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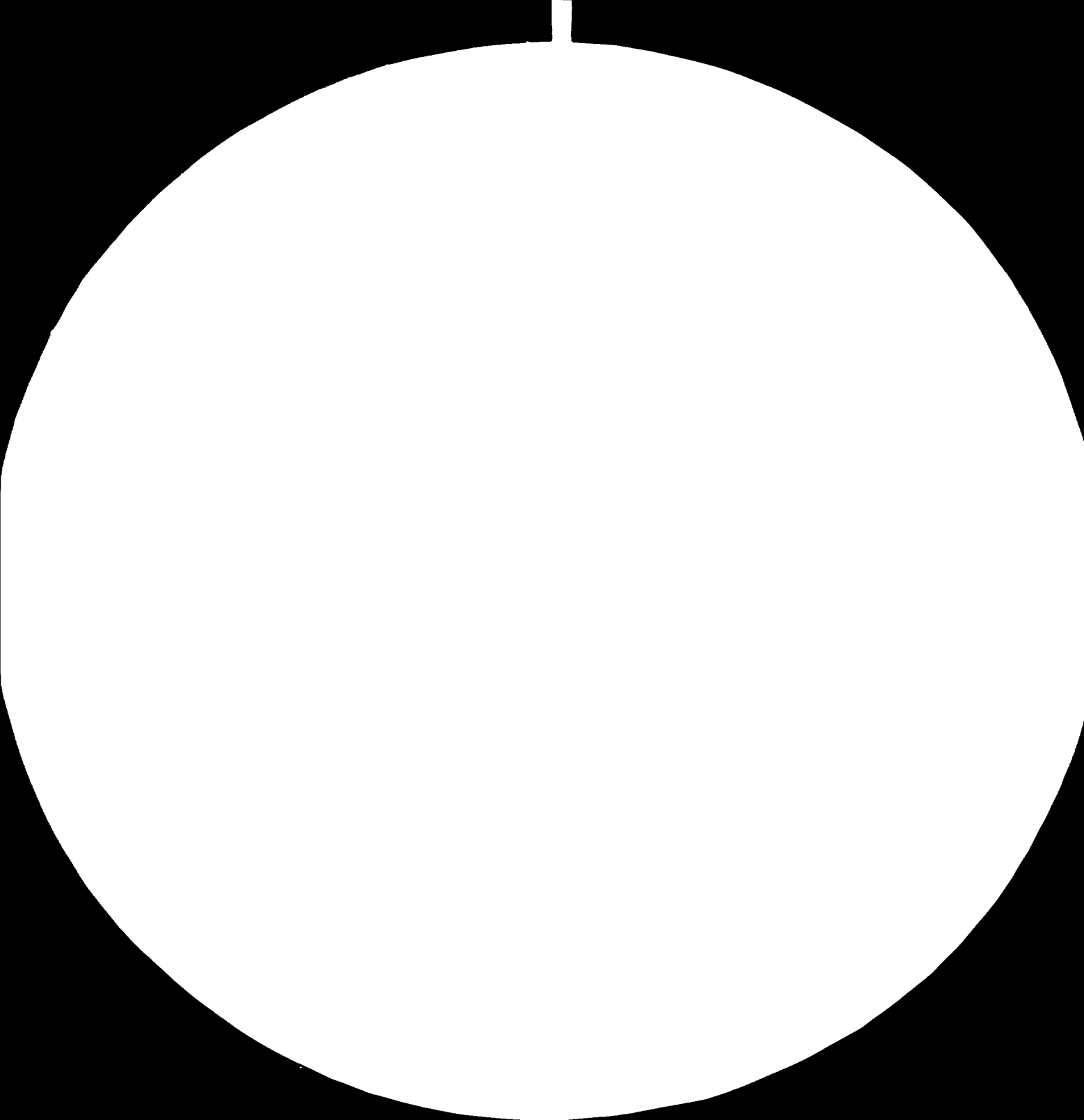

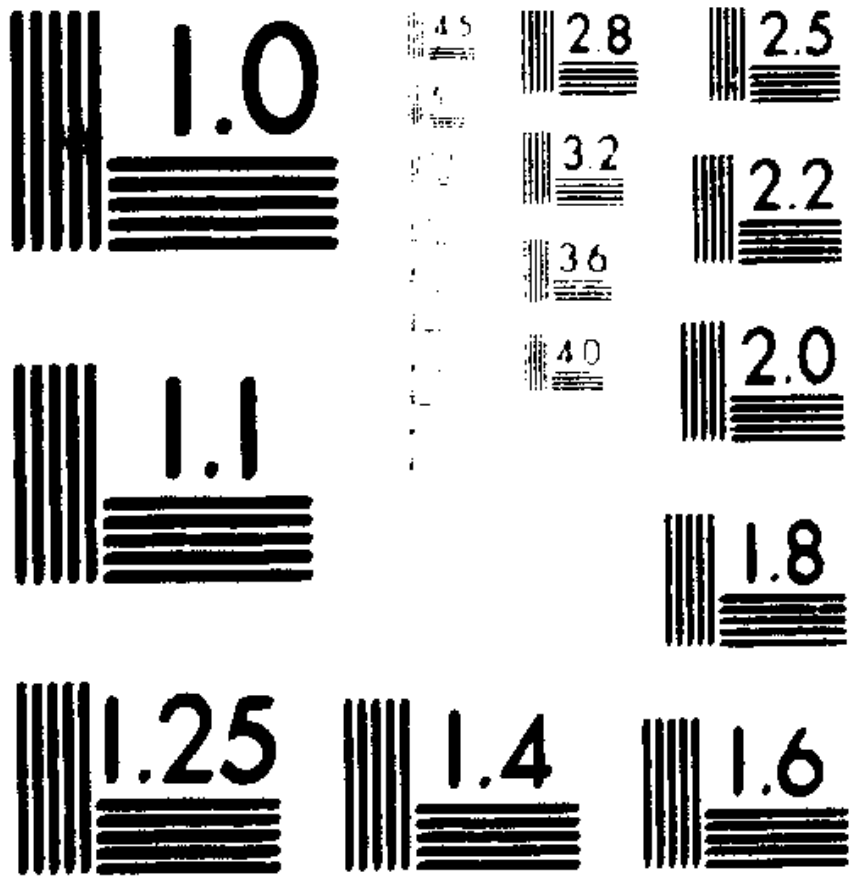

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UNITED NATIONS INDUSTRIAL
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ASSISTANCE TO CONSOLIDATE AND DEVELOP THE BENGHAZI CEMENT FACTORY COMPLEX

TF/LIB/75/002

LIBYAN ARAB JAMAHIRIYA

(R) Technical report: Assistance in instrument maintenance

Prepared for the Government of the Libyan Arab Jamahiriya
by the United Nations Industrial Development Organization

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

United Nations Industrial Development Organization
Vienna

80-40224

Explanatory notes

The following abbreviations of organizations are used in this report:

LCC	Libyan Cement Company
KHD	Kloeckner Humboldt Deutz, Industrieanlagen AG, Federal Republic of Germany
B and B	Bilfinger and Berger AG, Bauaktiengesellschaft, Federal Republic of Germany
PEG	Prospective Engineering Gestions, Switzerland

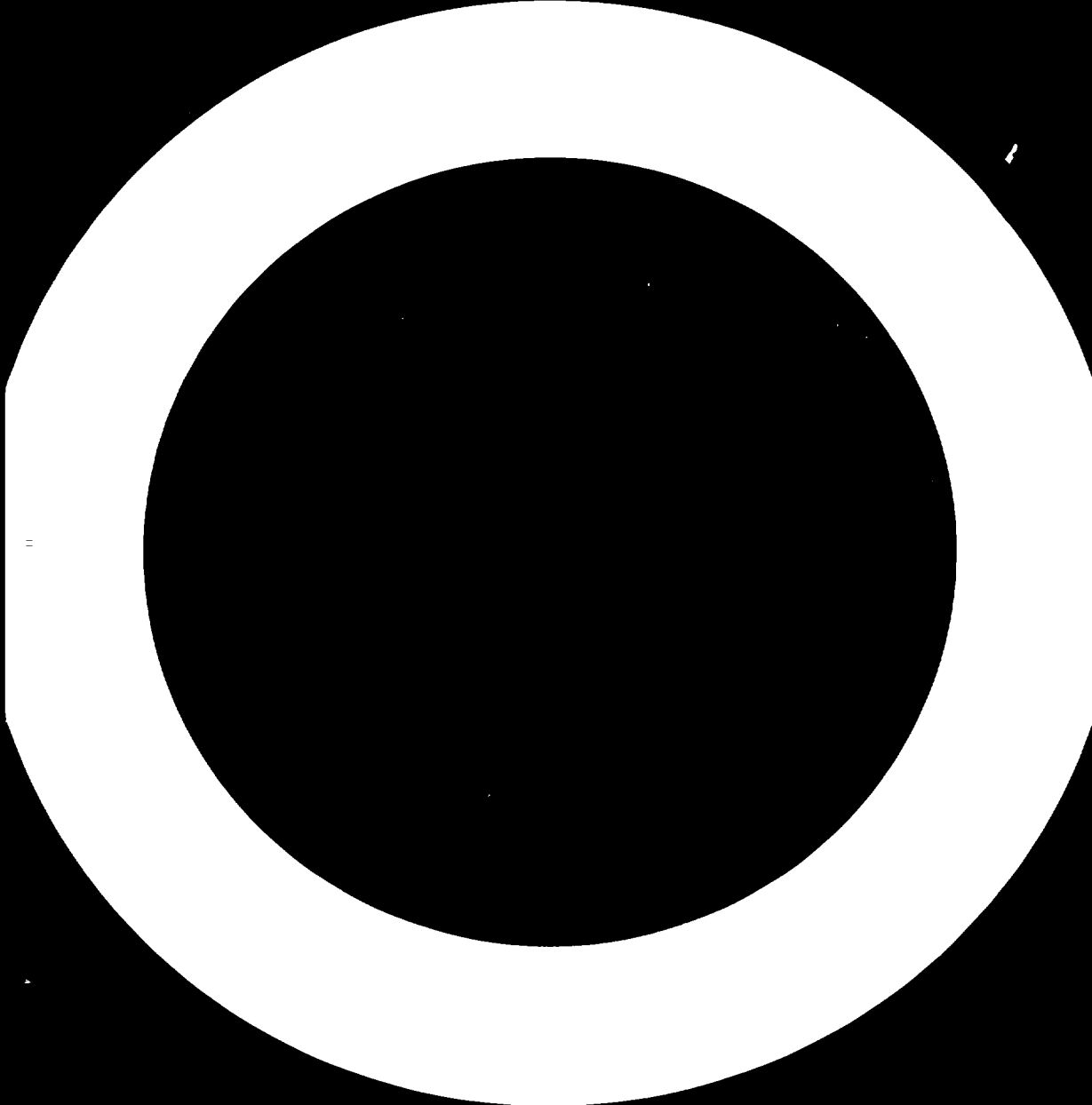
The following abbreviations are used in the specimen worksheets in annex II:

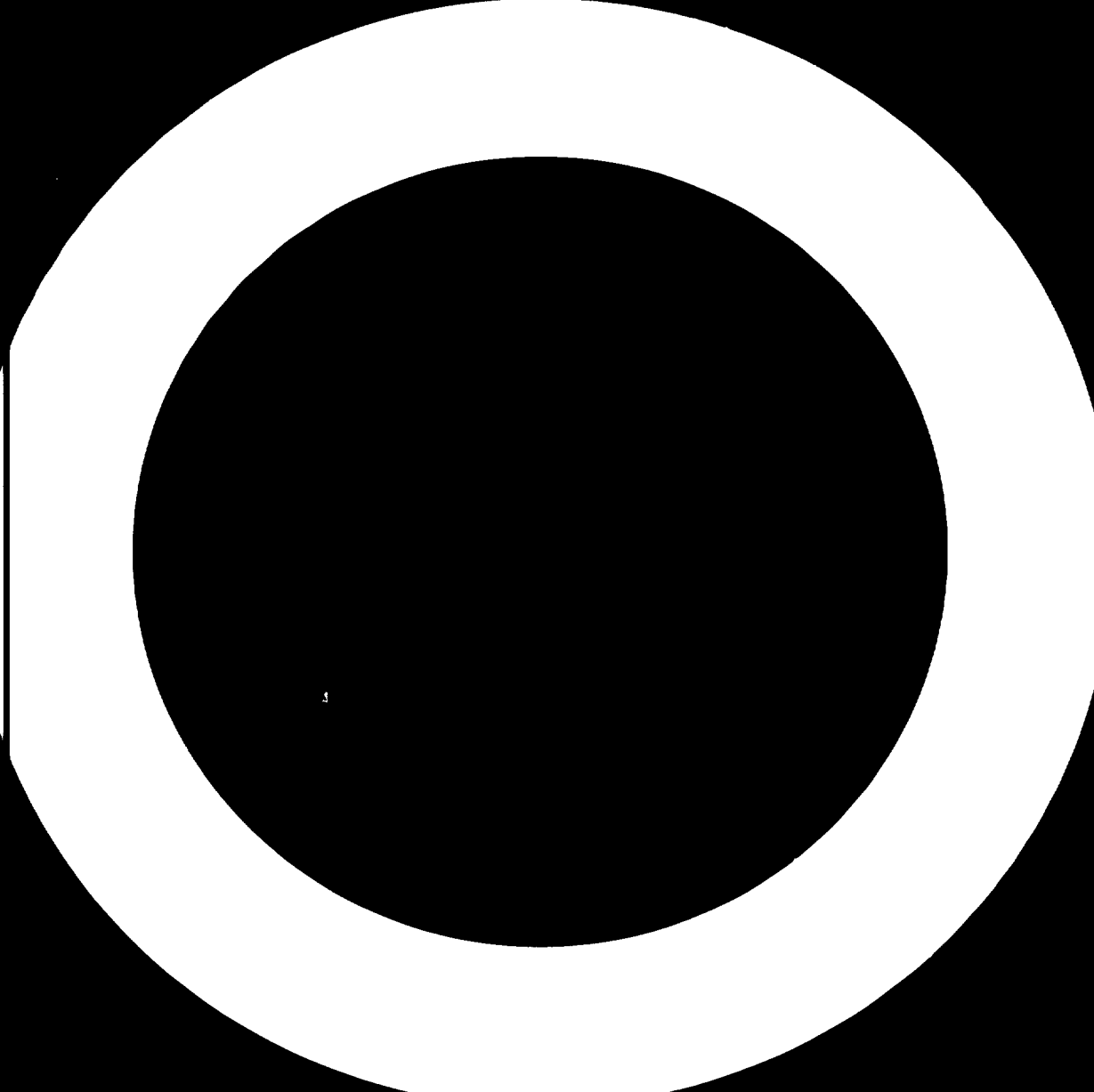
V. ch	Visual checking
Cl. o.	Cleaning outside
Cl. p.	Cleaning of pipe inside
S. a.	Small adjustment
Cl. f.	Cleaning of water filter
Ch. int.	Checking of interlocking and alarm
Exch. p.	Exchange of paper
Exch. l.	Exchange of lamps
Con.	Checking of connection
Trans. ch.	Checking of transmitter

ABSTRACT

The project TF/LIB/75/002, "Assistance to consolidate and develop the Benghazi cement factory complex", is a four-part project which is being financed by the Government of the Libyan Arab Jamahiriya through a trust fund arrangement with the United Nations Industrial Development Organization (UNIDO). The aim of the project is to assist the Libyan Cement Company (LCC) to develop and expand its complex of cement and building materials industries in the Benghazi area by providing technical advisers and personnel for the running of these industries. The second part of the project consisted of the missions of three maintenance experts to the Hawari cement factory which was commissioned in 1978. The present report covers the mission of the instrumentation electrical engineer who arrived at the duty station in July 1978 for one year which was then extended for a further six months. The purpose of his mission was to design and put into practice a system for the maintenance of the measuring and control equipment, including preventive maintenance, calibration and repair of the instrumentation. He also acted as leader of the team of Polish specialists who joined the project from May to August 1978.

The expert familiarized himself with the plant and took part in operational tests before the provisional take-over of machinery and equipment. He checked electrical documentation and drawings and reported defects and inadequacies in these to the suppliers. After this initial experience, he worked out and put into effect a detailed plan for the maintenance of the measuring and control equipment and, due to shortage of staff, took part himself in repairing and calibrating the more sophisticated electronic equipment such as the electronic weigh-feeder system. During the first six months of the operation of the maintenance programme, casual breakdowns of the measuring and control equipment decreased noticeably. The expert also concerned himself with ensuring an adequate supply of spare parts for the control systems. He makes recommendations for increasing and stabilizing the team of electrical maintenance personnel, for the establishment of a workshop-laboratory for the repair and maintenance of equipment, for protecting the control devices in the oil-treatment station and for improving the limestone and clay balances.





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INTRODUCTION

The project TF/LIB/75/002, "Assistance to consolidate and develop the Benghazi cement factory complex", is a four-part project which is being financed by the Government of the Libyan Arab Jamahiriya through a trust fund arrangement with the United Nations Industrial Development Organization (UNIDO). The aim of the project is to assist the Libyan Cement Company (LCC) to develop and expand its complex of cement and building materials industries in the Benghazi area.

This complex consists of the Benghazi cement plant with three production lines and a yearly production capacity of one million tons, the Hawari cement plant with two production lines and a yearly production capacity of one million tons, a lime plant, a concrete-block plant, a paper-bag plant and a ceramic-brick plant. Both cement plants use the dry process in cement making.

The Hawari cement plant was supplied on a turnkey basis by Kloeckner Humboldt Deutz (KHD), Industrieanlagen AG, with Bilfinger and Berger (B and B) as subcontractors for the civil work. The commissioning of the plant began in May 1978, with Prospective Engineering Gestions (PEG) controlling the guarantee tests on behalf of LCC. KHD and PEG had experts on the spot for the commissioning of the Hawari plant and five engineers from KHD stayed on as advisers on mechanical, electrical and production matters for a two-year period following the provisional take-over. A number of Libyan personnel were engaged by LCC for the take-over and operation of the plant, but it was impossible for LCC to get all the personnel needed.

UNIDO has been assisting LCC by providing technical advisers and personnel for the development and running of the plant. The first part of the project consisted of several missions by a building materials adviser, Mr. Ali Afify, who remained as co-ordinator of project activities. For the general development of the project and project personnel, see his reports UNIDO/IOD.37 and UNIDO/IOD.174.

The second part of the project consisted of the missions of three maintenance experts. This report covers the work of the instrumentation electrical engineer who was required to design and put into practice a system for the maintenance of measuring and control equipment in the Hawari plant. The full job description for his mission is given in annex I.

The expert's mission began on 25 July 1978, initially for a period of one year, but was then extended for a further six months. The expert also acted as leader and co-ordinator of the team of Polish operational specialists who

were the subject of the third and fourth parts of the trust fund agreement and who arrived between May and August 1978 to assist with the running of the plant.

The expert arrived at the duty station before the provisional take-over of the Hawari cement plant and the groupof technical specialists from KHD were still there. The expert had to familiarize himself with the layout and equipment of the plant and with the suppliers' documentation and drawings, and was able to get direct information from KHD's group of specialists. Language barriers between the Polish team, Libyan counterparts and the German group created difficulties in the transmission of technical information and the expert had to act as translator during shift work in the instrumentation field as well as between electrical and production personnel. In the beginning, there were a number of breakdowns in the main production units of the plant and the expert had to organize and carry out emergency repairs to equipment. On the whole, all this initial experience gave a sound foundation for the planning of an effective maintenance system for the instrumentation and control equipment.

I. FINDINGS

A. Layout of the Hawari cement plant and its control systems

The most important sections of the Hawari cement plant are:

Limestone and clay quarry
Limestone-crushing section
Clay-crushing section
Raw-mix grinding section (2 lines)
Hot gas generator (2 lines)
Homogenizing and storage silos (2 lines)
Raw-mix proportioning system (2 lines)
Preheater bypass rotary kiln section (2 lines)
Rotary kiln firing system (2 lines)
Clinker cooler (2 lines)
Clinker transportation and storage for clinker and gypsum
Cement-grinding section (2 lines)
Cement transportation and cement silo section
Cement packing and loading installation
Water treatment and water supply system

The complete plant is monitored and controlled from four independent stands:

(a) The control desk for the limestone-crushing section;
(b) The control desk for the clay-crushing section;
(c) The control centre for both production lines;
(d) The control desk for the packing section.

There are subsidiary control desks for the oil-firing and for the water supply systems.

The signal lamps, regulators, indicators, recorders and master control units of the control system are installed in the control desks. Most measurements are transferred to the indicators of the control units from transducers installed in local cabinets as standard signals of 0-20 milliampere.

The signals are transferred to pilot lamps in illuminated diagrams via auxiliary contactors installed on racks below the control centre or local cabinets. For monitoring the sintering zone and the clinker cooler there is a TV system. The image is transmitted to two monitors in the control centre.

This shows that the Hawari cement plant is very well equipped in measuring and control devices which makes the work of the operators of the central panels easy and reliable. On the other hand such a quantity and diversity of instruments requires a high degree of preventive maintenance.

B. Manpower in the electrical department

There are certain difficulties in obtaining qualified Libyan staff. The Benghazi cement plant, in operation since 1972, still has a lot of difficulty in finding adequate staff in fields which require more qualifications and experience, particularly in maintenance, supervision and operation of measuring devices. The new cement plant at Hawari has a higher degree of automation than the Benghazi cement plant. This fact decided LCC to arrange for a team of operational specialists who would enable them to overcome the difficulties of the transitional period. The team was recruited from Poland through UNIDO and included eight electricians and three specialists in instrumentation.

Because the provisional take-over was delayed, the commissioning specialists from the plant's suppliers had to stay longer. This was very helpful for the newly-arrived Polish team who were thus able to get direct information from the suppliers of the machinery and equipment.

During the guarantee period, specialists of various subcontractors visited the plant in order to inspect and, when necessary, to repair or replace instruments and apparatus. This also gave an opportunity for the Polish personnel to study methods and gain know-how and insight into the problems that might arise.

In August 1978, the Polish electricians were sufficiently prepared to take over the duty shifts and start training the Libyan staff. However, because of a limited knowledge of one another's languages, the Polish team had considerable difficulty in communicating with both the Libyan staff and the technical assistants from the Federal Republic of Germany, the expert helped in translations and interpretations both of language and technical documents.

The electrical personnel from the Libyan side consists of:

(a) A chief for both cement factories, Benghazi and Hawari;

(b) Two engineers (one of them has been trained in the Federal Republic of Germany for one year and the second one has begun training there);

(c) One foreman with some training in the Federal Republic of Germany;

(d) Several workers.

The workers in the electrical department tend to change. After a short time of training in the cement plant, some of them go away to other plants where they can earn more money.

Up to now, the Libyan electricians could not undertake separate duty shifts both because of insufficient professional preparation and because of this personnel fluctuation. At present, they work together with the Polish electricians and in this way are becoming trained.

At the present moment, there are no adequately qualified Libyan workers who could receive training in the automation field. That is why all control and measuring equipment was, and still is, under the supervision of one specialist from the Federal Republic of Germany and two Polish specialists.

The insufficient number of instrumentation specialists meant that the expert had himself to deal with the repair and calibration of the more complicated control systems, especially the weigh-feeder systems.

The shortage of personnel and the fact that all the instrumentation specialists work only on the morningshifts also means that it is not possible at present to separate the operations of repairing and preventive maintenance, as should be the case. To achieve this separation, it would be necessary to increase the group of instrumentation specialists to at least six people.

C. The electrical workshop

A mechanical workshop was established after the arrival of a second team of Polish specialists in August 1978. The workshop is quite well equipped with lathes and a press which allows repairs to be carried out on the spot.

An electrical workshop, next door to the mechanical workshop, is still not equipped with any measuring equipment. However, there is a place for mounting and dismantling the electric motors and other types of small equipment. The electric motors cannot be rewound here though this may be possible in the future. In this workshop, there is a drying oven and a Polish specialist who can operate this and, at the same time, train a Libyan in this type of work.

At that time, there was no workshop for the repair of control and measuring equipment and apparatus, but arrangements have been made for a provisional one at the suggestion of the specialist. This would only be a temporary workshop because discussions have already taken place on a contract for the construction of a completely new workshop. The place now used for the repair of this equipment is not suitable owing to dust and lack of space and, in these circumstances,

it is impossible to carry out repairs on control and measuring apparatus adequately. A solution to this problem would be to use a cabin in which to carry out this work until the new workshop is completed. Another possibility would be to share the barracks used by the contractors' electricians for the time being.

D. Electrical drawing and documentation

The electrical section of the technical documentation has been delivered in two languages, English and German. The drawings only contain explanations and titles in these two languages. All documentation has been checked by the expert in co-operation with the representative of the consulting firm Prospective Engineering Gestions (PEG) who are controlling the guarantee tests on behalf of LCC. Mistakes and lack of information have been pointed out to the supplier with remarks concerning particular drawings and technical data. Because of the amount of mistakes, the technical documentation has been included in a general list of defects which had to be remedied before the final date of take-over in August 1979.

During the commissioning period, there were many modifications and extensions made to the plant. The drawings and technical data for these were not brought up to date and this caused many problems and delays. It must also be appreciated that incomplete and unsuitable documentation creates a big problem in ordering spare parts.

The date fixed for delivery of completely updated drawings and documentation is still being postponed. When the final updated drawings are received, they will have to be checked very carefully. It has also been discovered that quite a few of the drawings are not standardized and properly classified which creates great difficulty in rapid fault-finding in the plant.

E. Spare parts

In December 1978, four months after the provisional take-over date, the spare parts from the guarantee period were transferred by the contractor to the LCC store. In this store, all spare parts have individual cards which allow them to be found easily and permit better stock control, although it seems that these cards are not arranged quite systematically enough.

Some of the spare parts for the measuring and control apparatus have been used up during the commissioning and operational test period. Up to now the spare parts have been rather few and of an uneven assortment. Certain individual parts are not available in proportion to the need for them.

The expert has reported the current lack of some spare parts and shortage of others to the supplier's technical experts to help them in ordering replacements.

It will also be necessary to order some parts indispensable for the further development of the plant before the expiry of the guarantee period.

It general, the supply of spare parts should be built up to ensure that equipment can be maintained in working order. The two-year guarantee period gives sufficient time to study the wear and tear on instruments and to assess the frequency with which individual parts have to be replaced.

F. Organization of maintenance

As mentioned before, the Hawari cement plant is automated to such a degree that it is possible to operate two main production lines from the central control panels. This system involves a large amount of apparatus for process control, indication and monitoring. Each main production line has about 220 measuring points which have indicators on the control panel. For two production lines this means about 440 points. In addition, part of the apparatus, transmitters and sensing devices from each control loop are located on the local racks and in cabinets. The large number of measuring and control circuits requires constant maintenance to provide a high degree of reliability for the operator in the control room.

A maintenance plan was worked out, based on the checking of individual measuring and control loops, so as to make the overall supervision of the system easier.

A maintenance cycle was established for daily, weekly, two-weekly, monthly, three-monthly, six-monthly and yearly checking of measuring points. This gives information at a glance on each individual measuring loop and instruction on the kind of maintenance required. Space is also provided on the cards to show who performed the maintenance, what was done and when. Specimens of the maintenance worksheets used in this system are given in annex II of this report. These are only a few examples. The complete set of maintenance lists

for one production line consists of twenty-four sheets. The preventive maintenance of all measuring points is run on the same system throughout the plant.

This method has eliminated most accidental breakdown of equipment and the number of reports from operators on the inaccurate regulation of equipment has decreased. A similar plan should be worked out for maintenance during any temporary or unforeseen shut-down of the plant.

It is planned to organize cards for each individual measuring circuit to show its history, repairs carried out and number of spare parts available at any given time.

Plans are also being worked out for preventive maintenance on the water and oil stations. If all these plans are strictly carried out it will prevent breakdown of equipment which often leads to a stoppage of the whole production line and loss of production. To operate this system, it will be necessary to allocate one engineer, one foreman and five qualified workers.

At present, LCC has insufficient qualified personnel in the instrumentation field to carry out repair work and preventive meaintenance separately. It is obvious that the repairs and preventive maintenance must be separated in the near future.

G. Further improvements

The weigh-feeder system

One of the most important measuring devices in the Hawari cement plant is the PFISTER weigh-feeder system for regulating the flow of material through the production process. Each of the production lines has nine balances and a fault in one of them causes the whole production line to stop. This is a sophisticated electronic system in which, providing each balance is working, a high degree of precision and ease of operating can be obtained.

Unfortunately, between July and December 1978, this electronic system had two serious breakdowns. The expert, together with the supplier's specialists, tried to find the reason for these breakdowns and to put the system back into operation. Finally the following facts emerged:

(a) The first breakdown was caused by overtension due to repeated turning on and off of the standby generator. It was then recommended that a new reserve electricity supply system for the cabinets containing electronic equipment should be installed;

(b) In the second case, the electronic cards had been damaged, probably because the earthing system was not correct. The necessary adjustments have been made. It also seems that the electronic cards are made of insufficiently high-quality electronic elements which both wear out and damage easily.

The weigh-feeder systems require continuous maintenance and periodical calibration. This was provided for in the monthly checking plan (see annex II). The calibration sheets have been worked out and duplicated so as to record all the necessary parameters. Such a system allows the correctness of the balances to be checked in a very short time.

A communication problem emerged during the weigh-feeder calibration. The specialists working directly with a mechanical part of the weigh-feeder have to be continuously in contact with those who are working at the electronic cubicle. There is a long distance between these two places and no means of communicating on the internal telephone. A headphone system has been constructed in order to solve this problem and to help speed up weigh-feeder calibration.

No provision was made in the construction plan for preventing limestone from running on to the weigh-feeder balances. Because of this, it was impossible to perform the periodical calibration or to repair the balances when broken down. Some kind of gate has now been constructed on the suggestion of the expert and this problem has been partially solved.

Gas-sampling probe

The test gas for carbon monoxide (CO) and oxygen (O_2) analysis is taken from the tube of the kiln inlet chamber by a water-cooled sampling probe. The gas-sampling mechanism is a tubular welded structure which must be cooled with water due to the high temperature in the rotary kiln. It is mounted on the vehicle of the withdrawal mechanism which automatically advances and retracts.

The gas-sampling probe could not be filled with water completely because it was not constructed according to the drawing. The whole sampling device was distorted so that it was impossible for it to pass through the window of the kiln operating automatically. The construction of the tubular structure was changed and a mechanical protection roll on the withdrawal mechanism provided.

It was noted that the amount of limestone getting into the cooling water caused a reduction in the diameter of the pipes and, from time to time, the cooling-water system of the probe was obstructed. A closed cooling system for probes in both kilns would be the best way to avoid this problem, although it is an expensive solution.

Draught in the kiln head

The measuring tube for atmospheric pressure was unsuitably installed at the kiln head and this caused the pipe to be often blocked. Because of that, oscillations developed in the regulation system and this made the operation of the kiln more difficult. After reconstruction of the pressure-measuring installation, all problems have been avoided.

II. CONCLUSIONS AND RECOMMENDATIONS

Maintenance personnel

As shown in the report, the complexity of the control system installed at Hawari requires a great deal of maintenance and it is important that the maintenance plan should be carried out correctly and systematically. The main difficulty at present is the lack of local staff with suitable technical training and the impossiblity of training an adequate number of people in a short time. It is hoped that the situation will change when a new training centre opens, but, in the meanwhile, the only solution is to employ foreign specialists. Fluctuations in personnel and language barriers are also problems. The expert makes the following recommendations:

1. The team for the maintenance of control equipment should be increased to seven people: one engineer, one foreman and five skilled workers.

2. Long-term contracts would promote greater stability of staff and increased efficiency.

3. Arabic language courses should be organized for all non-Arabic staff.

A central workshop-laboratory

The conditions under which measuring and control instruments have to be repaired at present in Hawari are very unsatisfactory and cannot continue much longer. There is also no suitable repair workshop at the Benghazi cement factory or at the lime plant, which is now being extended. It seems that the most rational and economic solution would be to construct one central workshop for this complex. The expert makes the following recommendations:

4. A central workshop-laboratory for the repair and maintenance of measuring and control instruments should be built as soon as possible and must contain at least four rooms:

(a) A room for repair and maintenance of electronic devices, which ought to be dust-free and equipped with an air-conditioner. There has also to be an electrical installation of 380 volts, 50 hertz;

(b) A room for repair and maintenance of physico-chemical, pneumatic and hydraulic apparatus, equipped with compressed-air and water installations;

(c) A store for measuring instruments, special tools and a basic stock of electronic subassemblies;

(d) A foreman's room for the measuring section in which all apparatus, documentation, drawings and cards of periodical checks could be kept.

5. This workshop will require one specialist in the repair of electronic instruments. He could be someone local who has trained abroad or a foreign technician capable of carrying out more complicated repairs on the spot, which would make for greater efficiency.

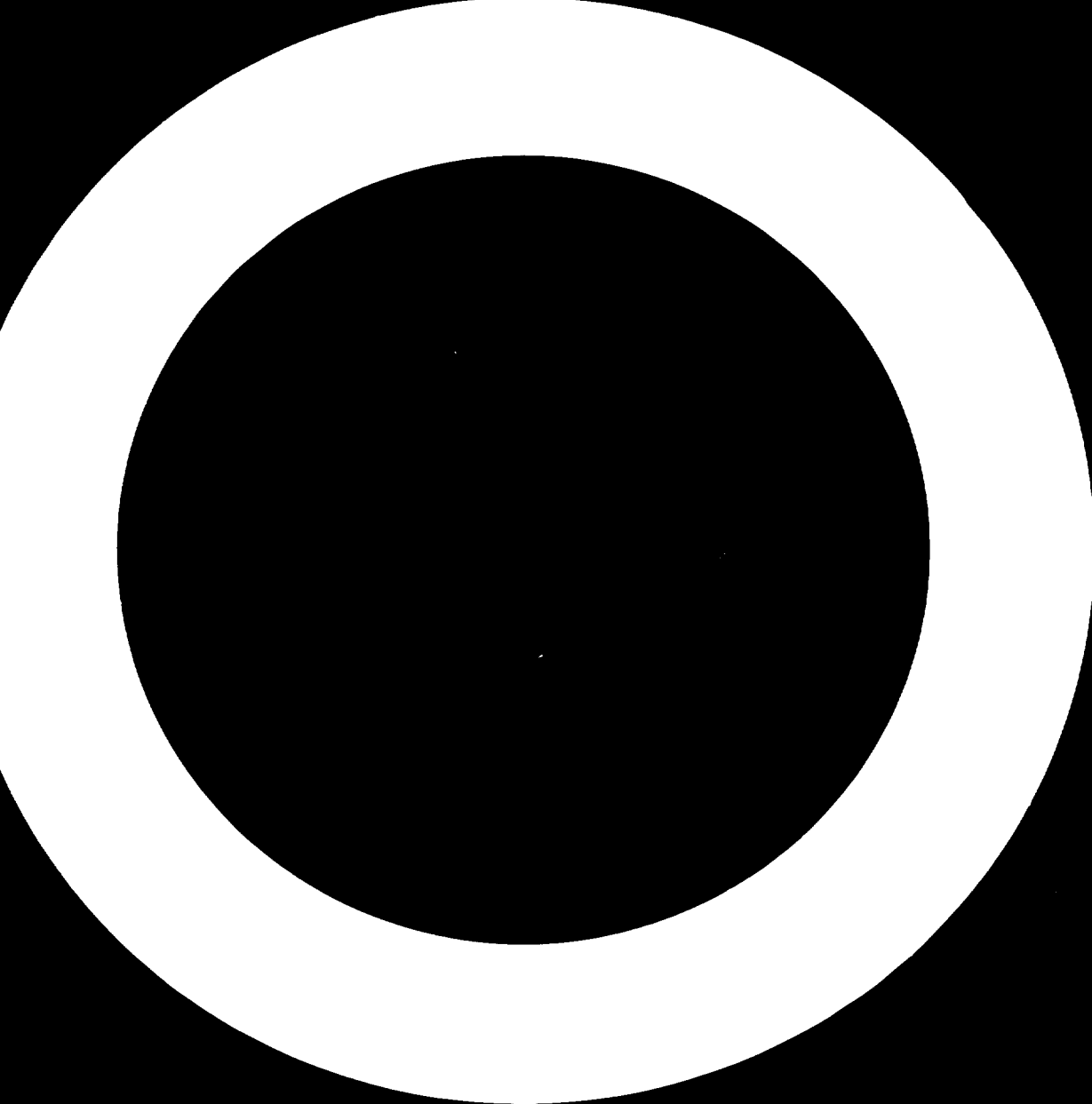
The oil-treatment station

It has been observed that the control devices and push-buttons in this station are deteriorating through the action of a mixture of dust and oil vapours.

6. A form of cabin for the protection of the control panel in the oil-treatment station must be constructed.

The limestone and clay balances

7. The shutters in the chute from the feed bins to the limestone and clay balances could be operated more easily and with less labour costs if they were equipped with fractive screws in the same way as the clinker balances.



Annex I

JOB DESCRIPTION

(TF/LIB/75/002)

Post title: Electrical engineer for instrument maintenance in the cement industry

Duration: Twelve months

Date required: As soon as possible

Duty station: Benghazi

Duties: The expert will be assigned to the Government of the Libyan Arab Jamahiriya and delegated to assist the cement industry in the Benghazi area. Specifically, he will be required to carry out:

1. Orgnization of programmes for testing, calibration and maintenance of measuring and control equipment.
2. Periodical inspection of measuring and control equipment to ensure its proper functioning, performance of necessary tests and adjustment.
3. Supervision of maintenance and erection work for measuring and control equipment, telephone installations, planning for any extensions thereof.
4. Keeping regular records for maintenance particulars of measuring and control equipment, deciding on spare parts to be ordered for ensuring a safe stock.
5. Proposal of technical specifications for new orders, technical and economic evaluation of offers.
6. Technical and administrative advice to personnel of instrumentation section to rationalize their efficiency.
7. Reporting about progress of maintenance work pertaining to measuring and control equipment, and activities of instrumentation personnel.
8. Organization of training programmes for personnel concerned with measuring and control equipment, for reinforcing their knowledge about testing, calibration and maintenance.
9. Establishment of basic principles for industrial security, rationalization of process for attaining best protection required through the control equipment.

Language: English

Qualifications: University degree in electrical engineering (communications) and experience of not less than seven years in the inspection, calibration and maintenance of measuring and control equipment in industrial projects.

Annex II

SPECIMENS OF MAINTENANCE WORKSHEETS USED AT HAWARI CEMENT PLANT

LCC Hawari

List of measuring points for daily maintenance cycle - line I

No.	Code	Marking	Kind of maintenance[a/] V.oh.	Cl.o.	Cl.p	S.a.	Exch. P.	Exch. l.	Remarks	Remarks of foreman
-	-	Control centre desk I	X	-	-	-	X	X		
Q 3311	QIRA	O_2 measuring behind preheat.	X	-	X	X	-	-		
Q 3511 Q 3512	QIRA	O_2 CO at the kiln inlet	X	X	X	X	-	-		
T 3511	TIAR	Temperature, inlet chamber	X	X	-	-	-	-		
T 3512	TIAR	Temperature, sintering zone	X	X	-	-	-	-		
T 3513	TR	Kiln shell temperature 1	X	X	-	-	-	-		
T 3514	TR	Kiln shell temperature 2	X	X	-	-	-	-		
Y 3511	YIA	TV camera, kiln head	X	X	-	-	-	-		
Y 3551	YIA	TV camera, clinker cooler	X	X	-	-	-	-		
T 3581	TIRA	Clinker temperature	X	X	-	-	-	-		
P 3512	PIRC	Draught at the kiln head	X	-	X	-	-	-		

Date: .....

Name: .....

a/ For explanation of the abbreviations used in this annex, see the explanatory notes.

LCC Hawari

List of measuring points for weekly maintenance cycle - line I

No.	Code	Marking	Kind of maintenance V.ch.	Cl.p.	Cl.f.	Ch.int.	Remarks	Remarks of foreman
L 3314	LA	Cyclone IV level control	X	-	X			
P 3311	PI	Draught in front of preheat. blower	X	X				
P 3317	PIRC	Pressure behind preheat. blower	X	X				
P 3322	PI	Draught into mix chamber	X	X				
P 3325	PI	Draught in front of waste air blower	X	X				
P 3511	PI	Draught, inlet chamber	X	X				
Q 3511 Q 3512	QIRA QUIRAS	O_2 CO at the kiln inlet	X	-	X	X		
Y 3511	YIA	TV camera, kiln head	X	-	X	-		
T 3512	FIR	Temperature, sintering zone	X	-	X	-		
T 3511	TIAR	Temperature, inlet chamber	X	-	X			

Date: .....

Name: .....

LCC Hawari

List of measuring points for 2-weekly maintenance cycle - line I

No.	Code	Marking	Kind of maintenance V.ch.	Kind of maintenance Cl.p.	Remarks	Remarks of foreman
P 2231	PI	Draught in front of hammer mill	X	X		
P 2241	PI	Draught in front of raw mill	X	X		
P 2242	PI	Draught behind raw mill	X	X		
P 2271	PIR	Differential pressure separator	X	X		
P 2276	PI	Draught before mill blower	X	X		
P 2292	PI	Draught in front of electrical precipitator blower	X	X		
P 3312	PI	Draught behind cyclone II	X	X		
P 3313	PI	Draught behind cyclone III	X	X		
P 3314	PI	Draught behind cyclone IV	X	X		
P 3315	PI	Draught in front of preheat. blower	X	X		
P 3511	PI	Draught, inlet chamber	X	X		

Date: .....

Name: .....

LCC Hawari

List of measuring points for monthly maintenance cycle - line I

No.	Code	Marking	Kind of maintenance V.ch.	Cl.o.	Cal.	Cl.p.	Ch.f	Remarks	Remarks of chief
F 222.01	FIRC	Weigh-feeder, limestone	X	X	X				
F 222.02	FIRC	Weigh-feeder, clay	X	X	X				
F 222.03	FIRC	Weigh-feeder, clay	X	X	X				
F 227.02	FI	Belt weight-feeder, gravel	X	X	X				
P 2252	PI	Draught behind hot gas producer	X	-	-	X			
P 2253	PI	Pressure into burner chamber	X	-	-	X			
F 313.04	FIRC	Raw-meal weigh-feeder	X	X	X				
Q 3311	QIRA	O_2 measuring behind preheater	X	-	X	X	X		
Q 3511	QIRA	O_2 at the kiln inlet	X	-	X		X		
Q 3512	QUIRAS	CO at the kiln inlet	X	-	X		X		
Q 3513	QA	Automatic withdrawal mechanism for the gas sampling	X	X					

Date: .....

Name: .....

LCC Hawari

List of measuring points for 3-monthly maintenance cycle - line I

No.	Code	Marking	Kind of maintenance					Remarks	Remarks of chief
			V.ch.	Cl.o.	Ch. Int.	Con.	Trans ch.		
L 1911	LAS	Level, limestone storage	X	X	X	X	-		
L 1912	LAS	Level, clay storage	X	X	X	X	X		
L 2221	LAS	Level, limestone bin	X	X	X	X	X		
L 2223	LAS	Level, clay bin	X	X	X	X	X		
L 2225	LAS	Level, additives bin	X	X	X	X	X		
P 2231	PI	Draught in front of hammer mill	X	-	-	X	X		
P 2241	PI	Draught in front of raw mill	X	-	-	X	X		
P 2242	PI	Draught behind raw mill	X	-	-	X	X		
P 2252	PI	Draught behind hot gas producer	X	-	-	X	X		
P 2253	PI	Pressure into burner chamber	X	-	-	X	X		
P 2271	PIR	Differential pressure separat.	X	-	-	X	X		

Date: .....

Name: .....

LCC Hawari

List of measuring points for six-monthly maintenance cycle - line I

No.	Code	Marking	Kind of maintenance V.ch.	Cl.o.	Ch.int.	Con.	Therm	Remarks	Remarks of chief
T 1121	TAS	Bearing temperature, crusher	X	X	X	X	-		
T 1122	TAS	Bearing temperature, crusher	X	X	X	X	-		
T 2231	TIR	Temperature in front of hammer mill	X	X	-	X	X		
T 2233	TAS	Bearing temperature	X	X	X	X	-		
T 2241	TIR	Temperature in front of raw mill	X	X	-	X	X		
T 2242	TICRA	Temperature behind raw mill	X	X	X	X	-		
T 2243	TAS	Temperature, trunnion bearing	X	X	X	X	-		
T 2244	TAS	Temperature, gear bearing	X	X	X	X	-		
T 2245	TAS	Temperature, gear bearing	X	X	X	X	-		
T 2246	TAS	Temperature, gear oil	X	X	X	X	-		

Date: .....

Name: .....

LCC Hawari

List of measuring points for yearly maintenance cycle - line I

No.	Code	Marking	Kind of maintenance V,ch.	Cl.o.	Ch.int.	Con.	Remarks	Remarks of chief
E112.01/02	EICAS	Power of double shaft crusher, limestone	X	X	X	X		
S111.01	SI	Speed of bin discharge	X	X	X	X		
E132.01/02	EICAS	Power of double-shaft crusher, clay	X	X	X	X		
S131.01	SI	Corrugated plate feeder	X	X	X	X		
E223.01	EIAS	Active power, hammer mill	X	-	X	X		
E224.01	EI	Active power, main drive	X	-	-	X		
G225.03	GIH	Pillard flap for mixed air	X	X	-	X		
F 2251	FIR	Oil-volume supply, return run	X	X	-	X		
E227.03	EIR	Active power mill blower	X	X	-	X		
G227.06	GIH	Twist adjusting on air separator	X	X	-	X		
G227.07	GIH	Flap preheater, blower to crusher	X	X	-	X		

Date: .....

Name: .....

Annex III

OFFICIALS MET DURING MISSION

Libyan Cement Company

Mr. Ali M. El-Gheriani	General Manager
Mr. Mohamed El-Neihum	Deputy General Manager
Mr. Ali Fathi	Production Chief
Mr. Abdullatif	Electrical Department Chief
Mr. Izzedin	Electrical engineer
Mr. Saad El-Sherif	Electrical engineer
Mr. M. Berruin	Mechanical Department Chief
Mr. M. Amin	Mechanical engineer
Mr. S. Shaker	Production engineer
Mr. Cunnod	Consultant, PEG
Mr. Hamdani	Consultant, PEG
Mr. B. Wendt	Technical assistance, KHD (mech.)
Mr. U. Killmaier	Technical assistance, KHD (instr.)
Mr. Kaluse	Technical assistance, KHD (electr.)