A maintenance workshop with associated stocks of spare parts and equipment and inventory control systems of the same kind as for SEMAPESCA should be installed.

Training and technical assistance programmes would also correspond those mentioned for SEMAPESCA.(For the salient points of recommendation see section 4.3).

A rehabilitation of the plants along the recommendations set forth above may soon prove to be a Urias task. Due consideration should be given to the simultaneous resolution of external constraints, e.g. sufficient supply of good quality fish, supply of fuel, proper electricity supply, institutional problems and general lack of motivation in the various phases of the activities. It is therefore recommended that a thorough feasibility study of how to remedy such constraints is carried out. With corresponding and detailed recommendations for rehabilitating the plants.

Finally, it is recommended that - prior to investing money at the rehabilitation program - a package solution should be considered, where the problems of the fish processing and storage sector is settled in the context of the external service sectors.

This would involve:

- Reactivation of the fishing fleet to secure sufficient supply of fish in good quality
- The identification and resolution of bottlenecks and constrains in the public electricity supply system
- Identification cf potential export markets of frozen fish products
- Training, Technical Assistance and Management.

I. SEMAPESCA

A. General Description

SEMAPESCA was built in 1976 as a joint venture formed by the Government of Guinea Bissau and a French Company.

The plant is located on the waterfront three kilometers apart from the commercial harbour of Bissau. Public utilities as water, electricity and sewage are connected to the plant.

The plant is designed to process and store fish (chilled/cold) and to produce scale ice. A lay-out drawing of the plant design is presented overleaf.

The plant complex consists of the following technical facilities:

- A power generating plant
- A central refrigeration plant using NH^3 (R717) as refrigerant
- Decentralized refrigeration equipment using Arcton (R12) as refrigerant. This unit is used for the production of scale ice and for chilled storage
- Processing facilities based on strictly manual techniques.

The major components of the central refrigeration plant are listed below along with the associated planned design capacity:

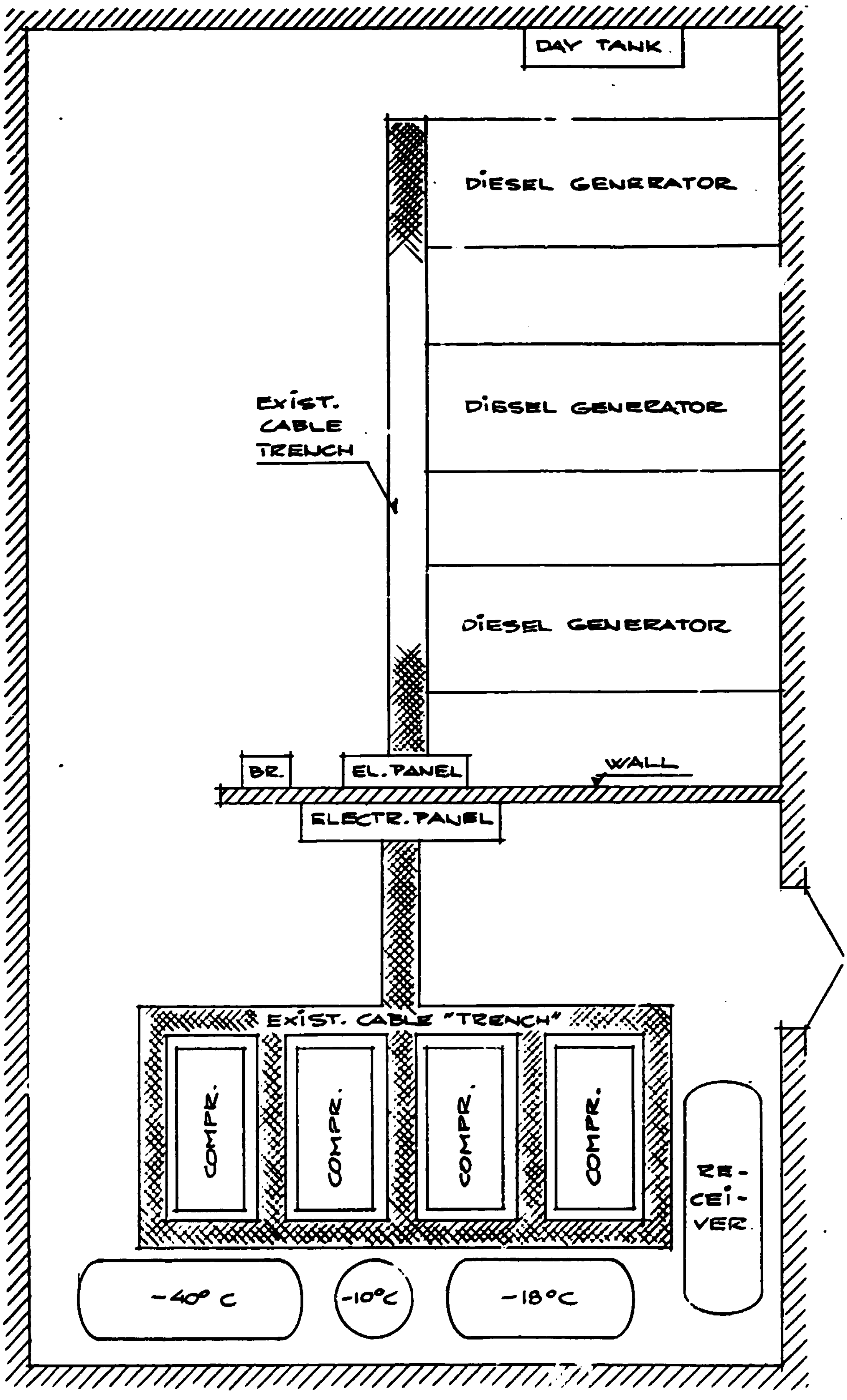
1. Scale ice production unit (capacity: 15 tons per 24 hours).
2. In-freezing unit (capacity: 20 tons per 24 four hours).
3. Cold storage (capacity: 1000 tons depending on the chosen storage system).
4. Chill storage unit (capacity: 15 tons depending on chosen storage system).
5. Handling facilities for a capacity of 30 tons per day.

6. Processing unit. The capacity can only be estimated roughly, since the processing equipment is strictly manual and depends to a very large extent upon the training and skill of the labour force. The processing area provide room for about 15 workers around a wooden table.
7. Chilled water capacity: none
8. Plate freezer (capacity: 15 tons per day).

However, the actual operating capacity is far from reaching these targets. The estimated operating capacity utilized for the various components are listed below:

re 2. In-freezing capacity about two tons per day.
re 3. Cold storage capacity, none
re 4. Chilled storage capacity, none
re 5. Handling capacity about five tons per day
re 6. Processing capacity of shrimps about one ton per day and filleting capacity etc. about five tons per day.
re 7. No equipment is installed for chilled water.
re 8. Plate freezer capacity: none.

EXISTING ENGINE ROOM.



B. Evaluation of the Major Components

1 The Power generating plant

The power generating plant functions as reserve capacity when supply from the public grid fails to meet demand at the plant or is too irregular. The generating plant is equipped as follows:

- three diesel power generating units with facilities for parallel running, the required capacity can be met with two generators with the third as spare
- a fuel supply system
- an electric panel

All three diesel units are operational but are severely underutilized due to the following factors:
- Poor erection
- Lack of fuel supply
- Lack of general maintenance.

1.1 Poor erection

a. Floor & Foundations

The floor serves as a base for the cable trenches and foundations for the diesel units. The foundations are elevated to a level of 80 mm above the general floor level. The elevation should be at a level of 300 mm above the floor permitting oil drainage from the crank case and to provide proper conditions for maintenance. The actual conditions causes water pits to remain on the floor.

The cable trenches are too shallow to contain all cablework. The trenched cablework is smeared in a mixture of oil and waste water.

Drainage of the trenches is not functioning due to an incorrect declination of the drain pipe and because the cables block the pipes. Otherwise, cablework is laying exposed on the floor.

b. Lack of Change-over Equipment

The lack of proper change-over equipment (needed to shift between public power supply and the generating equipment) forces the operators to conduct the changes by mechanically removing the cables and then to re-arrange and remount them. This procedure is cumbersome and time consuming and is therefore not undertaken until absolutely necessary. It is also hazardous, since there is a constant risk of handling live power cables.

c. Exhaust System

The exhaust system, i.e. the piping from the diesel engine to the free air is not satisfactorily supported. It is at one end resting on a wall bracket and at the other end resting on the cast exhaust manifold of the engine. This arrangement causes unnecessary strain on the engine and produces destructive vibrations to traverse the exhaust system - which inevitably reduces the life time of the system.

d. Starting System

The starting system of each engine consists of a large battery station - a start-up motor and a recharge generator.

The batteries are mounted on top of each engine and are not in any way sealed off from the room. During recharge - when the engine is running - the batteries develop hydrogen which besides being explosive also causes corrosion of all iron and steel structures. The uncladded electric installation suffers to a large extent from gradual deterioration.

The recharge system suffers from frequent mal-function and hence forces the operator to start the engines by means of mounting the cable from the batteries of one engine to the other. Sparks are hereby created which are not only dangerous in the hydrogen contaminated air, but it destroys mechanically the connection point of the batteries, gradually bringing the system to a point where none of the engines would be able to start normally, if at all.

Furthermore the batteries deteriorate because of lack of demineralized water for refilling (evaporation is normal).

c. Electric System

The installation of the electric equipment connected to the power plant is very poor as far as craftsmanship is concerned. Large parts of the installation are not clad at all leaving the terminals exposed to the environment thus causing safety hazards. The cable type used is in most cases non-oil resistant rubber cables normally just used for preliminary installations - so-called "building power cables" to be used short term during construction and erection.

Connections to the terminals/panels are not secured by the application of appropriate insulation.

The connections to the panels are not properly arranged in fact resembling the shape of a poorly build crow's nest and making checking and maintenance virtually impossible.

The bad connections are often causing superheating with subsequent melting of the cable-ends and destruction of the panel itself. This had gradually resulted in today's situation viz. that the cables are too short to be repaired, and the interior of the panels is destroyed.

f. Controls

The control equipment is designed for the control of the loading of the engines and their level of revolutions.

The electronic control box of each engine is connected to a set of parallel coupling controls including switches. This arrangement obstructs an overview of the tuning-in of the generators during start-up procedures. Thus in a majority of cases the synchronization will be poor, also causing frequent damages of the electronic controls.

1.2 Fuel stores & supply

A large fuel tank is found on site, and a smaller day tank is situated inside the plant. The fuel storage/supply system is envisaged to function in the following way: The engines are supplied fuel from the day tank which would make it possible to record when and how much fuel is transferred from the main store to the day tank. This procedure further works as a safety measurement reducing the amount of fuel present in the plant.

However, on inspection the system did not operate in the prescribed manner, essentially, due to a permanent shortage of fuel and fuel tankers. Which forces the operators to collect the fuel with a pick-up truck using empty lubricating oil drums. The drums usually leak, and a large amount of the fuel is therefore lost during transportation. In addition, the drums are unloaded by rolling them off the pick-up truck which destroys the drums rapidly.

After collection and unloading, the fuel drums are rolled into the machinery room, mostly with a trail of wasted fuel extending from the unloading spot to the day tank, where it is pumped into the day tank as quickly as possible to avoid further wastage.

It was clear that the ordinary storage tank had run out of fuel a long time ago, and that refilling would not take place for some time.

2 The Central refrigeration plant

2.1 The Central refrigeration machine room

The central refrigeration machine room serves as the provider of refrigerant, in this case ammonia, NH_3 or (R717). It is designed to meet the requirement of the following storage machinery:

- One blast freezer
- One cold storage
- One plate freezer
- One ice production unit
- One ice store

The machine room is equipped with the following machinery and equipment:

- Three Sabro two stage compressors
- One intermediate cooler
- One -18°C separator
- One -40°C separator
- Three ammonia pumps
- Support frame for separators
- One receiver
- One condenser
- One electric panel
- One ammonia piping system

2.1.1 Floors and foundations

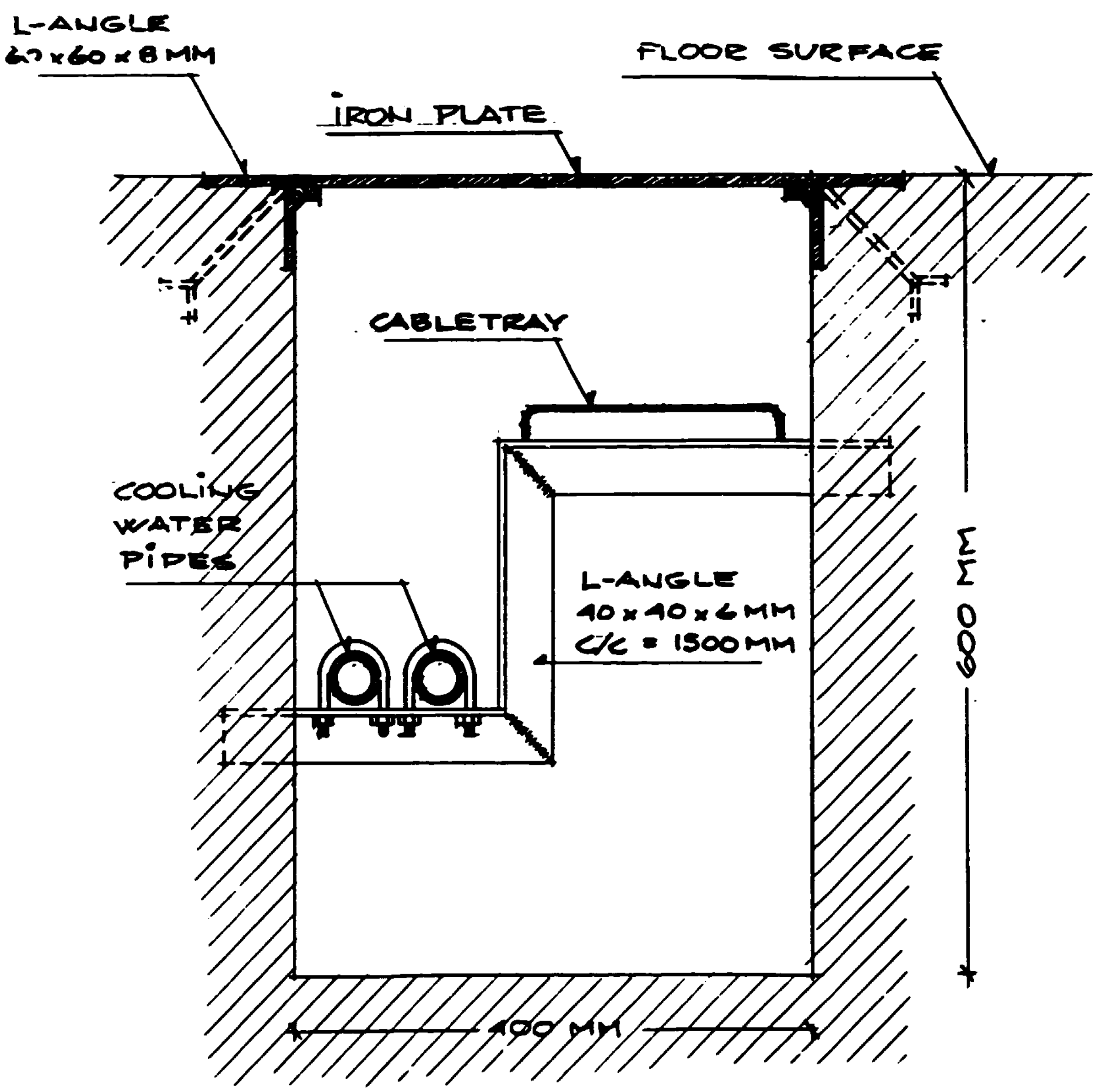
The floor is serving as a base for the cable trenches and as foundation for the compressors.

The cable trenches are too shallow - only about 80 mm - and constructed with no drain at all. A mix of water and oil causes the cables to rot away as the cables are of the same type as found in the diesel engine room.

It should be kept in mind that a refrigeration machine room cannot be kept dry. A continuous process of altering frosting and defrosting of pipes, valves, compressors, etc.. Draining is a must.

Furthermore, the linkage gates between the cable trench and the sewerage system should be grilled to keep out rats to from the trench as rats damage the cable insulation. Usually, the cable trenches are used as drain, but this requires a different kind of construction design (see sketch 1).

PROPOSE CABLE TRENCH
FOR SEMAPESCA.



2.1.2 The Compressors

The three Sabroe two stage compressors are in a quite miserable shape mainly due to the following reasons:

1. The lubrication oil is water contaminated. The oil drums (200 l) are not closed properly following usage. As modern good quality lubrication oil is hygroscopic. The level of contamination depends upon the humidity and the time passed since usage of the drum.

2. The mal-functioning of the ammonia piping system causes the plant to run permanently underfilled. This in turn overheats the suction gas causing the compressors to operate on a too high temperatures. The intercooler is in mostly empty of liquid.

3. The lack of insulation of the piping on both sides and the direct exposure to sunshine is adding to the superheating mentioned under item 2.

4. The compressors are constantly running at a too high condensing pressure, since the condenser is not working properly.

5. Due to the construction of the piping system When the plant runs on sufficient levels of refrigerant- this was "muito tempo passado" which can be everything from one to ten years - liquid hammering is continuously occurring. The conditions is inherent due to the construction principle used for the system. However, sufficient levels of refrigerant were reported not to have happened as long as anybody actually remembered.

6. The control units of the compressors are to a wide extent shortcutted and/or destroyed due to power supply variations.

7. The crankshaft of one of the compressors is destroyed. Two new pistons with pins and connecting rod are further needed for this compressor.

8. The operators do not have instruction books for proper maintenance, neither do they have any spare catalogue, this could be obtained from Sabroe.

9. The foundation for the compressors is not elevated from the floor thus causing enormous difficulties in regular maintenance as the changing of oil and oil filters.

2.1.3 Intermediate cooler

The intermediate cooler is not equipped with a control device for minimum liquid level control. The intermediate cooler thus runs without sufficient liquid supply. In fact, the plant is left as if operating without an intermediate cooler, which is superheating the compressors.

2.1.4 The - 18°C Separator

This separator is meant to service the cold store, the scale ice machine and the ice store. During inspection servicing was not possible, partly due to lack of refrigerant, and partly because the scale ice machine it out of operation due to lack of a replacement of the driving gear.

The insulation work of the separator is part of the prefab delivery and is carried out as steel cladding with foam insulation. The insulation was found to be in good shape.

The two float switches guiding the liquid level control of the separator are functioning but ought to be changed since the electric contact points are worn down, probably due to the very large variations in power supply.

2.1.5 The - 40oC Separator

This separator is servicing the plate and the blast freezers. Only the blast freezer was operating full time though not smoothly running. Even a part this small of the total installation is sensitive to the lack of refrigerant and the fact that the suction head of the ammonia pump is too small.

The level control does not turn-off the pump on target, and therefore the pump practically runs dry resulting in the likely destruction of the pump.

2.1.6 Ammonia pumps

The plant is equipped with three open type ammonia pumps manufactured by Witt. Each separator is exclusively serviced by a pump. The spare pump available is capable of servicing both separators. However, only the pump for the -40°C separator is operational. The motors of the other pumps are burned out because of power variations. Worn down positive suction heads have cavitated the pumps unreasonably. The functioning pump is merely capable of creating sufficient pressure to overcome the task of transporting the ammonia to the blast freezer.

2.1.7 Support frame for separators and intermediate cooler

The frame supports the -40°C, the -18°C separator and the intermediate cooler. The frame is of a sturdy and well built construction of U-shaped construction steel. However, the frame sides are too low to provide for the pumps (that are placed underneath) with a satisfactory positive suction head. The result is malfunctioning, extensive cavitation and finally rapid pump destruction.

2.1.8 Receiver

The receiver is meant to have the following functions:

- buffer tank for variations in levels of refrigerant
- to ensure that the plant is continuously supplied with refrigerant, and
- and to provide space for the refrigerant in case it should be necessary to close down part of the plant for repair and maintenance work

During normal operation the receiver should be quarter to third full. However, during inspection the receiver would only function if the whole plant was closed down and all refrigerant transferred to the receiver. The mounting of the receiver makes it difficult to drain oil and to check the level indicator for the actual content of refrigerant.

2.1.9 The Condenser

The condenser is placed on the roof and is of the evaporating type. It is equipped with one water pump and three ventilators. However, the pump motor and two of the three ventilator motors are burned due to power supply variations and poor electric installation.

The superheated coil is suffering from severe corrosion and the estimated remaining lifetime of the condenser is limited probably within a range of two to four years.

2.1.10 The Electric panel

The electric panel comprises the control functions and the power supply to most of the equipment and motors in the central refrigeration plant. The extent to which and how well it actually operates is difficult to measure without proper instruments and tools.

2.1.11 Cablework

The cablework extending from the electric panel is carried out without consideration to material quality, ii is characterized by poor engineering and total neglect of craftsmanship.

- Material Quality

  This statement refers to the circumstances described under floors and foundation and to the fact that non-oil resistant rubber cables are used. Cables of the used quality is normally only used for temporary installations on building sites, and for emergency power supply under similar circumstances.

- Engineering

  The automatic (electronic) control units of a given piece of machinery/equipment are connected to the electric panel by separate cables. By way of example it can be mentioned that one compressor is equipped with ten different safety and control devices. Installations adhering the normal standards the automatic control devices attached to the machinery are connected to one junction box residing on the machine from where a control cable would extend to the panel.

  Each control/safety device requires one earth connection. In the SEMAPESCA installation each earth connection is carried to "the bitter end". In a standard installation this is obtained by carrying one earth connection to the junction box and separate from there. In fact where one fifteen-lead cable would be sufficient and even leave space for further extensions there are eleven cables comprising 39 leads.

The disadvantages of the present installation include waste of material and makes attempts at trouble-shooting quite complicated as no informative lay-out plans exist.

- Craftsmanship

The cable ends are not fastened properly. Damages in terms of superheating at the connection points are frequent. Hence, the cable ends are melting, and the insulation is destroyed up to 400 mm from the connection points.

Proper tension reliefs have not been placed on the cables, and trouble-shooting actions usually tears the cable off at the points of connection at either end.

- Electric Panel Components

Panel components are to a large extent destroyed. The amount of destroyed relays and other components increases continuously by the day, mainly due to the large variations in power supply. The variations are up to plus/minus 20%. No electric equipment is constructed for such a variation and the result is obvious.

Drawings are not informative enough to enable the operators to reorder parts. Hence a cumbersome detective work is necessary whenever spare parts needed has to be identified. Otherwise the ability to access original spares depends upon the willingness of the original supplier to provide the information necessary making it possible to order from the original manufacturer.

2.1.12 The Ammonia piping system

The ammonia piping system serves the flow of refrigerant as follows:

- circulation of liquid refrigerant (NH^3 - ammonia R717) from the separators to the evaporators
- the retour flow of vapour/liquid refrigerant from the evaporators to the separators
- transfer the vapour refrigerant from the separators to the compressor
- transfer from the compressor to the condenser
- after condensation into liquid it is transported to the receiver from where it is distributed to the separators (the intermediate cooler is to be considered as a separator).

The system carries also an amount of lubrication oil from the compressors - so called two phase flow - and is equipped with the necessary valves, solenoids and automatic devices to regulate and/or maintain the flow according to the load and prevailing running condition.

The piping system is not insulated up to the standard in order to avoid superheating of the refrigerant in the liquid or vaporous state. Superheating is the main cause of mal-function of automatic controls and levies a too heavy load on the machinery.

Furthermore, the piping system lay-out should meet the requirement of machine safety - understood as protection against "liquid knocking" in the compressors. The compressors are not constructed to pump liquid refrigerant. Any amount of liquid returned through the piping system may cause immediate destruction of the machine as liquid is non-compressible.

A part of the piping system is exposed to direct sunshine which increases the superheating to degrees beyond the level of fungibility. The temperature of the suction gas from the parts which are not or only partly insulated is very close to +35°C instead of -40°C, or a span of 75°C.

The above factors explain the great number of leaks are found throughout the piping system and will continue to aggravate the situation.

The automatic controls are to a large extent out or order and are mostly irreparable due to the extent of the damages. Coils of the electrically controlled valves etc are burned, due to power supply variations.
No vapour barriers are found and insulation in general is insufficient. The level of insulation efficiency is virtually ground zero even where it is found.

2.1.13 The blast freezer

The blast freezer itself is in a reasonable shape and might be considered as the best part of the system as far as construction and craftsmanship are concerned. However, this part of the installation is not furnished with a lighting system designed for low temperatures. Minor repair works on walls, floors and door are also needed.

2.1.14 Cold storage room

The cold storage room has been exposed to some mishaps during construction. The most eye catching is that the shuttering for the roof has not been able to withstand the weight of the concrete during casting. The height in the room is varying 750 mm. However, the roof is level on the top.

It was not possible to thoroughly check the insulation of the room as it was out of operation during inspection. However, it is generally considered to be of the same satisfactory standard as for the blast freezer. It is constructed by the same company with the same materials and during the same period.

The piping of the three evaporators is placed on the outside of the building. Each evaporator has its own lead-in bush through the wall. This is not satisfactory as it increases the risk of letting the moisture into the room's insulation. Outdoor piping requires a much more efficient insulation due to daily temperature differences ranging from -40°C to +35°C (or 75°C) instead of only -40°C - -25°C (or 15°C).

The effect is further aggravated by the fact that most of the outdoor piping is not insulated at all.

The room is accessible from two different doors, one placed in the fish receiving area and one placed towards a ramp outside the building. The door placed towards the receiving area is for loading of products.

The door towards the ramp appears to be a good idea from the operational point of view. However, it is not furnished with any air flow restricting device offering direct access to the exterior. The air flow problem is aggravated if the other door is opened simultaneously causing the room to be totally ventilated.

2.1.15 Plate freezer

The plate freezer was not in operation during inspection. It appears to be good shape without any signs of wear and tear, most likely because in never has been in operation. All operating functions besides actual refrigeration were tested and found satisfactory. However, general and preservative maintenance is needed. Painting would help for both preservation and appearance.

Equipment and hand tools required for operational procedures as trays and frames for handling and in-freezing were not present.

2.1.16 Scale ice production unit (central system)

The ice machine is not operational as the gear is missing. It had been dismounted, because it was crushed.

The machine is placed on top of the ice storage bin, and the ice falls from the producing machine down into the silo by the force of gravity. Handling of the ice is strictly manual. Truck loading besides small vans are not loadable from the silo as the ice discharge door only is 1.10 m above the ground.

The ice machine shows general signs of wear, tear and possibly misuse. The latter is to be understood as a heavy build-up of ice on the drum and thereafter start of the rotation. The machine is constructed to be rotating when freezing of ice is started so that it can successively break-off the ice. The machine is badly corroded, and it is not considered suitable for repair.

The bin is constructed of wood. However, wood is not suitable for ice storage.

3 The Decentralized refrigeration unit

The purpose of the decentralized refrigeration unit is to produce ice for sale to the fishermen. The unit uses ARCTON 12-R12 as refrigerant and is driven by a Sabroe condensing unit. It comprises the following equipment:

- One Ice production unit equipped with a Sabro CMO 18
- One chilled store equipped with a Comet condensing unit.

During inspection the unit was operating and making fairly good ice, but only in small quantities due to short supplies of refrigerant.

The ice maker is placed on top of the storage bin inside the factory, and the ice is falling by gravity into the bin. The system works well except that capacity utilization was low. The actual production however, seemed to be higher than actual demand for ice. The reason may be that the fishermen are less inclined to use ice as the actual ice production level would only meet the fishermen requirement for a few hours.
The ice store needs cooling which would be provided by the Comet condensing unit. However, this is not working as the automatic controls are destroyed due to fluctuations in the electric power supply. Anyhow, the compressor needs to be replaced or to be receive a major overhaul. An overhaul on short notice is difficult due to lack of spare parts.

4 Maintenance section

The maintenance section faces considerable problems for various reasons. The most important appears to be lack of spare parts and lack of facilities and tools.

4.1 The Spare part supply and control system

A system for supply and control of stocks of spare parts and their use is non-existent. The actual inventory of spare parts is very low and any replenishment of stock is highly irregular or rather non-existent. The present "system" is one where everybody has access to the locker where spare parts are located. Since no records or ledgers are maintained the actual existence on stock of a specific spare part is not known. If it exists location of the item is unknown.

4.2 The Facilities and tools

At present no maintenance workshop facilities exist and there is practically no tools. Those available are not in a good shape and often useless due to wrong type. Actually the tool stock consists of a handyman box containing a few wrenches, a hammer and some screwdrivers. The application of wrong tools during repair and maintenance jobs actually destroy bolts and nuts.

5 Processing

Processing in the normal understanding of the term whereby raw materials are transformed into a product ready for consumption or prepared to meet the requirements of a certain market demand.

During inspection shrimps - about 40 kgs - were packed into small boxes. The only action as regards "transformation" was to assort the shrimps into three different sizes and subsequently to mark the box with size and weight.

Availability of raw materials was at a level of 1 tons received during the entire one month long inspection period. At least 15 tons received daily would be a reasonable level for a modern fish industry if economic feasibility for fish processing should be achieved.

Raw material supply is not available due to problems with the fishing fleet. The fleet appears to be inoperable mainly due to lack of maintenance, missing spare part stock and lack of fuel. Lack of fuel is disadvantageous to any industry, but in the fishing fleet it causes immediate paralysis, which rips away the bottom line argument for the existence of a fish industry.

6.1 Processing facilities

The processing facilities are designed for strictly manual operation. The facilities are limited to a number of wooden tables.

7 Handling facilities

Handling facilities comprise:

- a few wooden pallets
- two manual pallet lifters
- two scales for weighing of incoming/outgoing fish
- a number of unequal plastic boxes.

There is no reason for making processing and cold storage facilities operational, if there are no handling facilities complying with requirements in terms of easy handling and proper storage. Frozen products requires a "first in first out" strategy to ensure that parts of the product is not stored in large piles on the floor with no air circulation and no knowledge of the actual storage time.

It should be kept in mind that freezing of a product does not preserve it forever, and it is therefore important to keep track of the storage time.

8 External service facilities

The external service facilities comprise:

- Public water supply
- Public electric power supply
- Public sewerage

8.1 Public water supply

The public water supply comes out of a water storage tower located nearby. It was not made clear if testing of the water had taken place. If so the test results were not available on the premises. According to information received supply is sufficient.

Although water shortage is no problem at the actual level of production ice production at the scale corresponding to installed capacity will increase the water consumption to about twenty tons a day and thus cause water shortage.
As the plant is situated near the coast line salt water could be considered an alternative source of water supply. Salt water could be used in areas of production where fresh water is not necessary. The salt water could be pumped into a saltwater tower and be distributed.

The use of salt water within a fish industry could comprise:

1. Scale ice production
2. Rinsing of fresh incoming fish before processing
3. Cleaning of processed fish
4. Flushing of toilets
5. Cleaning of equipment

8.2 Public electricity supply

The public electricity supply is not reliable. During inspection the variations in voltage were measured to ± 20% meaning that a 220 V circuit is varying from 176 to 264 V.

The frequency varied 15% from 42.5 to 57.5 hertz. It must be emphasised that most manufacturers of electric, electronic and electromechanic equipment do not guarantee operation of the equipment if the level of variation exceeds a 5% absolute maximum limit.

The magnitude of the irregularities is the major cause of the destruction of almost all electric and electronic control equipment. This is the cause of the a large number of problems that are encountered technically within the fish processing and cold storage facilities.

A rehabilitated/modernized fish processing and storage industry would require a stabilization of the power supply. It may prove difficult as the public electricity utility faces paramount problems within the fields of maintenance and fuel supply.

The alternative solution would be to operate fish processing and storage facilities on the basis of power plants that are on the premises. However, the prevailing situation of fuel shortages for power production would also be present in the case of an on site power plant.

C. Proposal for the Rehabilitation of SEMAPESCA

The proposals are dependant upon the status and degree of deterioration of the actual component. The following categories of proposals are set forth:

- Condemnable Installations
- Reuseable Installations
- Rehabilitation Work
- Training
- Technical Assistance

These proposals would in sum lead to the reestablishment of the plant measuring up to the standards of modern plant.

1 Condemnable installations

The installations mentioned in the following are in such a poor condition that rehabilitation would be obsolete. The installations should be condemned.

1. The entire electric installation except for light armatures
2. The entire ammonia lubricating oil pipe system including automatic controls, valves and insulation
3. The entire decentralized refrigeration systems

2 Reusable installations

The following components from the central refrigeration room would be reusable:

1. The three Sabroe compressors
2. The separator frame including the -40oC separator, the intermediate cooler and the -18°C separator
3. The receiver
4. The blast freezer
5. The plate freezer
6. The cold store evaporators

7. The ice-machine of the central plant

These components should be dismounted, overhauled and subsequently stored until the proposed changes of the floors and foundations have been carried out.

3 Rehabilitation programme

3.1 Floors and foundations

The floors and foundations in the diesel machine room and the refrigeration machinery room should be cleared and cleaned and a new floor cast on top of the old one including proper cable trenches and proper foundations for the machinery.

3.2 Reinstallation of overhauled equipment

The overhauled machinery and equipment mentioned under 3.3.2 should subsequently be reinstalled on the new foundations in a proper way allowing for easy repair and maintenance and cleaning.

3.3 Installation of new equipment

3.3.1 Additional compressors

The central system should be extended with one or two additional compressors to ensure a spare capacity of at least one machine during scheduled major overhauls and/or repair activities. The new compressors should be of the same manufacture as the old ones in order to minimise the spare part stock.

3.3.2 Piping system

A whole new piping system should be designed for the central plant including valves, automatic controls, insulation etc.

The system should be placed inside the building and should preferably run through the cold rooms where possible in order to save insulation and operating costs. Otherwise design, material quality and insulation should comply with modern standards.

3.3.3 Electrical installations

The entire electrical installation systems should be replaced including electric panels and cable works. The new installation should comprise all needed automatics for the regulation of the diesel machinery and the generators.

3.3.4 Processing equipment

The plant should be furnished with proper fish processing equipment suited to meet the export market standards of Europe and Northwest Africa. Furthermore, the equipment should be designed to match the expected catch volumes and in terms of kind of catch (fish, shrimps etc.) once this is identified through scientific research.

Equipment of this nature may include a processing line for filleting to be delivered by a company possessing a thorough knowledge of the production conditions in developing countries, e.g that the handling should to a large extent be manual and easy to operate. The processing line should be complete including knives and grinding tools for the knives. At the same time it should be of a make able to withstand the environments, i.e. no parts should be made of wood, and the function should be simple and easily understood.

3.3.5 Handling system

A complete handling system should be designed and provided including an electric forklift for loading and unloading. The handling system should reflect the long term estimated inflow of raw materials so as to be equipped with the correct handling capacity from the onset. In this connection the following "software" should be furnished:

- one thousand corner tube containers for storage of frozen fish
- plastic boxes and wood pallets for transport of fresh fish ought to be furnished.

3.3.6 Maintenance workshop

A small maintenance workshop and a bench stock should be established within the factory. The maintenance workshop should contain at least all generally used hand tools such as spanners, screw drivers and a bench with a vice and a pillar drill as minimum.

The spare part workshop should be equipped with sound means of controlling and keeping track of the stock. In the following a brief description of how a normal system of supply and control of spare parts should be designed and operated is presented.

Stocks of spare parts should be available for normal maintenance and general servicing of technical facilities and installations. The spare part stock should be compiled with due respect to running conditions of the equipment and for maximum safety against breakdowns. It should also be designed and operated paying due respect to costs versus risk, i.e. the cost of a given level of supply of spares compared to the risk of breakdown of parts that might not be available when needed.

It must also be realized that it is impossible to plan and prepare a spare part stock to deal with any possible situation. Optimal design and utilization of a spare part store would rather require the presence of instruments and tools for detection of sources of breakdowns and appropriately trained personnel.

Most industries have an account for emergency spare parts that can be bought and airmailed to the factory on short notice. However, this procedure is very difficult to use within the system as administered in Guinea Bissau.

The paper work required to release foreign currency for such operations is very time consuming, and when and if this part is completed successfully, quick air transport is difficult to obtain as Guinea Bissau is only serviced by two weekly flights usually fully loaded. Hence, a very long time is passing from ordering of spare parts until the tual arrival of them.

Furthermore, a spare part stock must be equipped with an inventory stock filing system comprising at least the following information.

1) Whether the item in question is on stock and, in the affirmative, where it is actually located
2) If it is a normal stock item, what is maximum stock required and what is the bottom level before replenishment
3) Whether the item has been re-ordered and when
4) What is the actual consumption of the item over time
5) From whom to order the item as well as indication of price.

4 training

During and after completion of the rehabilitation of the plant training should take place. Training should cover as well food technology, planning, recording, store-keeping (especially of perishable goods), repair and maintenance activities and spare part purchase, inventories, control and administration.

The emphasis of the training programmes should be on-the-job training in order to allow the apprentices to be trained in trouble shooting on the spot . However, training in terms of scholarships overseas and regular vocational training programmes should be included as appropriate dependent upon the character of the actual job position.

5 Technical assistance

Upon completion of the rehabilitation of the plant two expatriate specialists should be provided for a period of two years.

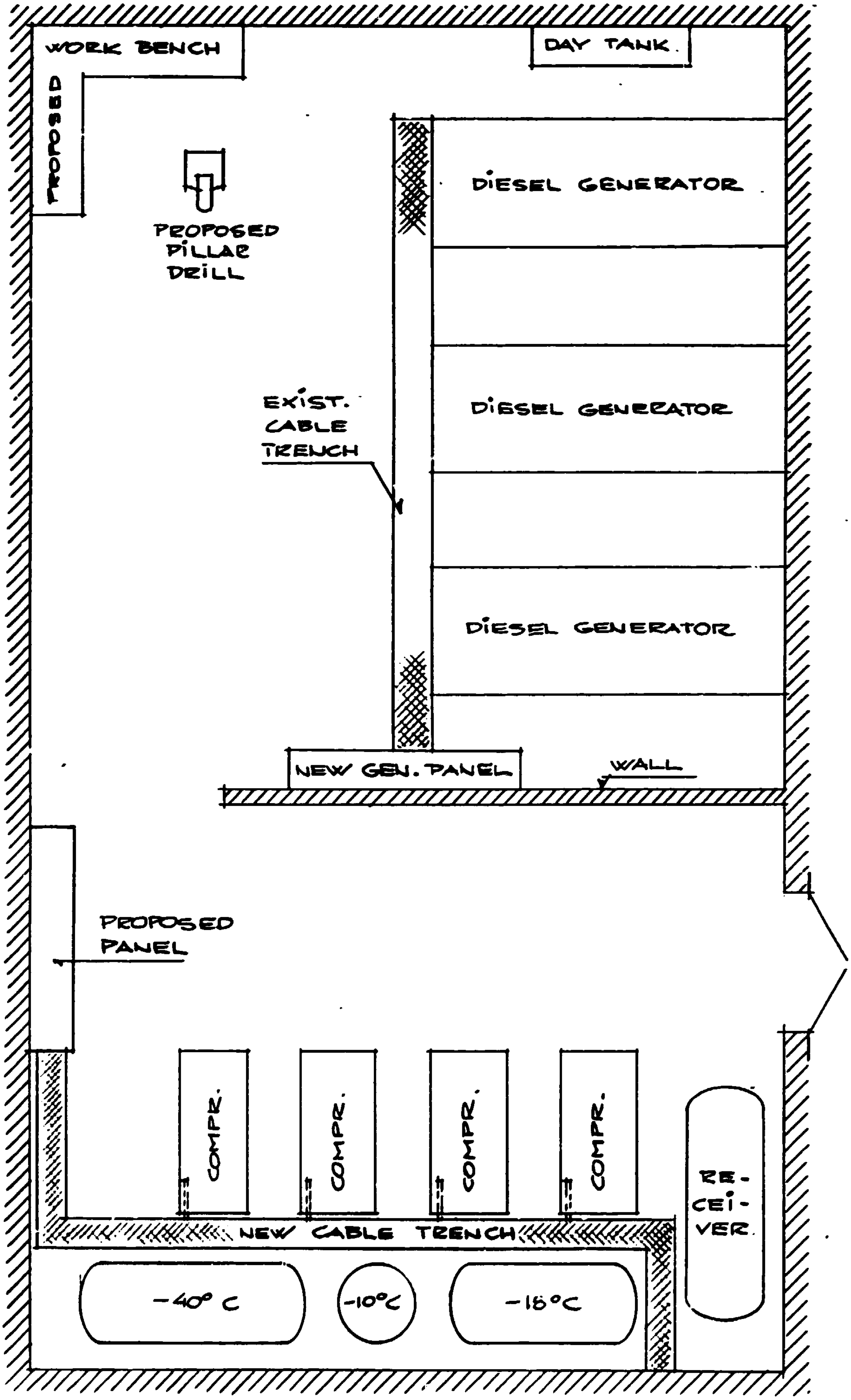
The purpose of the technical assistance would be to assist the running-in of the facility and to participate in the execution of the training programmes. The two specialists would be:

- a mechanic, and
- a fish processing specialist.

6 Maintenance fund

It is recommended that a fund of foreign exchange is established to meet the needs for the purchase of spare parts. The furd would exist for 3 - 4 years or until SFMAPESCA generates her own foreign exchange funds through exports.

PROPOSED LAY OUT OF ENGINE ROOM.



II. The "BOLOLA" Plant

A. General Description

BOLOLA was built in 1983 by a Spanish company. The complex is located about 0.6 kilometers from SEMAPESCA.

The design capacity of the plant could not be established on the basis of written documentation which was not made available during the visit to Guinea Bissau. The figures below therefore represent the Consultant's estimate:

- Scale ice production 30 tons per twenty four hours;
- Block ice capacity about 20 tons per twenty four hours;
- In-freezing capacity about 45 tons per twenty four hours;
- Cold storage capacity 10,000 tons depending on storage system chosen;
- Chilled storage capacity 40 tons depending on storage system chosen;
- Processing capacity cannot be estimated, since no processing equipment is installed;
- Chilled water capacity: none;
- Handling capacity will depend on the system chosen, which at present means carrying by hand.

The actual capacity utilized is as follows:

- Scale ice: none
- Block ice about 10 tons per twenty four hours (?)
- In-freezing capacity: none
- Storage capacity: 1,000 tons
- Chilled storage capacity 5 tons
- Processing: none (however, space id available for such equipment, but no raw materials for processing)
- Chilled water supply: not installed
- Handling capacity: not very easy to determine (but a man can

carry a fish about 4000 m in an hour, but it depends a lot on the fish and the man).

B. Evaluation of the Major Components

The BOLOLA complex is a modern type panel and steel construction. It is generally well designed and constructed with some minor errors mostly as far are ice bin construction is concerned.

Both mechanically and electrically this complex leaves a good impression. However it is largely inoperable due to electrical problems.

To give a list of warn out electric items is not as easy as to state what is left in operational condition due to the poor quality of the externally supplied electric power. The same fluctuations in power supply as for the SEMAPESCA plant are contributing to the list of worn out automatic controls, solenoids, motors etc. and it grows longer and longer every day.

If the above deficiencies are not remedied shortly the plant it bound to come to a total stop within a one year time span.

1 Electricity & fuel

The plant is equipped with its own power generating plant. However, fuel supplies are short leaving the plant virtually inoperable.

2 Cold storage

Only one cold storage out of six is actually in operation due to worn out electrical controls.

The plant runs on the basis of two common cooling towers. However, the motors hereof are burned out and the towers not in operation. The lack of operational cooling towers is a major cause for the actual low capacity utilization of the whole plant.

3 Compressors

Only three compressors out of nine are in operation.

4 Ice production

The BOLOLA complex has facilities for scale ice and block ice production. The facilities were found to be in poor operating condition. The water circulation pump was burned out. The pump had been dismounted and was not physically presented for inspection.

5 Ice store

The roof of the ice bin store is badly corroded. This roof has two functions: It serves as base for the ice producing machine and as a vapour barrier of the store itself. Consequently the corrosion means that the store is without vapour barrier. The cause of corrosion is salt water that leaks from the salt adding machine connected to the ice producing machine. The ice outlet box is corroded to destruction.

6 Fish handling

Fish handling is strictly manual. The incoming fish is picked by the tail and carried to its destination. The volume if incoming raw material was at a level of 40 - 60 kg. daily of assorted products - mostly shark and shrimp. A handling system of this nature and volume of throughput makes a cold storage system obsolete.

7 Cold storage

Produce is stored in piles on the floor due to lack of storage equipment.

8 Fish processing

The BOLOLA complex does not contain fish processing facilities other than an empty floor in a poor condition.

C. Rehabilitation Programme for BOLOLA

Rehabilitation of the BOLOLA complex would involve work as described under the major components below.

1 Ice production machine and store unit

The ice machine would need a new water pump.

The roof of the ice store should be replaced the roof and an extra layer of concrete should be casted on top to secure the ice machine a stable base.

The ice outlet bow should be replaced by a new one.

2 Handling and storage

A system for handling and storage of the fish should be introduced consisting of e.g. pallets, corner tube containers and the like. The system should fit the space available and be designed to handle the products to be stored. These factors are largely unknown, since the products to be stored depend on market requirements and available products, mostly shrimps or sharks.

3 Fish processing

A plan for the introduction of fish processing equipment should be prepared. The plan should carefully consider all aspects of the prevailing and future volume and nature of incoming raw material.

4 Maintenance, training and technical assistance

For the proposals related to these aspects please refer section I.C.4 above.

5 External conditions

The major problems causing the electrical systems to break-down are the high level of fluctuations and variations in the electricity supplied from the public grid. This condition is described under the SEMAPESCA plant .

The supply situation of diesel, refrigerant and raw materials also is characterized by the same conditions as for SEMAPESCA.

It is therefore recommended that the rehabilitation work as described in section 4.3 should be carried out only if the external conditions are remedied. Otherwise the break-down of electrical systems and dependant components will commence rapidly making the rehabilitation work obsolete on short notice and economic viability would not be achievable.