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

15183

Distr.
RESTRICTED

UNIDO/IO/R. 211
22 October 1985

ENGLISH

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ASSISTANCE TO THE SOUK EL KHAMIS CEMENT PLANT

SF/LIB/83/002

LIBYAN ARAB JAMAHIRIYA

Libya.

Technical report: Assistance to the Zliten Cement Compeny

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

Based on the work of Boguslaw J. Walczenko,
process instrumentation engineer

V.85-32376
2589T

Explanatory note

The monetary unit in the Libyan Arab Jamahiriya is the dinar (LD).

Reference to tonnes (t) is to metric tonnes.

In addition to the common abbreviations, symbols and terms, the following have been used in this report:

DWC Daewoo Corporation, Republic of Korea (the operation contractor)

FTO Final take-over

kA kilo Ampere

KHI Kawasaki Heavy Industries Ltd., Japan (the contractor)

kV kilo Volt

PTO Provisional take-over

ZCP Zliten Cement Plant

Mention of the names of firms and commercial products does not imply endorsement by the United Nations Industrial Development Organization (UNIDO).

ABSTRACT

Under the project "Assistance to the Souk el Khamis Cement Plant" (SF/LIB/83/002), for which the United Nations Industrial Development Organization (UNIDO) is the executing agency, a process instrumentation engineer was assigned to assist the Zliten Cement Company for a period of six months, which was subsequently extended to nine months. The present report covers the third period of three months of the consultant's split mission.

The original purpose of the consultant's mission was to design and implement a maintenance system for the electrical, process control and instrumentation equipment. On the request of the Execution Committee for the Zliten Cement Project his prime duty became the follow-up of the project and technical advising.

The expert continued to check the completion of outstanding items; prepared and checked the documentation for, and co-ordinated the sessions of, the meeting to review the two-year consumption of spare parts and the final take-over (FTO) meeting; assisted local engineers in the inspection of troubled machinery and continued to clear all technical information submitted by KHI and DWC as well as to co-ordinate the weekly technical meetings; revised the observation procedures for outstanding items enumerated in the minutes of the FTO meeting; evaluated the bids for the conversion to a gas-fired system; and prepared inquiries for a range of spare parts required for the future operation of the plant. The expert also assisted in the preparation of the project document for SF/LIB/85/001, which has been signed by the competent authorities and an application for a letter of credit submitted to the bank.

In his recommendations he makes detailed proposals of how to ensure that all equipment which either remains under observation, or for which the guarantee period has been extended, will be properly monitored and checked before it will be taken over.

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INTRODUCTION

This report covers the third period of three months (19 May to 18 August 1985) of the consultant's split mission under the project "Assistance to the Souk el Khamis Cement Plant" (SF/LIB/83/002) for which the United Nations Industrial Development Organization (UNIDO) is the executing agency. As explained in a previous report (UNIDO/IO/R.154), the consultant was originally assigned to establish a system of maintenance for electrical and instrumentation equipment in the newly-commissioned Zliten Cement Plant. However, since the situation existing in the plant called for an expert to deal with the follow-up of the project during the period after the provisional taking over, he was requested by the Project Execution Committee to change the priorities of his assignment and to take care of the technical problems existing or arising in the plant during the guarantee period. His primary duty has therefore changed to technical advising and co-ordination.

In the course of the third mission two more engineers completed their training at Cement Lafarge, Canada and resumed their duties as chief of production department and chief of mechanical department. Unfortunately two other engineers, the chief of laboratory and the chief of the electrical department, who had also been trained overseas, left the plant because they were elected to the Zliten municipality.

Generally the discipline of staff had improved. Local engineers and technicians showed much more interest in their duties. As weekly technical meetings continued, local engineers became more involved and active in the discussions of technical problems. Though they are very ambitious and some of them well-trained, the lack of experience is still evident. Therefore technical support through advisers or consultants will be necessary for a certain transitional period. This is the first large-scale industrial project in the Zliten region, and all engineers and technicians are from that area.

The number of technical assistants of the contractor (KHI) was reduced to five essential positions for the second year after provisional take-over (PTO), as it was recommended in the previous report. Those technical assistants were requested to share offices with their local counterparts instead of working in the central KHI offices. This measure should facilitate the transfer of know-how and experience on a person-to-person basis.

In spite of various troubles within the plant, such as corrosion of the pipes for industrial cooling water and drinking water, the malfunctioning of the water treatment plant, vibration in the kiln fan, pitting of reducers etc., the plant as such never had to be shut down due to technical problems and achieved a production level of 75 per cent of its capacity. The plant shipped daily an average of more than 3,000 tonnes of cement, and was only shut down every three months, when the cement silos were full, for periodical maintenance.

Recently due to a shortage of paper bags in the whole country, shipments decreased to 1,000 tonnes per day, which were dispatched by bulk carriers. This fact indicated that on the market there is more interest for bagged cement than it was assumed in one of the expert's previous reports.

During the third mission of the expert, i.e. 12 months after provisional take-over, the final take-over of the plant took place. The continuity in following-up all technical and contractual problems by the expert during the year of guarantee has certainly contributed to the success in the final negotiations between ZCP and KHI.

RECOMMENDATIONS

1. Since it was agreed in the FTO meeting that a large number of equipment has to remain under observation (for 3 to 12 months) before it can be taken over, whilst for other items the guarantee period has been extended, it is essential that those items are monitored and checked in a professional and reliable manner. Therefore a team of well-qualified advisers or experts of a consulting company should be engaged by UNIDO (under a new project) to ensure a satisfactory completion of all outstanding items.

2. The forms (log-sheets) which the expert has prepared for the observation of outstanding items should be regularly filled in by all specialists concerned and submitted to the ZCP engineers on a weekly or monthly basis for evaluation.

3. One of the most important and valuable outstanding items is the water treatment plant and the water distribution network. The detailed proposal covering the types of pipes to be used, their protection and the layout of the network, which will be submitted to ZCP for approval, should be checked by experienced engineers to avoid future corrosion problems. Under no circumstances should welded pipes be approved. Only seamless, galvanized pipes should be used for water networks.

4. The specifications for, and installation of, the new set of gears and pinions of the kiln reducer should be checked by a mechanical engineer or a consultant.

5. Recently, shortly after the expiration of the guarantee, the disk memory of the monitoring computer was mechanically damaged. Though KHI will repair it free of charge, it is necessary to establish the cause of trouble. One of the suspicions is that the damage was caused by vibrations which occur in all ZCP buildings during the blasting of raw material in the quarry. A technical assistant of Siemens should investigate the matter and take the necessary steps to prevent damage of the equipment in the future.

6. Since proper technical documentation is considered vital for maintenance, trouble-shooting, the ordering of spares and hence a smooth operation of the plant, it should be checked carefully by the technical assistants or by advisers from UNIDO before it is taken over.

7. High consideration should be given to training on the programmable logic controller (PLC) system. Since the Siemens specialist will continue giving courses only for two more months (total three months), as much information as possible should be gathered on the maintenance and repair of that system, which is vital for the operation of the plant.

8. With regard to the conversion of the oil-burning system to natural gas, the contract should be signed as soon as possible, because the validity of some offers will expire soon and prices can be increased when the offers are renegotiated.

9. The extended use of the existing computer system for administrative purposes should be investigated, as many foreign accountants will soon leave the country and could be replaced that way.

10. Orders for mechanical and electrical spare parts should be finalized and dispatched as soon as possible.

11. The expert would like to repeat and emphasize the following recommendations made in his previous reports:

(a) To derive maximum benefit from the technical assistance contract, the main task of the technical assistants should be to guide and advise their local counterparts. They should concentrate on activities that have a long-lasting effect, such as the establishment of maintenance plans and an appropriate filing system, and not simply issue instructions once a specific trouble has already occurred;

(b) The printing of the cards for the maintenance system should be expedited and they should be properly filled in by the technical assistants;

(c) Certain forms which were introduced by the expert (job request, job report and permission to work) should be submitted to ZCP engineers for approval before any job is carried out by the specialists of the operation contractor;

(d) To ensure an uninterrupted operation of the packaging plant, a stock of 10 million paper bags should be kept. As supplies from the local manufacturer of paper bags are not steady, additional bags should be bought from overseas through a company based at Homs and which is willing to accept payment in Libyan dinars or cement.

I. REVIEW OF SPARE PARTS

As mentioned in a previous report (UNIDO/IO/R.193), the meeting to evaluate the two-years spare parts consumption had been postponed in order to permit the preparation of more accurate consumption data and to carry out an inventory in the storehouse. It was finally held on 1 June 1985 with the following result:

While originally a nine-month period after PTO was agreed to be the basis of the assessment, this was extended to 12 months after PTO, due to the fact that the evaluation had been delayed by two months. This also simplified the pro-rate calculation.

ZCP stressed the fact that occasionally KHI had delivered various kinds of spares directly to the plant, thus bypassing the store control system. To achieve a proper evaluation of the consumption of all spares, whether two-years' spares, commissioning spares or additional parts it was requested that they all be recorded by ZCP's store.

Furthermore, it was not possible at the time of the meeting to establish true consumption figures for items or units which were out of order during the guarantee period. Therefore, those items will be evaluated separately after the expiration of their guarantee period.

Lists of consumed spare parts were prepared by KHI, DWC and ZCP, and KHI was requested to check the discrepancies between the three lists, to make the necessary corrections and to elaborate a second revision of the spare parts list before 10 July 1985. The evaluation meeting had been scheduled for 10 July.

In some areas, e.g. in the refractory bricks store, it was impossible to carry out an inventory due to poor arrangement of the items. ZCP therefore requested KHI to rectify the situation prior to inventory.

Separate meetings were held to discuss, item by item, spare parts of which quantities beyond normal wear and tear had been consumed because defective equipment had been repaired. To prove that the high consumption of spares ceased after repair or modification of the equipment, actual consumption figures over 12 months were shown.

Spare parts such as grinding media, mill liners and refractory were evaluated on the basis of the wearing ratio indicated in the contract.

Since KHI was not able to finalize the revised spare parts list before the day of the meeting, the meeting was, on the request of ZCP, postponed to give them enough time to check the submitted documents. The documents contained a large number of errors and omissions and it was necessary for the expert to study them carefully. Finally an agreement was reached and KHI was required to submit the final version of the spare parts list at the FTO meeting.

II. PREPARATORY WORK FOR THE FINAL TAKE-OVER MEETING

Prior to the meeting it was necessary to check the completion of all major and minor outstanding items. If the result of the modification, replacement or observation was satisfactory, a certificate of completion was issued.

However, as it was difficult to make a professional judgement on some outstanding items, which were either left after PTO or had arisen during the guarantee period, such as:

- Pitting/wear of various reducers
- Settlement of cement silos
- Limestone/clay reclaimer rail settlements
- Vibration of kiln fan,

it was suggested to appoint independent experts to check those items. Two engineers of WYP, the previous consultant for erection, were assigned for one month for that purpose. They studied each item carefully, prepared their expertise and recommendations for the final taking over and discussed with ZCP engineers and the expert the seriousness of those problems and their effects on the expected life of the plant.

The civil works (buildings and roads) were checked by a civil engineer of SHI Tripoli, while all other outstanding items were taken care of by the expert himself.

The reports of all those experts were discussed during internal meetings of ZCP engineers and the expert.

That excellent preparation of all documents required for FTO allowed ZCP to elaborate a good strategy for the FTO meetings with the KHI management and engineers, and consequently to achieve optimal results and solutions for the future operation of the plant.

As mentioned in previous reports, the water treatment plant and the water network were persistently causing problems (especially the reverse osmosis units and the corrosion of all pipes throughout the plant) and KHI was requested to submit a comprehensive proposal for a complete solution of that problem. However, the necessary documents were not available in time for the FTO meeting, which had to be postponed to 22 July 1985.

III. FINAL TAKE-OVER MEETING

The agenda of the meeting covered the following items:

1. Obligations of KHI after PTO
   - (a) Major outstanding items
   - (b) Minor outstanding items
   - (c) New outstanding items
   - (d) Documentation
   - (e) Civil works
2. Spare parts
3. Guarantee
4. Other business
5. Final take-over certificate

All matters of technical nature were discussed and agreed upon during five sessions held between 22 July and 1 August 1985. The draft minutes of all sessions were studied and corrected by both parties on 5 August 1985.

When the meetings, after two sessions, faced a deadlock, it was necessary for ZCP to remind KHI of their contractual obligations. ZCP then made it clear that the terms of the contract were binding, and that, if only part of the minutes could be misinterpreted or were at variance to the contract, the contract will take precedence.

Because the contractor had intended to delay the meetings and some documents promised by KHI were not ready, ZCP was forced to state that unless the discussions, the presentation of the documentation and the signature of the agreed minutes of the FTO meeting were completed by 1 August 1985, ZCP will postpone discussions and the FTO agreement for the plant by one year. After that statement had been made, the meeting gathered momentum and the contractor began to co-operate.

A. Major outstanding items

Concerning the major outstanding items, from PTO and new ones, the following were not accepted or accepted conditionally.

Code No. 1 - 2: limestone hopper

ZCP required observation for further nine months, starting July 1985, at 80 per cent of the filling level.

Code No. 1 - 4: homo silo (settlement)

ZCP is ready to take over this item on condition that:

(a) Penetration of water to the foundation is prevented;

(b) A slope is provided away from the silos to allow drainage of water;

(c) Vehicles are prohibited from entering the foundation area along the restricted road.

Code No. 1 - 5: kiln (vibration)

KHI has in the past done the following to solve the vibration problem of the kiln:

(a) Installation of a scraper for cleaning purposes;

(b) Installation of oil-lubricated bearings and pedestals;

(c) Dynamic balancing of the fan impeller and shaft;

(d) Experimental insertion of rubber spacers into spring-type coupling;

(e) Replacement of coupling by a "KE" type;

(f) Pneumatic hammer (multi-needle type) provided for rapid cleaning.

Those modifications are satisfactory from a mechanical viewpoint, however, it is unacceptable from a plant-operation aspect for the kiln to be shut down every four to five weeks to remove the coating from the fan.

ZCP's objective is to achieve an uninterrupted kiln operation of at least three months. Therefore ZCP requested an observation period of three months, with the coarser meal, to make sure that there is no adverse effect on the plant output. In addition, the frequency of kiln shut-downs for fan cleaning shall be monitored.

Code No. 1 - 6: kiln girth gear

The consultants found that minor pitting occurred on the tooth surface. The expert recommended to take a tape print of the tooth surface during the next kiln shutdown and another print six months later, for comparison. Therefore an observation period of six months is required.

Code No. 1 - 8: gypsum hopper

The KHI proposal to install vibrators of larger capacity and hitting plates was accepted by ZCP.

Code No. 1 - 9: cement silo (settlement)

Will be taken over on the same conditions as the homo silo (code No. 1 - 4).

Code No. 1 - 12: blending control computer system

ZCP requested that the whole blending control system composed of blending computer, X-ray analyser, sampling stations, pneumatic transport of samples, automatic preparation of samples and automatic correction of weigh-feeders be observed for further 12 months, because components of the system were out of order for a long time.

As a compromise it was agreed that the guarantee for the X-ray analyser will be extended only for the period during which this equipment was out of

order. The X-ray analyser can be used efficiently for manual operation, even if other components of this sophisticated blending control loop are out of order.

Code No. 3 - 1: gas analyser

As mentioned in the expert's earlier report, the gas analyser at the discharge side of the kiln fan was functioning properly and was accepted by ZCP. However, further 12 months of observation of the analyser at the kiln inlet were requested, as it was put into operation only in May 1985, after KHI had installed a new type of gas probe.

New item 1: cement mill reducer

The WYP consultant confirmed severe pitting on the gear of reducer No. 1, which had previously been reported by the expert. Furthermore, minor pitting was found on the gear of reducer No. 2.

ZCP requested to put the reducers under further observation for a period of 12 months. The expert recommended to monitor the pitting by taking tape prints.

New item 12: kiln reducer

KHI had modified this reducer in June (turned the gear and installed a new pinion). However, the same minor pitting occurred again after only three weeks of operation. ZCP requested therefore that the complete set of gears be replaced by one of higher quality and harder material (ground to JIS1 instead of hobbed to JIS3). That quality should be certified by the manufacturer or even checked by an engineer or consultant at the manufacturer's place.

The taking of print-outs of the teeth of the reducers should be witnessed by engineers of ZCP and DWC. It should be pointed out that reducers must have a sufficient wear allowance to last for the projected 20-year life of the plant and not only for the guarantee period.

New item 13: limestone/clay crusher reducers

Since minor pitting had been noticed, an observation period of three months was agreed, followed by tape comparison.

New item 14: raw mill reducer

A scoring/surface roughness was found, and consequently further observation over nine months was agreed upon, during which time KHI will carry out periodical inspection.

Water treatment plant and distribution system

KHI eventually submitted a proposal which was discussed and the following was agreed:

(a) Water pipes from wells: the pipes from well 1 and 2 to the water treatment plant are to be replaced by synthetic ones;

(b) Water treatment plant: KHI will supply new membranes for both lines of the reverse osmosis units. The control system and equipment for the dosing of the sulphuric acid will be modified. Corrosion and coating inhibitors will

be installed and a procedure for the monitoring of the concentration of inhibitors established;

(c) Water distribution system: KHI agreed to replace the entire pipe network for industrial water by pipes of better quality. The detailed proposals, including specifications for pipes and other material, layout of the pipe network and methods of installation are subject to prior approval by ZCP.

(d) Guarantee for the entire water system: After long negotiations, the following guarantee periods were agreed:

(i) For the water pipelines from both wells, one year from the date of completion of erection and acceptance by ZCP;

(ii) For the water-treatment plant, one year, excluding such items which are not affected by water;

(iii) For the cooling and drinking-water networks, one year from the date of completion of erection and acceptance by ZCP.

B. Minor outstanding items

Those items were discussed item by item and generally accepted, subject to extended guarantee or delivery of additional material.

C. Documentation

The documentation was still not ready for comprehensive checks. ZCP made it clear that it was impossible to invite a third party to improve or complete the documentation, as it had been done in the case of other outstanding items, and that they have to rely on the co-operation of KHI in that respect. ZCP stated that the revisions and additions to the documentation already listed do not, in any way, preclude the additional work required to bring the documentation to a satisfactory standard for the operation and maintenance of the plant.

D. Civil works

A list of deficiencies in the civil works was submitted to KHI on 25 July 1985. KHI agreed to rectify those deficiencies which they considered their responsibility, and shall submit detailed proposals for the approval by ZCP.

It was agreed that the factory access road would be considered separately and not as part of the FTO agreement.

E. Spare parts

KHI submitted a revised list of the two-years spare parts consumption which had been the subject of separate meetings (see chapter I). The list still contained errors and omissions which were reflected in the minutes of the FTO meeting, and KHI agreed to provide an updated spare parts list, incorporating all amendments and revisions.

ZCP pointed out that the review of spare parts does not cover items which are under extended guarantee or observation. A review of those items will take place at the end of the respective guarantee or observation periods.

KHI confirmed that they will deliver all spare parts which have not yet been delivered but were referred to in the spare parts list, and those parts which were not found during the last inventory control.

F. Guarantee

Machinery and equipment which was put under observation for a further period is automatically subject to extended guarantee.

Items which were subject to a one-year guarantee after PTO, but had to be replaced or modified, will be covered by a one-year guarantee from the date of replacement, unless otherwise agreed.

KHI had been requested to submit a list of the items concerned, and the expert compared it with available records on troubles which occurred during one year.

During the FTO meeting the KHI list was discussed and variations, deletions and additions were agreed. KHI re-submitted the corrected list which is given in the annex.

G. Guarantee deposit

KHI submitted an itemized list of the amounts to be withheld until completion. Their figures were based on 10 per cent of the contract value.

The expert had prepared a similar list, but his figures were based on what it would cost ZCP if the completion of all outstanding items were carried out by another contractor. The difference between the KHI proposal and the ZCP list was more than three million LD.

As a compromise ZCP proposed to reduce the total amount to be withheld on condition that the outstanding items be divided into three groups (essential, non-essential and spares) and that the essential items always be covered by more than the individual price, until the last item will be completed, while non-essential items will be covered collectively until the last item will be settled. The bond for spare parts will be released as soon as they will have been received in ZCP's store.

The KHI site management was not in a position to take a decision without the consent from their headquarters in Japan. Therefore the meeting was adjourned and the certificate for conditional final take-over was not signed.

It is advisable that ZCP always keeps as deposit an amount large enough to cover all necessary expenses ZCP would incur, should KHI abandon their contractual obligations.

The collective bond for minor items is essential, because it will put the contractor under pressure to finalize all items.

IV. CONVERSION TO GAS-FIRED SYSTEM

The expert had been requested to follow up the tender procedure for the conversion of the existing oil-burning system to a system using natural gas.

By July 1985 a total of six quotations had been received, some of which had been re-submitted after modification following the receipt of more accurate data on the existing reducing station.

The expert studied them and clarified certain aspects by telex. Engineers of the bidding companies visited the plant to gather additional information about existing equipment, facilities and layout in order to prepare suitable offers. Several meetings were held concerning the conversion, and some reductions in prices were achieved once the scope of the bids had been made uniform and the conditions of the conversion confirmed.

Two of the offers were no turn-key projects and therefore excluded from further consideration. From the remaining four offers one was deleted because the price quoted was considerably higher than that of the other three, and the company had no previous experience in cement industries.

The three offers left were studied very carefully, some technical points clarified by telex or by meetings with representatives of the respective companies, which shall be called A, B and C.

Offer of company A

The share of the payment to be effected in foreign currency is rather high. The burning system will be bought from a well-known manufacturer of this type of equipment. All necessary electrical changes will be done by the staff of the company.

Since the overall control system is based on the Siemens-made programmable logic controler, and all other electrical equipment and instrumentation is also provided by Siemens, problems of compatibility with existing installations are foreseeable which could result in extended shut-downs of the kiln and cause additional production losses.

Furthermore, it would seem that the necessary adaptation of PLC programs and documentation would be a very difficult task for any other engineer but from Siemens.

Offer of company B

The price is favourable, but it was quoted as preliminary only. The company reserves the right to revise the offer, as it was based only on assumptions. Although that bid was submitted last, it still needs a lot of technical clarification. Besides, this company has not much experience in cement but rather in boiler systems. Furthermore all payments are requested in foreign currency.

Offer of company C

That offer is the best from the technical viewpoint, and only second in price. The company is a well-known manufacturer of burning systems for cement industries. It offers Siemens as a subcontractor for all electrical work and Mannesmann, who is a contractor for the coastal gas pipeline and related reducing systems, as a subcontractor for the erection. The experience and

expertise of both subcontractors would contribute much to the success of this project. Siemens' engineers would modify the control system, prepare a new program for the interlocking system and correct the documentation. Erection and commissioning of the gas-burning system could be substantially shortened.

The cement plants at Benghazi, Souk-el Khamis and Lebda are already equipped with burners from that manufacturer.

As a very experienced supplier of cement industries all over the world, company C agreed to guarantee not only the erection works and equipment, but also the capacity of the kiln.

Taking into consideration all above mentioned factors such as price, quality of equipment, references, subcontractors' reputation, compatibility with existing equipment, spare parts and post-erection service, the expert recommended to choose company C.

V. COMPUTER APPLICATION IN ADMINISTRATION

The Zliten Cement Plant has two Siemens system 300 computers installed for:

(a) Process monitoring and

(b) Blending.

The first one is used close to the limit of its capacity. The second one, which has the same capacity, is used only partially due to the nature of its application, i.e. the control of raw meal blending. A peripheral disc storage unit with a net capacity of 13.2 M bytes per drive could be extended by adding a maximum of three drives of the same capacity. Therefore it would be easy to extend the existing system for the following administrative tasks:

(a) Payroll;

(b) Cost control;

(c) Inventory control;

(d) Invoicing;

(e) Financial budgeting and control.

Several terminals could be linked to the central processing unit (CPU) and operated simultaneously through a "time-sharing" system, which allows each user to get nearly immediate response from the computer.

Many program packages (known as application software) are available commercially in a ready-to-use form. Such ready-made packages can carry out such routine tasks as payroll, invoicing, accounting, inventory control etc.

Ready-made packages are offered by hardware manufacturers, software and system houses. For ZCP, since the computers are manufactured by Siemens, it would be advisable to ask that company to undertake a study of the possibilities of using the available capacity for management application.

Co-operation with the manufacturer would avoid troubles with compatibility of software packages made by other companies and facilitate implementation.

As some foreign accountants and administrative personnel will soon leave the plant and return to their home countries, this would be a good point in time to use the computer for those tasks, instead of employing new and inexperienced accountants.

VI. ACTIVITIES AFTER FINAL TAKE-OVER

As explained in chapter III of this report, many items are still under further observation or guarantee. To avoid a possible misinterpretation of observation results, procedures for the observation of the major outstanding items had to be established. Two examples are reproduced in annex II and III. These were discussed with the engineers of KHI and DWC and for some items special log-sheets and forms were prepared, which will facilitate the evaluation of performance of a given piece of equipment.

This log-sheet system should be used for all items under observation. The forms should be distributed to the responsible technicians and engineers of the operation contractor and filled in daily. They will then be used to prepare a monthly report.

Furthermore, the spare parts consumed during the observation period should be monitored, and any used spares supplied by KHI free of charge.

Although some spare parts for a two-year consumption will be supplied by KHI, ZCP has to prepare orders already now for spares required after that period.

The expert prepared inquiries for the following spares which will be necessary for a smooth operation of the plant:

(a) Refractory bricks: Drafts of inquiries to four manufacturers of bricks. After receipt of the quotations, they will have to be evaluated by the responsible engineers;

(b) Electrical spare parts: Lists of various spares were prepared with the help of DWC engineers. The inquiries have been drafted and should be finalized and posted as soon as possible.

Annex I

ITEMS FOR WHICH GUARANTEE PERIOD HAS BEEN EXTENDED

Item No.	Equipment	Item	Date	
			Renewed	Expiration
04.11	Bag filter	Motors for screw conveyors	30 June 1985	29 June 1986
04.15	Rotary feeder	Shaft of gear reducer	25 March 1985	24 March 1986
05.01	Stacker	Pinion and gear for running wheel	10 February 1985	9 February 1986
05.02	Reclaimer	Hydraulic cylinder with mechanical seal	9 December 1984	8 December 1985
		Wire rope for supporting rake	24 December 1984	23 December 1985
06.10-030	Classifier	Upper bearing and casing (22244 BMB-FAG)	20 January 1985	19 January 1986
07.05(A)	Blower	Shaft	26 June 1985	25 June 1986
10.02	Distributing bucket conveyor	Wire and holders	15 August 1985	14 August 1986
12.09(E)-1	Air compressor	Cylinder and piston	1 December 1984	30 November 1985
12.09(E)-2	Air compressor	Piston	10 January 1985	9 January 1986
12.09(E)-1 & 2	Air compressor	Oil filters	29 November 1984	28 November 1985
12.09(E)-1 & 2	Air compressor	Silencers	16 January 1985	15 January 1986

continued

Annex I (continued)

Item No.	Equipment	Item	Date Renewed	Date Expiration
12.14	Air separator	Inside cone, No. 1 No. 2	24 June 1985 27 June 1985	23 June 1986 26 June 1986
13.10	Rotary packer	Vibrator	10 December 1984	9 December 1985
14.23	Drinking water pump	Impeller	20 August 1984	19 August 1985
15.7.6	Mobile crane (20 tonnes)	Boom	24 June 1985	23 December 1985
12.1.7	Two-way chute	Power cylinders A12.MO33A A12.MO33B B12.MO33A B12.MO33B	12 June 1985	11 June 1986
06.32(D) 08.16 13.22(C)	Air compressor	Flow switches (9 pcs)	21 June 1985	20 June 1986
14.01	Deep well pump (No. 2)	Stainless steel pipes, motor, cable and pump	25 July 1985	24 July 1986
A-164	Air conditioner	Motor and refrigerant-cycle component	20 January 1985	19 January 1986

continued

Annex I (continued)

Item No.	Equipment	Item	Date Renewed	Date Expiration
09.03	A09.XF02	Rotary-type flow meter	1 July 1985	30 June 1986
	Weighing feeder cabinets Z83.Y001 (raw mill) Z83.Y118 (kiln)	Rectifier unit 3D24		
	Weighing feeder cabinets Z83.Y002 (EP dust) Z85.Y001A (clinker) Z85.Y002A (clinker)	Rectifier unit 710	1 July 1985	30 June 1986
	A13.XZ01	Camera for shipping bay television	1 July 1985	30 June 1986
08.05	A08.XZ01	Camera for kiln hood television	22 November 1984	21 November 1985
B-2-b	Z82.D202	1250 kVA distribution transformer	20 March 1985	19 March 1986
I-2-5	Z88.H010-H013	Uninterrupted power supply	1 February 1985	31 January 1986
07.05(C)	A07.M007A	Motor 18.5 kW 1LA3166-2	16 May 1985	15 May 1986
08.03	A08.XT12A/B	Pyrometer	17 June 1985	16 June 1986
	Z85.Y001B Z85.Y002A Z85.Y002B	weighing feeder cabinet		

continued

Annex I (continued)

Item No.	Equipment	Item	Date Renewed	Date Expiration
	Z83.Y001 Z83.Y002 Z83.Y118 Z85.Y001A	Ventilation fans for	1 July 1985	30 June 1986
15.1.4	X-ray spectrometer	X-ray spectrometer a/ X-ray transformer	1 August 1985	16 February 1986
		X-ray transformer	1 August 1985	31 July 1986

a/ This item has been in normal operation for 5.5 months after PTO.

Annex II

OBSERVATION PROCEDURE FOR X-RAY ANALYSING AND BLENDING COMPUTER SYSTEM

Observation period

One year after KHI's notification.

Observation intervals

The down time shall be recorded on a monthly basis, at the end of each month, based on the daily log sheet, a specimen of which is attached.

Observation procedure

Sum up the down time of the X-ray spectrometer and the blending control computer for which KHI is responsible.

Down time for the following reasons, and for which KHI does not take responsibility, should be excluded:

(a) Time for the exchange or repair of parts due to normal wear and tear (to be discussed between ZCP and KHI on a case-by-case basis);

(b) Time for maintenance work described in the operation manual or performed according to instructions by KHI;

(c) Time for restoration due to improper operation or maintenance by operation contractor (to be discussed between ZCP and KHI on a case-by-case basis);

(d) Time for the calibration of X-ray spectrometer or raw material weigh-feeders;

(e) Time during which the sections concerned were out of operation due to reasons not attributable to KHI;

(f) Stoppage time due to force majeure.

Judgement after termination of observation period

The results can be judged as being satisfactory when KHI has fulfilled the following:

(a) When the mean down time for the automatic operation of the blending control system which is attributable to KHI, does not exceed 0.9. Calculate the mean downtime as follows:

$$\frac{\text{hours of downtime over one year}}{365} \times 24 \geq 0.9$$

(b) When the average range, over three days, of the lime saturation factor (LSF) and the silica modulous (SM) are within:

± 2 for LSF and
± 0.15 for SM.

If KHI could not fulfill (a) and (b) above, then the guarantee period for the blending computer should be extended by a period equal to the mean down time (hours) of the blending control system for which KHI is responsible.

Confirmation on monthly observation record

The monthly down time shall be recorded on the attached form and confirmed by the electrical engineer of ZCP and the guarantee engineer of KHI, who shall sign the form at the end of each month.

MONTHLY OBSERVATION RECORD
FOR BLENDING CONTROL SYSTEM

	Month / Down Time	1985 8	9	10	11	12	1986 1	2	3	4	5	6	7	8	SUM
				guarantee period				16							
A	Down time of X-Ray Spectrometer for which KHI is responsible (hours)							0	0	0	0	0	0	0	
B	Down time of Blending Computer for which KHI is responsible (hours)														
P	Sampling system Pneumatic system, Specimen preparation														
Signature of ZCP															
Signature of KHI															

Mean down time (hours) of blending control system for which KHI is responsible over 1 year

$$= \frac{\text{SUM (X)} + \text{SUM (B)}}{2}$$

ELITAN CEMENT PLANT

DAILY LOG SHEET FOR OBSERVATION OF
X-RAY ANALYSING & BLENDING COMPUTER SYSTEM

	Item \ Date			
1	Sampling Station (raw material)			
2	Sampling Station (raw meal)			
3	Pneumatic transport system (raw material)			
4	Pneumatic transport system (raw meal)			
5	Sample preparation equipment			
6	X-Ray spectrometer			
7	Blending computer			
8	Automatic control of Weigh Feeder			
9	Lime Saturation Factor (raw meal)	Target		
		Actual (Average)		
10	Silica Modulous (raw meal)	Target		
		Actual (Average)		
11	Remarks			
Signature		ZCP (Labo)		
		KHI		

Annex III

OBSERVATION PROCEDURE FOR GAS ANALYSER AT THE KILN INLET

Observation period

8 July 1985 to 7 July 1986.

Observation intervals

The down time shall be recorded on a monthly basis, at the end of each month.

Observation procedure

Sum up the down time for the following reasons, and for which KHI does not take responsibility, should be excluded:

(a) Time for the exchange or repair of parts due to normal wear and tear (to be discussed between ZCP and KHI on a case-by-case basis), except for the gas probe which shall last for a minimum of six months;

(b) Time for maintenance work described in the operation manual or performed according to instructions by KHI;

(c) Time for restoration due to improper operation or maintenance by the operation contractor;

(d) Time for the normal calibration described in the operation manual;

(e) Time during which the sections concerned were out of operation due to reasons not attributable to KHI;

(f) Stoppage due to force majeure.

Judgement after termination of observation period

Judgement shall be based on the monthly record form, which shall be reviewed by ZCP and KHI. The results are satisfactory when the mean down time of the gas analyser at the kiln inlet does not exceed 0.9. Calculate the mean downtime as follows:

$$\frac{\text{hours of downtime over one year}}{365} \times 24 \geq 0.9$$

If KHI could not fulfill the above, then the guarantee period for the gas analyser at the kiln inlet should be extended by a period equal to the period of the down time (hours) of the gas analyser at the kiln inlet for which KHI is responsible.

Confirmation on monthly observation record

The monthly down time shall be recorded on the attached form and confirmed by the electrical engineer of ZCP and the guarantee engineer of KHI, who shall sign the form at the end of each month.

MONTHLY OBSERVATION RECOED

FOR GAS ANALYSER AT THE KILN INLET

(A08.XQ01/02)

Month / Down Time	1985						1986							SUM
	7	8	9	10	11	12	1	2	3	4	5	6	7	
Down time of Gas Analyser for which KHI is responsible (hours)														
Signature of ZCP														
Signature of KHI														