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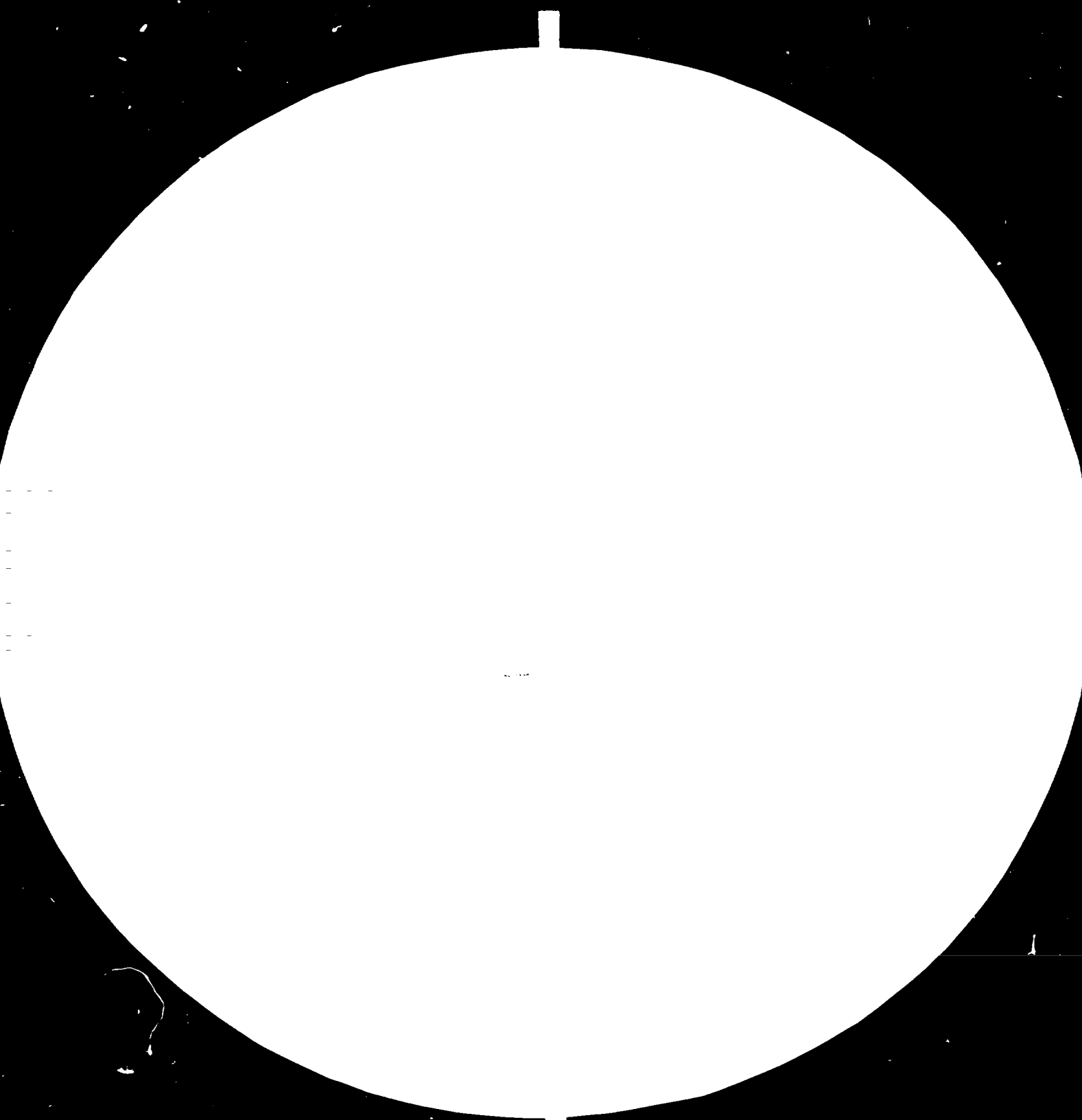

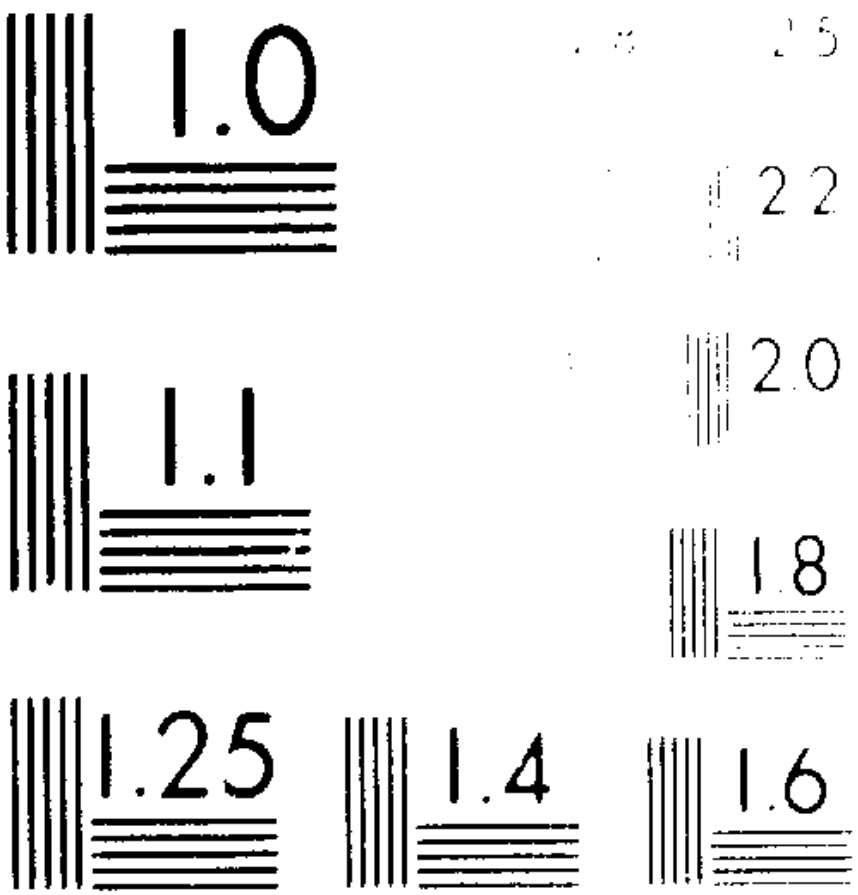
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UNITED NATIONS INDUSTRIAL
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ASSISTANCE TO CONSOLIDATE AND
DEVELOP THE BENGHAZI CEMENT INDUSTRY
TF/LIB/75/002
LIBYAN ARAB JAMAHIRIYA

Technical report: Libya. Instrument maintenance systems at the Benghazi complex: final summary

Based on the work of Boguslaw J. Walczenko, electronics engineer

V.81-22891

Explanatory notes

Reference to "tons" is to metric tons.

LCC is the Libyan Cement Company.

ABSTRACT

As part of the Project "Assistance to consolidate and develop the Benghazi cement industry" (TF/LIB/75/002), an expert was assigned by the United Nations Industrial Development Organization (UNIDO) to assist the Libyan Cement Company to establish a maintenance organization for measuring and control instruments in the newly erected Hawari cement plant.

The assignment which began on 17 July 1978 was extended from the originally authorized one year period to last two and a half years.

When the expert arrived the new plant with two production lines with a capacity of 1500 t/d each was being commissioned.

After participating in the commissioning tests, a Polish team of instrumentation electrictions organized and later worked out in detail the plans for the maintenance of measuring and control equipment.

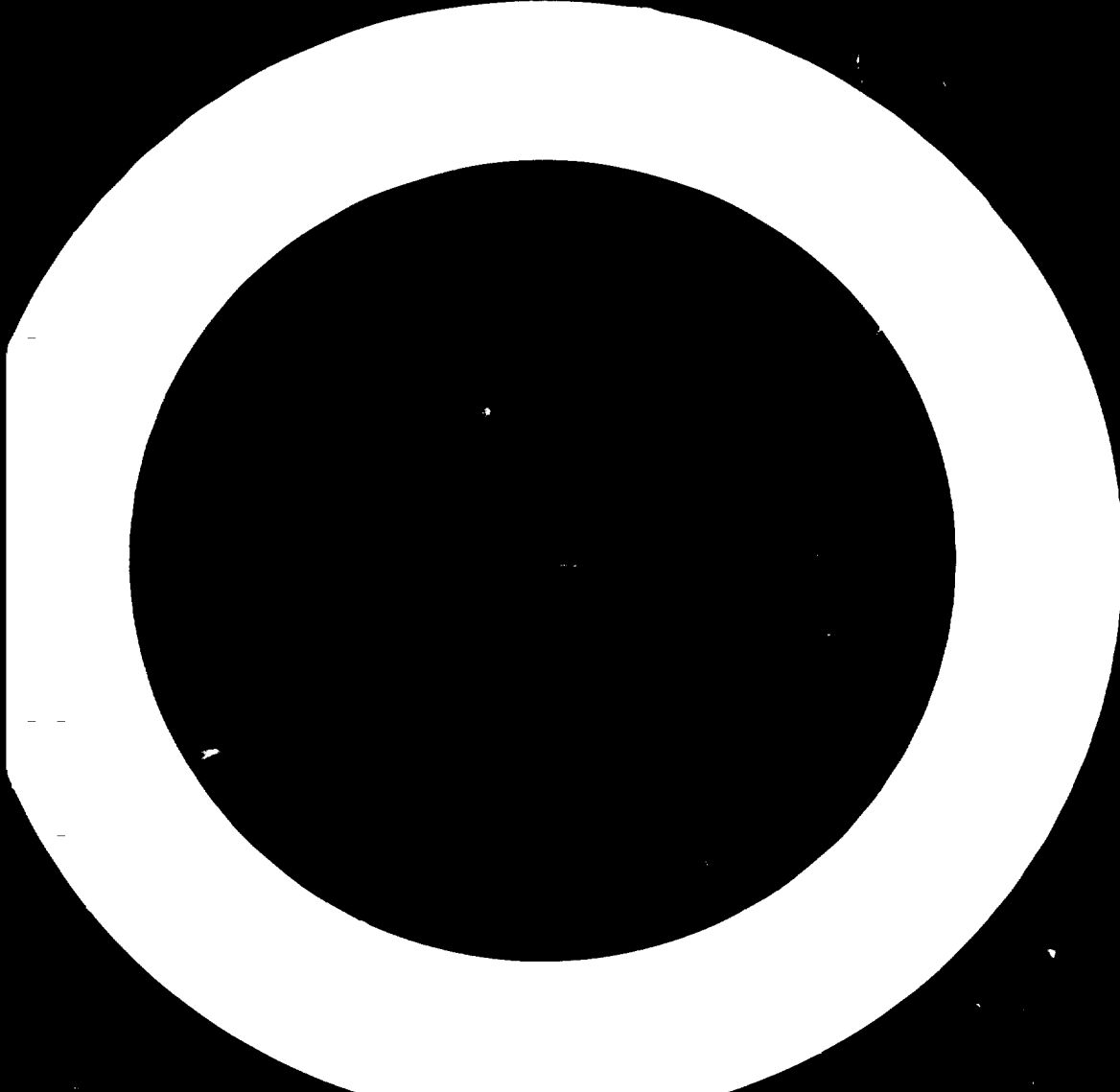
Through the expert's efforts a workshop for the repair and overhaul of electronic measuring and control equipment was put into operation.

The expert also dealt with the following: the organizaiton of a system of spare parts, the calibration of measuring systems, periodic equipment tests, the verification of electrical documentation, improvement in the drawings of control circuits, and a daily technical advisory service.

Through the location of weak points at the automated and cement packing and loading plant a more efficient operation was achieved.

At the end of the mission the expert drafted a system of measuring and control equipment maintenance for the old Benghazi Plant, based on the one at the Hawari Plant.

Technical reports with suggestions for equipment modernization and standardization, and a uniform spare parts stock system were submitted to the electrical department.



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INTRODUCTION

As part of the project 'Assistance to consolidate and develop the Benghazi cement factory complex" (TF/LIB/75/002), an electrical engineer was assigned by the United Nations Industrial Development Organization (UNIDO) to establish a system of maintenance for measuring and control instruments at the new Hawari cement plant. Originally for one year, the assignment was extended by three successive six-month periods. The expert began work at the site on 25 July 1978; his report on the first year of his assignment is the technical report UNIDO/IOD.354 dated 15 August 1979. The extensions are covered in UNIDO/IOD.383 dated 16 September 1980 and in this report, which also summarizes the work of the whole assignment.

The Libyan Cement Company (LCC), has a cement plant with five rotary kilns with an annual production capacity of 2 million tons. The first of these kilns had been put into operation in 1972, the last two in 1978. In addition the factory also includes two production lines of lime with capacity of 43,000 t/a, a concrete block factory with a capacity of 12,000 m^3/a, a brick factory with a capacity of 60,000 t/a and a paper bag factory with the capacity of 200,000 paper bags per day.

Upon arrival of a group of Polish specialists in 1978 the new Hawari Plant of the company was still in the testing stage, awaiting provisional take-over. These specialists were confronted with the problems of an industrial centre in the process of rapid expansion with a shortage of staff and training personnel. It became their task to help overcome difficulties in process operation and maintenance as well as providing for on-the-job training of local personnel. The expert was the technical leader of a team of instrument and control electricians drawn from the group of specialists.

The main activities of the team were:

(a) Organization of a maintenance system for control and measuring instruments at the Hawari Plant;

(b) Verification of electrical documentation and drawings supplied by the contractor. Remarks about deficiencies in documentation have been submitted to the contractor;

(c) Participation in commissioning tests;

(d) Participation in the establishment of an electrical deficiency list which has been attached to the main provisional take-over protocol;

(e) Implementation of the established maintenance programme in the routine duties of the instrumentation team;

(f) Periodical calibration and testing of the more sophisticated measuring and control devices like weighing and feeding systems, level controls, analysers etc.;

(g) Organization of the workshop for repair and overhaul of measuring equipments;

(h) Improvement in measuring and control loops in order to reduce breakdown of production;

(i) Preparation of a system of standard orders of spare parts like lamps, recorders paper etc.;

(j) Inventory of new equipment and spare parts in stock;

(k) Final approval of measures taken by the contractor to correct deficiencies;

(l) Elaboration of daily, weekly, bi-weekly, monthly, quarterly, semi-annual maintenance programmes for line II and III at the Benghazi Cement Plant;

(m) Elaboration of a proposal for new installation of pyrometers and a TV system for the Benghazi Plant.

CONCLUSIONS AND RECOMMENDATIONS

Some new recommendations in addition to those that have already been made are as follows:

1. The schemes of maintenance elaborated by UNIDO experts should be put into practice and executed systematically. The person responsible for the execution of the programme should keep a record of all remarks concerning maintenance and have the needed measures taken.

2. The technical data for measuring circuits in the new system of "measuring point record cards" should first be supplied for the Hawari Plant and later on extended to the Benghazi Plant and the lime factory. Repairs, overhauls, modifications etc. should be recorded systematically.

3. Weekly meetings should be held in the departments to discuss old and new technical problems.

4. Weekly inter-departmental (mechanical, electrical, production) technical meetings should be introduced.

5. A new central workshop for measuring and control equipment according to the proposal in chapter I.C of this report should be built. Such a workshop would make it possible to repair, maintain and overhaul sophisticated instruments from all plants belonging to the LCC.

6. Steps should be taken towards gradual standardization of measuring and control equipment at all plants belonging to LCC.

7. Offers from various companies giving full information about materials needed to set up a workshop for rewinding electric motors should be given further consideration. As it is difficult and costly to rewind motors at the local workshop, it would be profitable to own a workshop equipped for rewinding.

8. The Hawari Plant should be used as a training centre for national technical personnel with the aim of gradually replacing UNIDO experts.

9. Control loop circuits should be put into operation step by step at the Benghazi Plant. This would demonstrate the high efficiency of automatically controlled temperature, pressure etc.

10. The numbering systems for spare parts should be standardized when the Benghazi and Hawari electrical stores will be consolidated into one facility.

I. ASSISTANCE TO THE HAWARI CEMENT PLANT

The expert's main task was the organization and supervision of instrument maintenance at the Hawari Cement Plant. The plant was going through all the growing pains of a new installation and a proper maintenance programme did not exist. While technical assistants from the Federal Republic of Germany were getting the plant ready for the provisional takeover, Polish experts in various fields helped in a variety of tasks after getting acquainted with the plant.

The contractor's specialists were kept busy repairing defects rather than performing preventive maintenance. Since there was no local personnel with adequate technical experience, maintenance tasks had to be carried out by the Polish experts. One of them, an expert in automatic control engineering, had to be transferred to work with shaft electricians to compensate for the shortage in manpower.

A. Organization of instrument maintenance

As had been mentioned in an earlier report, the Hawari Cement Plant is well equipped with measuring and control instruments. A high degree of automation makes it possible to control the whole technological process from the Central Control Room.

At the same time such a large number of measuring instruments (about 500 measuring points) requires a proper and accurate maintenance programme adapted to the operating conditions of installations. A detailed plan of this was presented in the first report.

Although the implementation of the maintenance plan was helped by the fact that nearly all the automation experts were Poles, the group was not large enough to carry out the entire programme under the conditions that existed. It had to wait for the arrival of new experts in January 1980 to achieve its task.

The maintenance programme contained the list of measuring points together with the description of necessary operations which were due to be performed at a given period of time. Cards of daily, fortnightly and monthly inspections were introduced.

The maintenance programme made it possible to avoid sudden breakdowns and to extend the life of installations. Thus each installation was inspected and maintained at the proper time making it possible to save spare parts and to order them in due time.

When the maintenance programme had been applied for two years, it became possible to modify the programme to conform with specific operating conditions. Thus the frequency of preventive maintenance and the adjustment of all remote indications had to be changed from one year to six months. This reduction had become necessary because the equipment, operating under severe conditions of dust and high temperatures, was subject to frequent mechanical failures.

When the maintenance programme was two years old, it was possible to summarize the results obtained as follows:

(a) Reduction of breakdown ;
(b) Higher plant utilization ;
(c) Better utilization of spare parts;
(d) Easier operation.

To be successful, the maintenance system needs to be the responsibility of a separate maintenance section with a foreman in charge.

B. Electrical documentation and drawings

Without complete technical documentation and drawings showing equipment connections, adequate service is nearly impossible. For the Hawari Cement Plant the contractor had delivered electrical drawings and documentation of equipment in two languages, English and German. The electrical drawings are contained in 84 volumes, the collection of operating manuals for the equipment are in 20 volumes.

At the very beginning of the mission the expert was asked to check the documentation and drawings in co-operation with the consulting firm representative. A result of this work was a list of deficiencies in the electrical documentation and drawings. The number of deficiencies was so large that electrical documents were put on the general deficiency list with the provisional take-over protocol of September 1978.

After correction of the electrical documentation and drawings had been sent back by the contractor, the expert took part in the verification and take

over. The contractor was also supplied with a running commentary on mistakes that appeared.

Later the documentation was suitably arranged, classified and distributed among the electrical units. During the initial period of operation many innovations and improvements were made and always the expert took care that all changes would be recorded in all the sets of drawings and documentation which were in the plant.

It has to be underlined that properly classified and accurate documentation helps substantially to shorten the time spent on trouble-shooting and reduces down time. Besides, proper documentation facilitates the arrangement of the maintenance programme.

It would be a good idea to assign one qualified man in the electrical department to be responsible for documentation with the duty of keeping documentation up-to-date and in order. Documentation used directly by shift electricians is exposed to loss or to damage, and from time to time ought to be verified and supplemented or replaced.

C. Instrument workshop

As had been mentioned in a previous report, the contractor had made no plans for an instrumentation workshop or laboratory. The cement plant has only a large mechanical workshop with a small room designated for the electrical workshop. There are no known reasons why the contractor had not foreseen in his project an adequate space for a precise instrumentation workshop, and it seems strange that the consultant had not become aware of this.

As the cement plant does have chemical analysis laboratories in three independent buildings, it is probable that the instrumentation workshop had become the victim of limitations in the budget when the plant was delivered on a financially binding contract.

Indispensable laboratory equipment necessary for repairing measuring and control instruments was at last delivered by the contractors one year after provisional take over.

After many efforts a room near the stand-by generator under the preheater tower was obtained. Unfortunately dust penetration made it

impossible to use this room to repair precise measuring devices, and the expert began to look for a more adequate room.

In July 1979 a room that had belonged to the X-ray laboratory inside the Central Control Room building was made available.

The organizational details of the instrumentation workshop have been given in a previous report. Already in the first report this expert had recommended the establishment of one central workshop for the whole Libyan Cement Company. This would provide for a better use of tools and testing equipment and better management of spare parts, resulting in a greater efficiency of operation.

Taking into consideration the long distance to European service centers and the absence of their representative in the Libyan Arab Jamahiriya, it seems necessary to establish a high quality workshop in which the most complicated instrumentation equipment could be repaired. Up to now in spite of very limited workshop facilities about 80% of the measuring devices could be repaired on the site.

A central instrumentation workshop would permit quick repair of equipment and reduce production stoppage due to equipment failure.

This central workshop should consist of at least the following rooms:

1. A room for the repair and maintenance of electronic devices. This room should be dust free and air-conditioned. The room is to be supplied with electricity at 380/220 V, 50 Hz, from which all other DC and AC voltages needed can be obtained.

2. A room for the repair of measuring devices of chemical and physical values, pneumatic and hydraulic equipment etc. In this room a compressed air installation with adequate reducers and water supply installations are needed.

3. A room for the storage of needed testing equipment, special tools and a basic stock of electronic spare parts like transistors, diodes, resistors, capacitors etc.

4. A room for the chief or the foreman who will be responsible for the instrumentation workshop. In this room all technical documentation and drawings as well as cards for the maintenance programme would be kept.

While the organization of repair and maintenace of measuring and control equipment would mean additional expenses in the beginning, it would bring many advantages in the long run: more effective use of manpower, reduction of acci-

dental damages, reduction of failures and independence from expensive service assistance from abroad.

Either because of a lack of funds or some other reason there has been no offer accepted for the construction of an instrumentation workshop. In the expert's opinion the delay has been due to the fact that the cement plant is supervised by a staff that is more concerned with the problems of production as such and less with the proper functioning of plant facilities. This has been the cause for a lack of interest in a central instrumentation workshop.

II. ASSISTANCE TO THE BENGHAZI PLANT

In September 1980 the expert was asked by the management of the electrical department to help take care of problems concerned with measuring and control equipment at the Benghazi Plant. From the end of November he was engaged full time on the elaboration of the maintenance programme for the instrumentation of the plant.

The Benghazi Cement Plant consists of these production lines:

Line I - put into operation in 1972 with a capacity of 200,000 t/a
Line II - put into operation in 1974 with a capacity of 600,000 t/a
Line III - put into operation in 1977 with a capacity of 600,000 t/a

As it appears from the above-mentioned dates, the equipment of those plants is worn out enough to cause frequent breakdowns. The two oldest lines need a general overhaul as well as some modernization of equipment.

Because of the kind of engineering used at the time of construction of the earlier Benghazi production lines, each line has an independent control board equipped with its own instruments. The dispersion of measuring and control equipment rooms makes the maintenance procedure more difficult.

Furthermore, a high degree of wear and inefficiency on the part of the measuring and control devices delay implementation of the planned maintenance.

Before the maintenance schedule can be observed it will be necessary to overcome the ravages of past neglect and to bring the equipment up to the required operational standard. When the basic work is completed and the maintenance scheme is in effect, substantial benefits can be expected. The initial organization and subsequent operation of any planned maintenance system will involve time, money and hard work.

Planned maintenance is not a panacea for every maintenance problem. It will not compensate for poor workmanship, lack of tools, bad design or abuse of machinery by the personnel, nor will it convert worn out, obsolete equipment into modern, highly efficient units.

However, the mere fact that maintenance is being carried out in a systematic, constructive manner must result in benefits.

A. Elaboration of the maintenance schedule

After being familarized with the main problems at the Benghazi Plant, technical documentation, drawings, equipment and layout, the detailed maintenance plans for two production lines (II and III) were drawn up. Because the plans were drafted only near the end of the mission, there was not enough time to implement them. Nor was there time to work out the maintenance plans for production line I which is different from and older than line II and line III.

In order to facilitate adoption of the maintenance plans they were arranged in a manner similar to the maintenance plans for the Hawari Plant. The list of measuring points for daily, weekly, fortnightly and monthly maintenance cycles have been worked out to give information on the position of each individual loop and to give indications about the kind of maintenance required. A space on the cards is provided to indicate who performed the maintenance, what had been done and when, and other remarks that would call for subsequent action. (The annex contains maintenance cycle forms for the Benghazi Plant, line II.)

In the earlier report only specimens were given, but a full set of 50 cards was submitted to the electrical department. At the Benghazi Plant there is a separate workshop for instrumentation (in old barracks) where a crew takes care of maintenance and necessary repairs as well. It would be much better if repairs and preventive maintenance were separated.

The frequent interruptions of production in the Benghazi Plant are a very serious problem. It causes the maintenance and the instrumentation team to be more involved in repairs of breakdowns. The production department ought to attempt to eliminate unexpected breakdowns through better preparation of the lines before start up.

Parallel implementation of planned maintenance in the electrical and mechanical departments ought to give the following results:

(a) Greater plant utilization:

(i) Fewer breakdowns will occur in a plant that is regularly and correctly maintained;

(ii) Maintenance is carried out when it is most convenient and will cause the minimum loss of production;

(iii) Regular, simple maintenance results in less downtime than infrequent expensive and ad-hoc maintenance;

(iv) Excessive length of downtime is reduced because spares and equipment demands are known in advance and parts are available when necessary;

(b) Regular, simple servicing is cheaper than sudden, expensive emergency repairs;

(c) Regular, planned servicing and adjustment maintains a continuously high level of plant output, quality, performance and efficiency;

(d) Greater and more effective utilization of labour;

(e) The servicing and adjustment of equipment contained in the programme are not overlooked or omitted.

B. Proposal for modernization

During the project, the expert was asked to work out a system of measuring the temperature in the rotary kiln shell in all three lines, and also a TV-monitoring systems for the inside observation of the kiln and grate cooler of line III.

After a detailed study of the problem and to keep costs low it was recommended that the company purchase only certain system components such as pyrometers, transmitters, recorders, indicators etc. and let the company's own skilled technicians instal them. The purchase of equipment similar to that used at the Hawari Plant would permit a greater standardization of equipment, better arrangement of spare parts and easier maintenance.

A similar procedure was proposed for the installation of a TV system, but because of its high cost, the LCC management has not yet made the decisi to authorize its purchase.

In co-operation with the mechanical department a new system of pressure measurement was installed in rotary kiln head No. II. This was an essential step taken for the proper operation of the kiln. The mechanical workshop also made protecting covers for the pyrometers in the kiln heads.

During the shut-down of rotary kiln II, devices in the main control loops were carefully checked and prepared for automatic operation.

III. THE LIME FACTORY

At the time of commissioning in June 1980 and during the guarantee period as well, the expert was asked to take part in the inspection of the new lime factory. Deficiencies that were found in the installation were brought to the attention of the project engineer. Later on, because of troubles that appeared in the measuring and control equipment, the expert took part in an investigation into the background of the problem and tried to find a remedy.

In the meantime remarks concerning spare parts, documentation, drawings and the interlocking system between the old lime factory and the new have also been submitted to the contractor.

Because a great part of the documentation for the old lime factory had been lost, and problems with spare parts and maintenance arose as a result, the expert catalogued all motors installed in the factory. In this way a complete list including all necessary technical data was compiled and distributed throughout the electrical units.

IV. STANDARDIZATION

Standardization is fundamental to modern industry, and it is as relevant to administrative procedures as it is to material objects. There are many different aspects of standardization so this chapter will only be concerned with its application and effect upon the maintenance function.

Both the Hawari Plant and the Benghazi Plant were constructed under turn-key contracts. In order to reduce his costs the contractor had to buy a great deal of equipment and sometimes entire production units from the sub-suppliers who offered the lowest prices. That resulted in the use of different components for similiar purposes. The designer could have standardized all the components, but it would have raised costs. The great number of different suppliers for electric motors, controls, instruments, recorders, transmitters etc. creates a major obstacle in planned maintenance procedure.

Particularly in the case of the Benghazi Plant it would be reasonable, as the need arises, to exchange the old measuring devices for the types used in the new plants of the company. But, of course it always should be the subject of a specific engineering study. The expert already has taken such steps in some instances where old devices for level measuring in silos were exchanged for new ones when spare parts were not available.

There are many examples like the necessity of exchanging the old devices for the chlorination of drinking water at the Benghazi Plant for the type used at the Hawari Plant. The additional cost of standardization at the beginning would lead to savings later on.

The main advantages of the standarization are as follows:

(a) The selection of equipment is simplified;

(b) The types, variety and numbers of spares held in the stores are reduced:

  (i) Less capital is tied up in stocks;

  (ii) Less storage space is needed;

  (iii) Stock taking, store keeping and purchasing are easier and less costly;

(c) The delivery of spares is quicker;

(d) Easier interchangeability of modules between different facilities results:

(i) Unit replacement, i.e. contractors, transmitters, sensory valves, indicators and motors, becomes practical and economical;

(ii) The cost in both labour and downtime of overhauling or repairing a unit at a site can be very high. It is often much quicker and cheaper to install new or reconditioned replacements so that the old unit can be overhauled in the workshops and made available for reuse at another facility;

(e) Fewer reference drawings, specifications and maintenance instructions are required;

(f) A smaller variety of devices requires fewer specialized tools. But on the other hand it becomes more profitable to purchase special maintenance and test equipment instead of spreading the same cost to cover a larger number of general purpose tools to suit all equipment;

(g) Because fewer types of equipment are involved, familiarization is quicker: less time is required to train operating and maintenance personnel. The pattern of maintenance becomes more intimately known; faults are recognized, diagnosed and located more easily.

V. REMARKS ABOUT THE TECHNICAL ASSISTANCE PROJECT

The following is a summary of the expert's observations during the two and a half years of work with a team of UNIDO experts.

The primary duties of the experts on the site were to give assistance to personnel of all specialties from operational technicians to skilful maintenance men. During the first period of operation they not only filled positions that had not yet been staffed, but also gave on-the-job training to local technicians, so that each UNIDO expert had at least one trainee at his side.

In 1978 there were no more than 50 UNIDO personnel at the project. Some time later the number of local personnel was decreased due to departures for training abroad, military service or other jobs, which, after a minimum of industrial training, the workman could easily find. Simultaneously the number of UNIDO experts also decreased for reasons which will be described, thus creating an acute manpower shortage.

As a result, the authorities of the Libyan Cement Company decided to increase the number of UNIDO specialists.

After a meeting in July 1979 the number of UNIDO specialists at the plant reached 80. They were assigned to the Benghazi Plant as well as the lime plant.

When the number of UNIDO specialists was at a minimum and when it was at a maximum, on-the-job training came to a standstill because of a shortage of local partners.

The team of UNIDO specialists has more or less evolved into a group of foreign employees, one of many operating in the country. The average duration of an assignment of one year is too short a period, especially for electricians and instrumentation specialists, because three months or longer are needed to become familiar with the plant layout. Frequent exchanges of specialists decrease the efficiency of production.

The main reasons of termination of assignment are as follows:

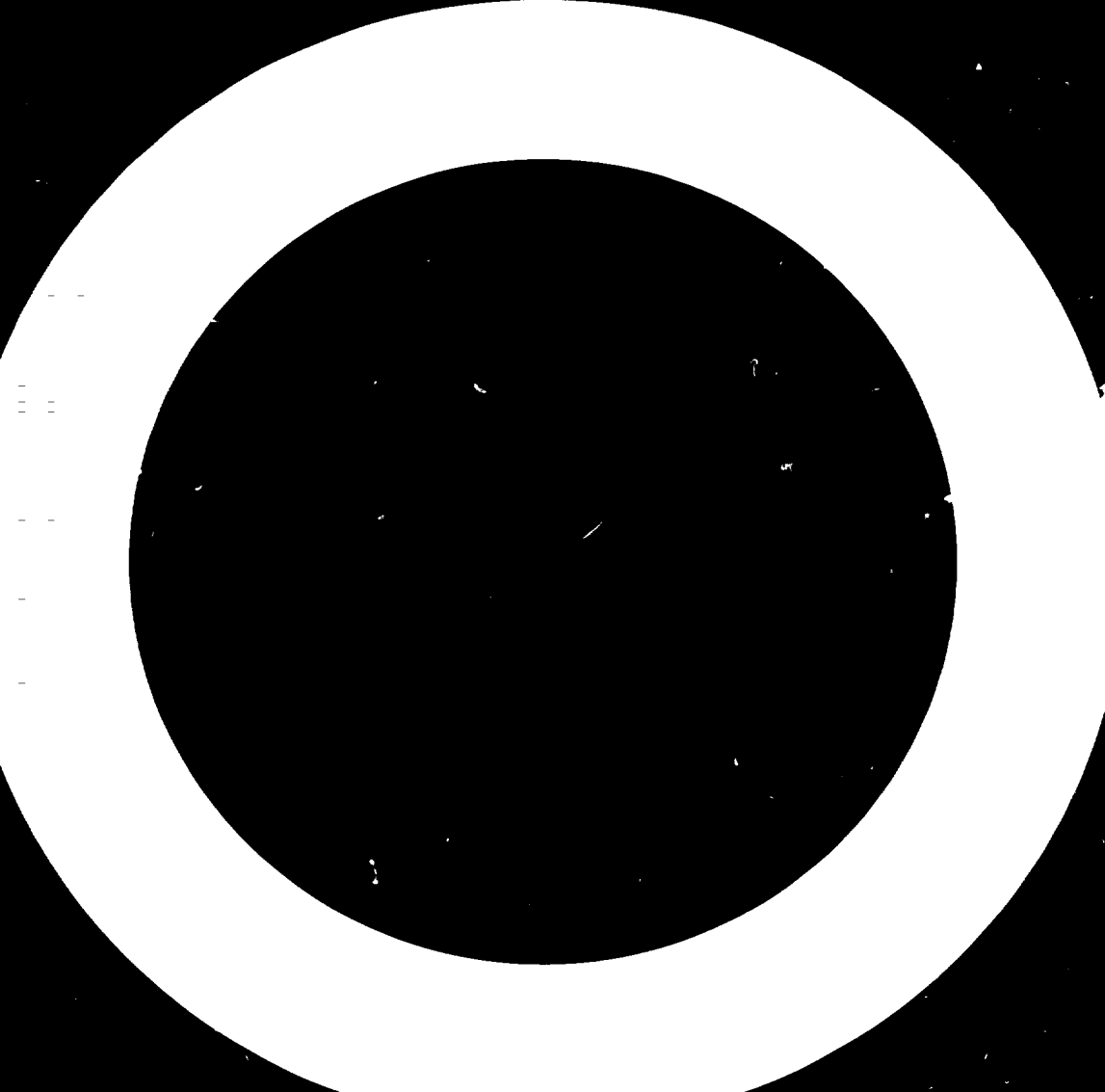
(a) Separation from family;

(b) Conditions of accomodation (two persons in one room, six in a flat);

(c) Dissatisfaction with professional position on the job (lower than than in mother country).

The majority of the engineers work as technicians and don't even hold the post of foreman. It has been noticed that the specialists develop the tendency to reduce their professional ambitions.

The local personnel after training abroad assume posts as technical supervisors, but there is as yet a shortage of skilled workers. There is as yet no trend toward a gradual replacement of UNIDO specialists with local personnel, but on the contrary there is the tendency to increase the number of specialists.



The Libyan Cement Company
Plant - Benghazi II

LIST OF MEASURING POINTS FOR
DAILY MAINTENANCE CYCLE

Point No.	Description	Kind of maintenance						Remarks	Remarks of chief
		V.ch.	Cl.O	Cl.P	S.a.	Exch. P	Exch. L		
-	Control desk - kiln II	X				X	X		
-	Control desk - raw mill II	X				X	X		
-	Control desk - cement mill II	X				X	X		
315.15	Temperature sintering zone	X	X						
317.01	Temperature clinker behind cooler	X	X						
325.20	Draught at the kiln head	X		X					
371.32	O_2 at the kiln inlet	X	X	X					
371.33	CO at the kiln inlet	X	X	X					

Abbreviations:

V.ch. - Visual checking
Cl.O - Cleaning outside (for example lens)
Cl.P - Cleaning pipe inside (for example pipe to transmitter)
S.a. - Small adjustment
Exch. P - Exchange of paper for recorders
Exch. L - Exchange of lamps for signalization

Name:
Date:

The Libyan Cement Company
Plant - Benghazi II

LIST OF MEASURING POINTS FOR
WEEKLY MAINTENANCE CYCLE

Point No.	Description	Kind of maintenance						Remarks	Remarks of chief
		V.ch.	Cl.P	S.a.					
320.20	Draught at preheater	X	X						
321.25	Draught at preheater behind stage 4	X	X						
321.25A	Draught at preheater behind stage 4	X	X						
322.20	Draught at kiln inlet	X	X						
326.20	Pressure in chamber 1	X	X						
340.20	Exhaust gas behind preheater	X	X						
371.10	O_2 at the kiln inlet			X					
371.15	CO at the kiln inlet			X					

Abbreviations:

V.ch. - Visual checking
Cl.P - Cleaning pipe inside
S.a. - Small adjustment

Name:

Date:

The Libyan Cement Company
Plant - Benghazi II

LIST OF MEASURING POINTS FOR
FORTNIGHTLY MAINTENANCE CYCLE

Point No.	Description	Kind of maintenance						Remarks	Remarks of chief
		V.ch.	Cl.P						
221.20	Differential pressure raw mill	X	X						
226.20	Pressure behind separator	X	X						
227.20	Pressure before separator	X	X						
228.20	Pressure behind E-filter	X	X						
321.20	Draught at preheater behind stage 1 left	X	X						
321.21	Draught at preheater behind stage 1 right	X	X						
321.22	Draught at preheater behind stage 2	X	X						
321.23	Draught at preheater behind stage 3 left	X	X						
321.24	Draught at preheater behind stage 3 right	X	X						

Abbreviations:

V.ch. - Visual checking
Cl.P - Cleaning pipe inside

Name:

Date:

The Libyan Cement Company
Plant - Benghazi II

LIST OF MEASURING POINTS FOR
3-MONTHLY MAINTENANCE CYCLE

Point No.	Description	Kind of maintenance						Remarks	Remarks of chief
		V.ch.	Cl.P	Ch. int.	Con.	Trans.			
221.20	Differential pressure raw mill	X	X	X	X	X			
226.20	Pressure behind separator	X	X	X	X	X			
227.20	Pressure before separator	X	X	X	X	X			
228.20	Pressure behind E-filter	X	X	X	X	X			
320.20	Draught at preheater	X	X	X	X	X			
321.20	Draught at preheater stage 1 left	X	X	X	X	X			
321.21	Draught at preheater stage 1 right	X	X	X	X	X			
321.22	Draught at preheater stage 2	X	X	X	X	X			
321.23	Draught at preheater stage 3 left	X	X	X	X	X			
321.24	Draught at preheater stage 3 right	X	X	X	X	X			

Abbreviations:

V.ch. - Visual checking
Cl.P - Cleaning pipe inside
Ch.int. - Checking of interlocking and alarm
Con. - Checking and tightening of connecting screws
Trans. - Checking and adjustment of transmitter

Name:

Date:

The Libyan Cement Company
Plant - Benghazi II

LIST OF MEASURING POINTS FOR
6-MONTHLY MAINTENANCE CYCLE

Point No.	Description	Kind of maintenance						Remarks	Remarks of chief
		V.ch.	Cl.O	Ch. int.	Con.	Trans.			
211.01	Temperature of stone in firing chamber								
212.01	Temperature of gas outlet firing								
213.01	Temperature of gas mill inlet								

Abbreviations:

V.ch. - Visual checking
Cl.O - Cleaning outside
Cl.P - Cleaning pipe inside
Ch.int. - Checking of interlocking and alarm
Con. - Checking and tightening of connecting screw
Trans. - Checking and adjustment of transmitter

Name:

Date:

The Libyan Cement Company
Plant - Benghazi II

LIST OF MEASURING POINTS FOR
6-MONTHLY MAINTENANCE CYCLE

Point No.	Description	Kind of maintenance						Remarks	Remarks of chief
		V.ch.	Cl.O	Ch. int.	Trans.				
237.80	Twist-regulator before transp. fan	X	X	X	X				
231.80	Twist-regualtor before sep. fan	X	X	X	X				
232.80	Damper-separator exhaust air	X	X	X	X				
235.80	Damper-gas before grinding plant	X	X	X	X				
230.80	Damper before mill	X	X	X	X				
238.80	Flat before exhaust air fan	X	X	X	X				
335.80	Draught at kiln outlet	X	X	X	X				
332.80	Air quanitity in chamber 1	X	X	X	X				
326.65	Grate 1, pressure chamber 1	X	X	X	X				
326.64	Grate 2, pressure chamber 1	X	X	X	X				

Abbreviations:

V.ch. - Visual checking
Cl.O - Cleaning outside
Ch.int. - Checking of interlocking and alarm
Trans. - Checking and adjustment of transmitter

Name:

Date: