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UNITED NATIONS INDUSTRIAL
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ASSISTANCE TO CONSOLIDATE THE BENGHAZI CEMENT FACTORY

TF/LIB/75/002

LIBYAN ARAB JAMAHIRIYA

Prepared for the Government of Libyan Arab Jamahiriya
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

-- JUN

Based on the work of Alfred Madsen, cement consultant

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Explanatory notes

The following abbreviations have been used in this report:

B and B	Bilfinger und Berger Bauaktiengeselschaft, Federal Republic of Germany
INDUMONT	KHD Industrieanlagen AG, Federal Republic of Germany
KHD	Kloeckner Humboldt Deutz, Industrieanlagen AG - Humboldt Wedag, Federal Republic of Germany
LCC	Libyan Cement Company, Benghazi
MINEL	Minel OOUR Termoelektromontaza, Yugoslavia
PEG	Projective Engineering Gestions, Switzerland
WEDAG	Westfalia Dinnendhal Groppel AG, Federal Republic of Germany

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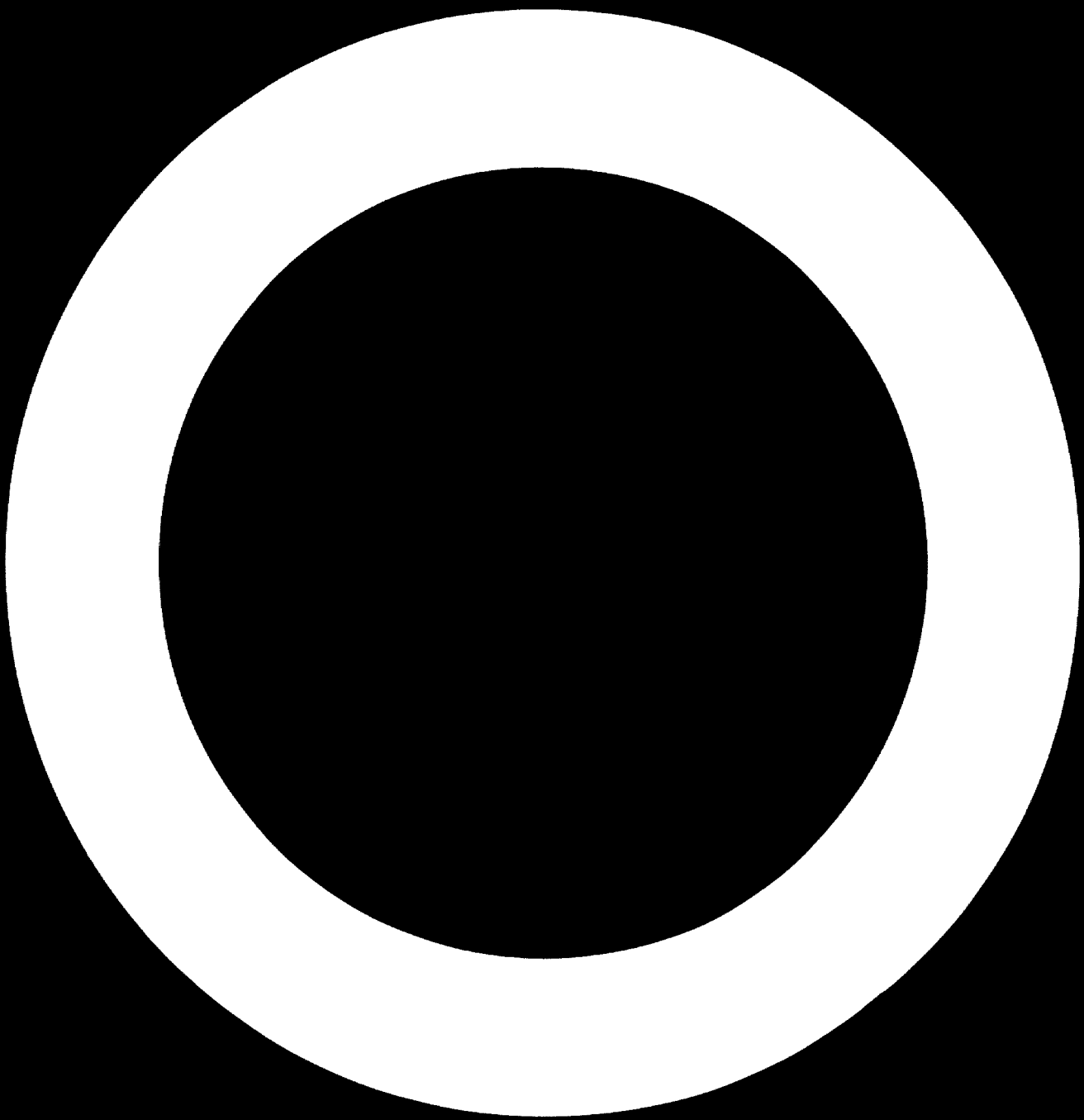


INTRODUCTION

The four-part project TF/LIB/75/002, "Assistance to consolidate and develop the Benghazi cement factory" has been operational since February 1976. It is being financed by the Government of the Libyan Arab Jamahiriya through a trust fund arrangement with the United Nations Industrial Development Organization (UNIDO). In the first part of the project, a building materials adviser made two missions, from February to April 1976 and from November 1976 to August 1977 (see UNIDO/IOD.37 and UNIDO/IOD.174). He has continued to work on the project as co-ordinator of activities.

The second part of the project comprises the services of a team of three maintenance experts, the third part that of a group of operational specialists and the fourth part that of a group of maintenance specialists.

The present report concerns work undertaken in the second part of the project. A sum of $108,000 was allocated for the recruitment of a mechanical engineer for maintenance planning, a mechanical engineer for cement machinery maintenance and an instrumentation electrical engineer. The work of the expert in maintenance planning was to be the basis for the work of the two specialists. When, however, the expert in mechanical maintenance joined the project for three months starting on 9 May 1978, the post of mechanical engineering for maintenance planning had not yet been filled. It was therefore necessary for the maintenance machanical engineer to take up the planning work specified for the other expert. (The job descriptions for both posts are given in annex I.)

Project background

A list of cement factories in the Libyan Arab Jamahiriya is given in annex II. In the past six years, since the start-up of the first cement rotary kiln in 1972, there has been rapid growth in the building materials industry in the Benghazi area. The cement plants in operation or being commissioned have a combined production capacity of 2 million tons per annum. The Benghazi plant has three production lines:

	Commissioned	Tons per annum	Nominal tons per day
I	Wedag, 1971	200 000	600
II	Wedag, 1974	400 000	1 200
III	Humboldt, 1977	400 000	1 200

The Hawari plant, which is next to the Benghazi plant, has two parallel lines, commissioned by Humboldt-Wedag in 1978, each with a capacity of 500,000 tons per annum (nominal capacity of 1,500 tons per day). The production lines in both plants use the dry process.

A lime plant is situated between the two cement plants, and next to them, outside the enclosure, are a concrete-block plant, a paper-bag plant and a ceramic-brick plant.

The Klöckner Humboldt Deutz (KHD) Industrieanlagen AG, Cologne, Federal Republic of Germany, is the supplier of the Hawari turnkey job. The subcontractor under KHD for the civil work is the company Bilfinger & Berger, also of the Federal Republic of Germany. The sister company of KHD, INDUMONT, has been doing the erection work, and the electrical installation has been carried out by the Yugoslav company Minel. The commissioning of the plant has been in progress since the beginning of May 1978, with Prospective Engineering Gestions (PEG) controlling the guarantee tests on behalf of the Libyan Cement Company (LCC).

KHD and PEG have experts on the spot for the commissioning of the Hawari plant, and five engineers from KHD will stay as advisers on mechanical, electrical and production matters for two years after provisional take-over of the machinery (expected 15 August 1978). A number of Libyan personnel have been engaged by LCC for the take-over of production and operation of the plant, but it is impossible for LCC to get all of the personnel needed.

UNIDO is assisting LCC in providing personnel for the running of the plant: mechanics, burners, millers, foremen, laboratory and control-panel personnel. Furthermore, LCC has, through KHD-INDUMONT, engaged a group of people from the Federal Republic of Germany to aid in the initial period of production.

Summary of activities

The expert introduced a card system for preventive maintenance, to consist of a machine card (history card), a period card and a job card. The cards were ready for printing in May. The system is described in the next section.

At the beginning of his stay the expert inspected all sections of the Hawari plant in order to familiarize himself with the equipment, and commented on several problems and questions raised by the counterpart. He attended several meetings between KHD, PEG and LCC and took part in the discussions when asked to comment on specific matters. Occasionally he gave lectures on such subjects as principles of kiln alignments (rotary drums) and preventive maintenance.

Together with the counterpart and the mechanical engineer from KHD, the expert worked out the specifications for the equipment needed for the workshop and for the personnel attached to the workshop and the maintenance group. The list of tools and equipment for the maintenance group has also been dealt with.

The expert was asked to advise on mechanical problems at the Benghazi plant and made a number of suggestions. He commented on the spare parts delivered in accordance with the contract with KHD and drew up a list of additional parts needed. He also had discussions regarding the 4 roto-packers in the packing plant.

Finally, he visited the site of the Derna cement plant project.

The specific on-the-spot comments and advice given by the expert relative to the Hawari and Benghazi plants are on file both in the field and at UNIDO.

A list of the persons met during the mission is given in annex III.

I. FINDINGS

Although the largest obstacle to the development of the cement industry is the lack of trained personnel, workshop conditions also present a problem. The Benghazi plant is next to the Hawari plant, and the idea has been that the Benghazi workshop should attend to the needs of the new Hawari plant, i.e. should be able to handle all five production lines. However, the workshop at the Benghazi plant already appears to be over-burdened, and furthermore it is located at the end of the Benghazi plant most removed from the Hawari plant.

Although the Hawari plant includes an adequate building for a workshop, appropriately located, little equipment has been supplied, apart from a big lathe, a drilling machine and some welding machines. The intention apparently has been to save money by using the Benghazi workshop for the maintenance crews for the Hawari installations. Nonetheless, a separate, routine maintenance shop and facilities should be established at the Hawari plant.

During the building of the plant and the installation of the equipment, each of the contractors, i.e. civil engineering (Bilfinger & Berger), erection (INDUMONT) and supplier (KHD), have had well-supplied workshops, which will be dismantled when the plant is taken over. The personnel from Poland and the UNIDO experts will therefore have almost no means of carrying out maintenance or repair activities.

Evaluation of projects

The expert found that no advice had been sought on tender documents or preliminary offers submitted for the setting up of various parts of the cement facility. Advice on technical matters such as layout, choice of appropriate machinery etc. before a contract was signed would have been useful. An outside opinion is particularly important in the case of turnkey arrangements, such as those entered into for the construction of the Benghazi and Hawari plants.

II. PREVENTIVE MAINTENANCE

A card system for preventive maintenance was worked out and the notations were made ready for printing on cardboard. The system is based on three cards with print on both sides. As these cards will have to be in Arabic and English, it was decided to print the Arabic on the front and English on the back and to make three extra cards - the reverse side - also with Arabic on the front and English on the back.

Thus a total of six cards will have to be printed.

These machine cards (history) cards must be available before preventive maintenance can be carried out. They will be used to set up the facility register which is basic to a preventive maintenance system (see annex IV). When the cards have been printed, they should be filled out with all the pertinent information. There should be a card for each machine, giving its history, the KHD instructions and experience relating to its use.

The system is supposed to function as follows:

Based on the information on the machine cards, the period cards are prepared by section planning offices; there should be one such card for each period of routine lubrication, changing of spare parts, adjustment, routine inspection etc.

For practical reasons the following index figures are used for activities to be attended to at specified times:

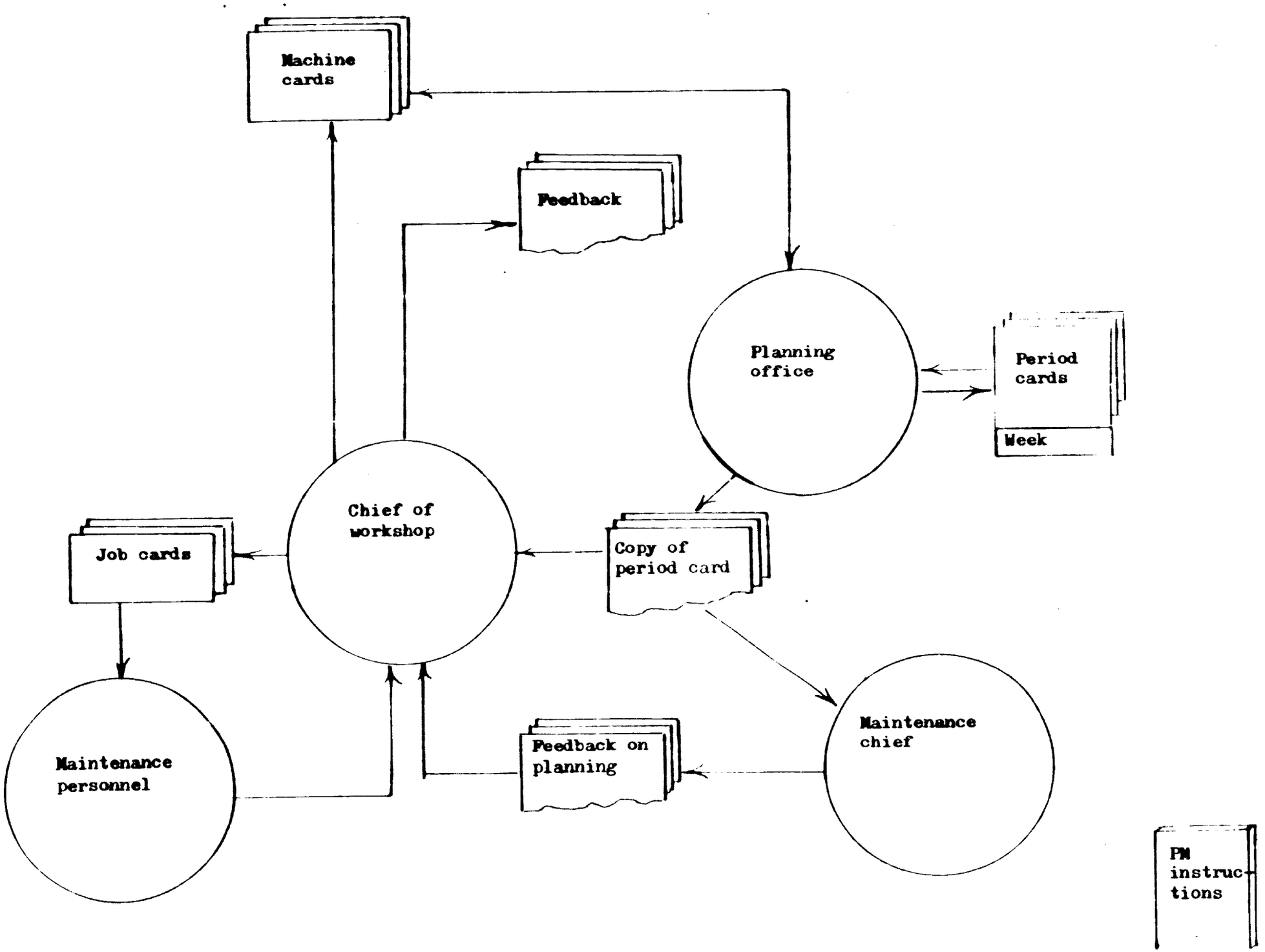
Week(s)	Index figure
Every 1	1
Every 2	2
Every 4 (1 month)	4
Every 8 (2 months)	8
Every 12 (3 months)	12
Every 24 (6 months)	24
Every 48 (1 year)	48
Every 72 (1½ years)	72
Every 96 (2 years)	96
Every 120 (2½ years)	120
Every 144 (3 years)	144

Forty-eight weeks is considered to be one year in order to shift the period from year to year by four weeks; the purpose is to avoid carrying out certain routine maintenance at the same season each year.

There are separate job cards for dealing with daily routine.

The figure below shows the preventive maintenance system at work. The planning office takes out the period cards for the week in question and makes photocopies for distribution to the workshop chief and maintenance chief, who make up the job cards for the machanics and workers (foremen). When the job has been done, a report is sent back to the planning office (feedback), which sees to it that the new information is entered on the machine card for future planning.

Annex IV gives information on setting up a facility register for preventive and general maintenance.


Machine cards
Feedback
Planning office
Period cards
Week
Chief of workshop
Job cards
Copy of period card
Maintenance personnel
Feedback on planning
Maintenance chief
PM instructions

III. RECOMMENDATIONS

The expert made recommendations regarding training, preventive maintenance and a clean-up of the plant.

Training

1. The expert discussed the establishment of a training centre for the cement industry, and suggested that assistance from international organizations might be sought in carrying out such a project.

Preventive maintenance

2. Groups of Libyan staff should be formed to assist the cement plant engineers in organizing facility registers. The groups should work closely with the staff of the cement plant, but they should not take part in the daily work of production and maintenance. In carrying out their duties, they would make use of information gathered from existing files, archives and other records and, to a great extent, of information supplied by the production staff from notes, personal technical records, files and memory.

The physical accoutrements of the planned preventive maintenance system - filing cabinets, hanging folders (charts) and stationery such as printed record cards and journals for listing drawings and instructions - should be on hand. After discussions with production and other interested staff, the basic code system should be laid down in order to ensure uniformity at the plant. After this centralized spadework had been accomplished, the work groups would be in a position to consolidate the information and to establish the facility registers.

Plant clean-up

3. As maintenance work always begins with a clean-up of plant premises, the expert recommends that a group of 50-100 persons, a chief and two or three foremen should be assigned to clean up the plant. This group should work completely independently of other plant activities such as production, workshop etc. It should be provided with equipment, such as trucks, front loaders, shovels and brooms. It should be responsible to the chief of production.

After the first, thorough cleaning, the group may be considered reduced.

Annex I

JOB DESCRIPTION
TF/LIB/75/002/11-03/32.1.A

Post title: Mechanical Engineer for Cement Machinery Maintenance

Duration: Twelve months; possibly in several short missions

Date required: As soon as possible

Duty station: Benghazi

Duties: The expert will be assigned to the Libyan Cement Company (LCC) and will assist the Cement Industry in the Benghazi area. Specifically, the expert will be expected to:

1. Supervise regular mechanical maintenance, occasional repairs and general overhauling.
2. Keep registers for recording details of maintenance and repairs for illustration of life history for machine parts and applied spares.
3. Establish periodic statements for maintenance requirements of materials and labour forces.
4. Follow up of greasing and oiling programme, revision of lubricants particulars, substitution reccoding to maintenance schedules.
5. Inspect mechanical behaviour of machinary and equipment, and adopt technological solutions for eventual anamolies.
6. Participate in implementation of modifications for amelioration of productivity and elimination of undesirable incidents.
7. Supervise new erection work complying with general plans and possibilities for future extensions.
8. Rationalize operation of workshop machines for best productivity.
9. Manufacture locally simple spare parts in the workshop of LCC or through local facilities.
10. Evaluate offers and analysis of tenders, with consideration in terms of technical and economic faotors.

11. Organize training programmes for mechanical maintenance personnel either by participation in training seminars or on-the-job training seminars.

12. Implement industrial security principles for personnel and machinery.

13. Report activities of mechanical maintenance and workshop, efficiency of personnel and propose amelioration measures.

14. Rationalize application of spare and maintenance materials, and establishment of economical principles through rational utilization on quality promotion.

The expert will also be expected to prepare a final report, setting out the findings of his mission and his recommendations to the Government on further action which might be taken.

Qualifications: University degree in mechanical engineering with extensive experience in the field of mechanical maintenance of cement marking machinery.

Language: English

Background information: The development of building materials industry started in Benghazi by installation of the cement works in Hamari which was put into operation in 1972, with 200,000 tons annual production capacity. Vast extensions have been realized that raise the production capacity up to 2 million tons per year. Furthermore, several building materials industries are being installed, for production of building lime, ceramic bricks, concrete blocks and cement products, in addition to production of paper bags for packing of cement and lime.

The rapid growth of industries in general and in particular the cement manufacturing area with its subsequent industrial extensions, has led to this request for technical assistance. It is expected that through such assistance appropriate cement industry personnel will be fully trained, enabling them to ensure the required daily production output.

JOB DESCRIPTION
TF/LIB/75/002/11-02/32.1.A

Post title: Mechanical Engineer for Maintenance Planning in the Cement Industry

Duration: Twelve months; possibly in several short missions

Date required: As soon as possible

Duty station: Benghazi

Duties: The expert will be assigned to the Libyan Cement Company and will assist the Cement Industry in the Benghazi area. The expert will work on the shift system and will specifically be expected to:

1. Study procedures of preventive maintenance and conclusion of systems capable of its rationalization.
2. Study records maintained for machinery and equipment, analysis of particulars recorded about life history of each part and average consumption of spares and maintenance material.
3. Study technical documents, drawings, suppliers instructions and establishment of security fundamentals for machinery and equipment.
4. Study procedures for oiling and greasing, revision of specifications for oils and greases and analysis of circumstances of operation and maintenance.
5. Apply these findings for planning preventive maintenance and its organization over time units.
6. Program oiling and greasing procedures, oil changes, tabulation of oils and greases with running hours.
7. Simplify reference numbers for greases and oils, unifying the distinguishing marks and specifications for rational application of local products.
8. Keep records for applied spare parts for conclusion of average consumption and analysis of anamolies in machine life.
9. Revise reference numbers and technical specifications of spare parts for simplification of nomenclature to comprehensive marking.
10. Stipulate basic substantials for spares and production materials in terms of minimum, maximum and ordering stocks.

11. Program systematic supplies of spares and production materials and establish follow up system for the whole cycle.

12. Inspect work sections for revision of execution, analyse occasional difficulties and propose suitable solutions.

Qualifications: University degree in mechanical engineering with extensive experience in planning for mechanical maintenance and organization of spare parts in cement industry.

Language: English

Background information: The development of building materials industry started in Benghazi by installation of the cement works in Hamari which was put into operation in 1972, with 200,000 tons annual production capacity. Vast extensions have been realized that raise the production capacity up to 2 million tons per year. Furthermore, several building materials industries are being installed, for production of building lime, ceramic bricks, concrete blocks and cement products, in addition to production of paper bags for packing of cement and lime.

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Annex II

CEMENT FACTORIES IN THE LIBYAN ARAB JAMAHIRIYA

Place	Kiln No.	Kiln size	Pre-heater	Cooler type	Tons/day	Start of date	Supplier	Remarks
Homs I	1	3,2 x 3,0 x 40 m	4-stage DOPOL	Recopol, 14 m^2 Travelling grate	330	JAN 69	Polysius-Krupp	Operation
	2	4,0 x 60 m	5-stage GEPOL	Satellite cooler 1,8 x 15, 8 x 8	1,000	AUG 74	Polysius-Krupp	Operation (partly)
Homs II (expected figures)	1	5,5 x 90 m	4-stage	Grate cooler	3,000	79		Project
Benghazi	1		4-stage	Grate cooler	600	72	Medag	Operation
	2		4-stage	Grate cooler	1,200	MAY 74	Medag	Operation
	3		4-stage	Grate cooler	1,200	NOV 76	Humboldt-Medag	Operation
Hawari I	1	4,4 x 60 m	4-stage	Grate cooler	1,500	JUN 78	Humboldt-Medag	Commissioning
	2	4,4 x 60 m	4-stage	Grate cooler	1,500	JUN 78	Humboldt-Medag	Commissioning
Hawari II	3	4,4 x 60 m	4-stage	Grate cooler	1,500			
	4	4,4 x 60 m	4-stage	Grate cooler	1,500			
Souk El Khamis	1	4,4 x 60 m	4-stage	Grate cooler	1,500	77	Humboldt-Medag	Operation
	2	4,4 x 60 m	4-stage	Grate cooler	1,500	77	Humboldt-Medag	Operation
Derna I	Project				1,500			
Derna II	Project				1,500			

Capacity in operation June 1978 approximately 3,500,000 t/year.

Expected capacity in the 1980's 6,500,000 t/year.

Annex III

LIST OF PERSONS MET DURING THE MISSION

Libyan Cement Company (LCC)

Ali M. El-Gheriani	General Manager
Ali Fathi	Head of Production Department
Ahmed Berruin	Head of Maintenance Department (counterpart)
Essam Shehadeh	Mechanical Engineer, Benghazi plant
Abubaker Saltani	Chief of Production, Benghazi I, II, and III
Mohammed Neihum	Deputy General Manager

Klöckner Humboldt Deutz (KHD) Industrieanlagen

W. Goergen	Resident Engineer
P. Korf	In-charge of commissioning

Bilfinger & Berger

H. Diederichs	Resident Engineer

Indumont

Mr. Barz	Resident Engineer

Prospective Engineering Gestions (PEG)

G. Keuntze	Resident Engineer
F. Podzorski	Project Engineer
A. Mortensen	Mechanical Engineer
R. Hamdani	Electrical Engineer

United Nations Development Programe (UNDP), Tripoli

I. Adly	Resident Representative
A.A.J. Udo	Assistant Resident Representative
G.G. Deeb	Administrative Officer
S.Y. Krekshi	Senior Administrative Assistant

Annex IV

SETTING UP OF A FACILITY REGISTER

The importance of maintenance is obvious, and much has been written on the subject.[a/] To be able to plan any preventive or general maintenance in a cement plant, the first step is always to compile a comprehensive facility register, that is, an inventory of the plant equipment and buildings that form part of the installations on which maintenance is to be carried out.

Drawings, instructions, lubrication charts, maintenance instructions etc. are an important part of the facility register, and consequently the filing of these documents should be correctly organized. Actual planning of preventive and general maintenance cannot be done until the registers are organized and have been in use for a reasonable time.

Compiling the register

The facility register is the heart of a preventive maintenance system. In some plants maintenance control is the sole purpose of the register; in others the cards provide varying degrees of financial information as well, so that the depreciation of the plant and additions to it may be recorded and a continuous record made of its standing value. The type of register chosen should be simple and flexible. It often consists of a single-drawer file cabinet that contains the whole system. It has been the expert's experience again and again that systems are introduced that prove to be too sophisticated to have any practical value.

Use of complex multidigital numbering or coding systems for the equipment, difficult to remember in everyday work and with a great chance that human errors will be made, should be avoided. Multidigital code numbers are often needed when a preventive maintenance system is based on the use of computerized data processing, but they should be avoided in simple and flexible systems. It is risky to make the system too rigid and to demand too much paperwork, control and double control, cards and copies from good foremen, mechanics and maintenance personnel who have plenty of other work to do and sometimes have problems in writing and reading. Planning necessitates paperwork, but the paperwork has to be organized properly.

[a/] See, in particular, Introduction to Maintenance Planning in Manufacturing Establishments (United Nations publication, Sales No. 75.II.B.6).

A facility register should first of all have a card for each machine giving all the information needed about the equipment or unit. The type of information placed on these cards will depend on the requirements of the system adopted for the particular plant.

There is a difference between organizing a register for a new plant and organizing one for a plant that has been running for several years. For a new plant, the information going into the files should be drawn from the information and experience, including that regarding the need for spare parts, lubrication etc., that the supplier of the equipment passes on to the customer. The establishment of a new plant in fact provides a rare opportunity to design and introduce an appropriate maintenance system. For a plant already in operation, the information comes from existing files and often from the memory of the personnel. In this case it is much more difficult to set up a register, and the chance of making mistakes and of including misleading information is greater.

A facility register should contain all information pertinent to the unit in question, including:

(a) Name of supplier, serial number and other details of the unit, a written description of the item and details of ancillary equipment, and the names of suppliers for reference purposes;

(b) Spare parts recommended, existing spare parts and where they are to be found;

(c) Complete history of the unit from construction and erection, with detailed history of repairs carried out, reasons for and date of repairs;

(d) The location of supplier's instructions, pamphlets, drawings etc.;

(e) Existing stock of spare parts, information on minimum stock of spare parts, either according to supplier's experience or according to experience acquired during the time the unit or machine has been in operation.

Schedules then have to be prepared, listing the routine maintenance requirements of each item shown in the register.

A facility register should be simple and appropriate to the circumstances of the country in which it is organized. It should also take into account costs.

Suggestions for a filing system

Each machine would be assigned a number, independent of any serial or other number given by the supplier. The number should be simple and short to

lessen the chance of error. The first one or two digits should indicate the section inside the plant (see schedule at end of this annex) and the digits following should be numbers in sequence, without any special consideration of material flow, location and the like.

In principle, each machine would have one hanging file chart, marked with the machine's identification number and containing information about the machine. If one chart is insufficient, to note all the information, two or more may be added; they should have the same machine number with the addition of a prefix such as A, B, C or I, II, III. The carts should also contain any sketches or other records made by the staff during the lifetime of the machine or unit, thereby giving a complete history of the machine or unit for use when preventive maintenance is implemented.

All drawings received from suppliers of equipment (construction drawings, infrastructural drawings) should be filed together. They should be folded to DIN A-4 size (21 x 29.5 cm) and given numbers in simple sequence. A drawing from KHD showing some element of the kiln has a KHD number and now receives a plant number (Benghazi or Hawari), for instance B.II 4 (kiln section) 632 (if 632 happens to be the next free number). A card size DIN A-6 or similar will have the Benghazi number B.II 4-632 in one upper corner and the KHD number in the other upper corner, and the rest of the card space will give the title of the drawing and any changes or remarks concerning it, such as date of receipt and location of the drawing if someone has taken it out of the file (name of person and date removed).

In a registration book labelled "KHD drawings", the KHD drawings should be registered by their Benghazi I plant number. The next drawing coming in may be, for example, of a Pfister raw-mill feeder in use at the Hawari I plant. This drawing would receive the Hawari I number C-3-633 and be filed next to number 632 (the KHD); a card for the drawing is made up and registered in the registration book under Pfister drawings. Irrespective of the kind of drawing, whether of machinery, assembly, layout, concrete foundation or building construction, the drawings should be filed in this way and given plant numbers in succession.

Original drawings, made in the plant drafting room, should receive the next free number in the sequence; a copy should be made, folded to size DIN A-4 and filed, and the original kept in a flat drawer in another building to diminish the fire hazard and risk of loss. All spare-parts lists,

maintenance instructions and directions for using the equipment have a number given by the supplier. Such instructions or lists should be given a plant number in the same sequence as the drawings. They should be registered on an A-6 card by suppliers number and plant number. A Pfister feeder direction book, for example, may have number H.II (Hawari II) 3 (raw mill) 634, but it will be filed for practical reasons in a separate drawer from the drawings. Consequently, in the drawers containing the drawings some number will be missing because they are being used to identify items kept in other filing cabinets. (Short instructions may be noted on the cart of the particular machine or unit.)

Summary

Each machine or unit has a simple number irrespective of its place in the production line or location within the plant. Each drawing, regardless of its origin, has a plant number. These numbers are consecutive inside the plant; they do not change from section to section. For each drawing there is a card giving the history of the drawing (instruction, direction, charts etc.). A registration book serves as a link between the number of origin and the plant number.

After the facility registers have been functioning according to the accepted methodology for some years, the information they contain can be used to plan preventive maintenance. Repairs and replacement of spare parts and general maintenance will have to be planned in order to avoid accidents or breakdowns, which may cause downtime, not only of one machine but also, depending on the machine, of other machines and whole sections. When a unit has to be repaired, plans should be made to carry out maintenance on related equipment at the same time.

Suggested code numbers for sections of cement plants

Sections may be numbered in accordance with existing code numbers at the plants, but the goal should be to achieve uniformity from plant to plant. The following code is suggested:

0	Buildings, roads, railway sidings etc. (infrastructure)
1	Quarry and precrushing
2	Secondary crushing and storage
3	Preparation of raw mix[a]
4	Kiln section[b]
5	Clinker storage and handling
6	Grinding of clinker to cement[c]
7	Cement storage and handling dispatch
8	Power plant or substations, electric motors[d]
9	Workshop
10	Spare parts and stores
11	Laboratory
12	Water supply

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[a] "Raw mix" signifies the material going to the kiln section for producing clinker, i.e. either raw slurry or raw meal. This indicator includes homogenization.

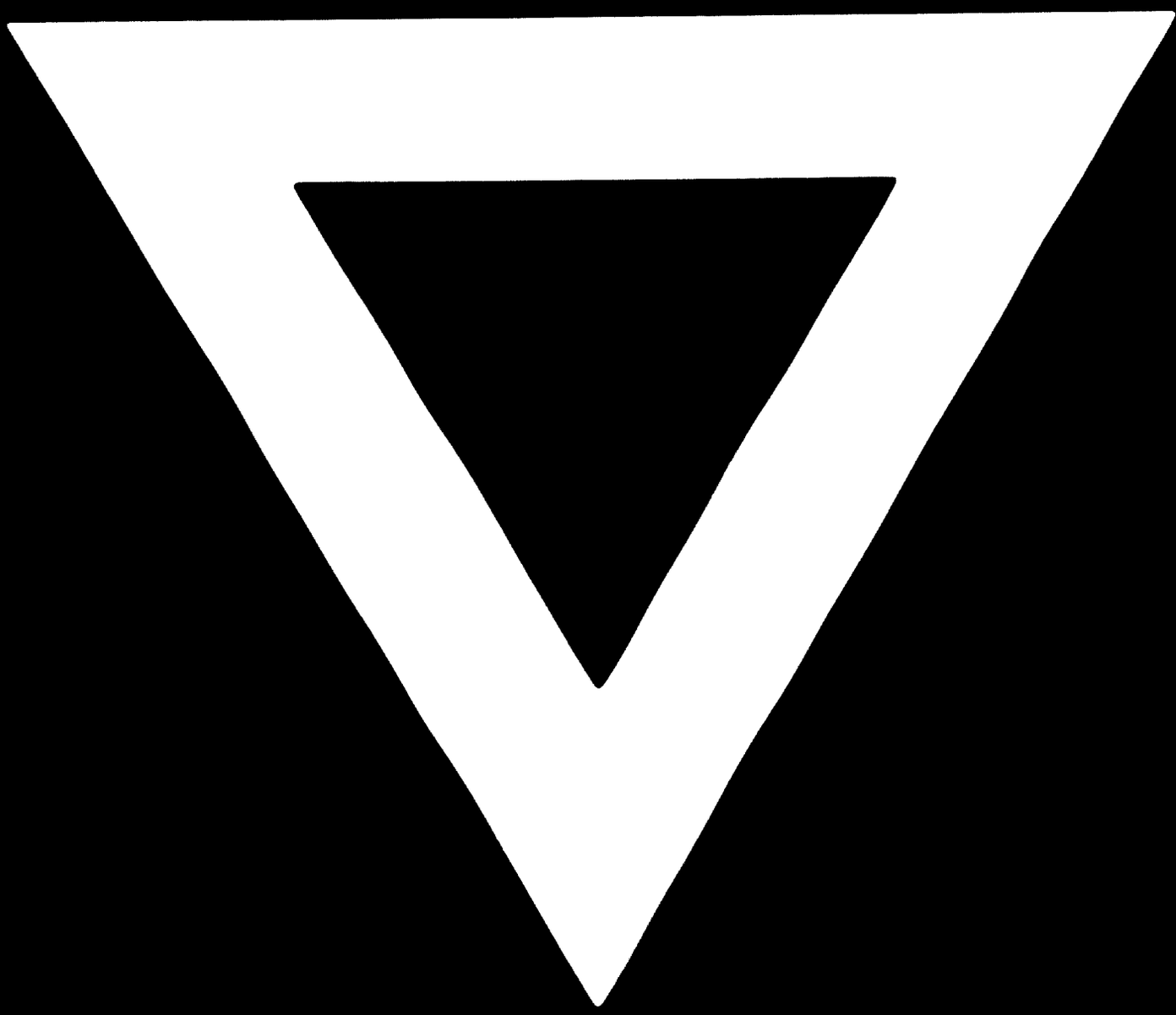
[b] "Kiln section" includes possible pelletizing, lepol-grates, pre-drying (heating) system (cyclones), calcinators etc. and finish with outlet of clinker cooler and crushing.

[c] Includes clinker transport to storage, transport of clinker to cement mill, storage and handling of gypsum.

[d] Necessary when the motors do not form an integral part of the machine.

BENGHAZI I AND II

01	Limestone quarry equipment
02	Clay quarry equipment
03	Raw material equipment
04	Limestone crushing section
05	Clay crushing section
06	Raw material transport to storage
07	Raw material grinding plant
08 A	Raw meal transport pneumatic
08 B	Raw meal mixing silo
08 C	Raw meal mixing transport to pre-heater
09 A	2 pre-heaters
09 B	Bypass - chamber
09 C	Rotary kiln plant
09 D	Clinker cooler
10	Oil firing
11	Clinker transport
12	
13	Cement grinding plant
14 A	Cement transport system
14 B	Cement silo station
14 C	Loading equipment for bulk cement
14 D	Bagging and loading station
15	Water supply system
16	
17	Laboratory equipment
17.2	Workshop equipment
17.5	Fire fighting equipment
17.6	Auxiliary equipment limestone and clay quarries
17.7	Miscellaneous
17.9	Additional material and equipment
17.10	First aid station



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