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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


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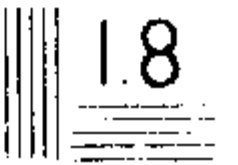
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March 1984
English

Kuwait

ASSISTANCE TO SHUAIBA AREA AUTHORITY

DP/KUW/80/002

KUWAIT

Terminal Report

Project Findings and Recommendations

Prepared for the Government of Kuwait
by the United Nations Industrial Development Organisation
acting as Executing Agency for the United Nations Development Programme

Based on the work of:

A.K. Lahiri, Expert in Corrosion Prevention

M. Puskas, Expert in Chemical Analysis

F. Shikhaliyev, Expert in Industrial Safety

United Nations Industrial Development Organisation
Vienna

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INTRODUCTION

1. Background

The economy of Kuwait is heavily dependent on non-renewable resources of crude oil and natural gas and therefore for diversification of the economy and broadening of the production base, the Government of Kuwait has embarked on a policy aiming at the development and advancement of the industrial sector. To realise this objective various industrial areas have been set up, a forerunner of these being the Shuaiba Industrial Area (SIA) which is in the nature of a model industrial complex.

The SIA was set up more than 18 years ago, under the administration of the Shuaiba Area Authority (SAA). The SAA made considerable progress in providing basic industrial services and facilities, including harbour facilities for export and import of materials, not only for the needs of the industries in the SIA but for the whole of Kuwait. Continuous expansion and development are in progress which pose various technical problems requiring competent handling.

The most important problems being faced are connected with environmental pollution, industrial safety and corrosion damage of various installations. SAA has taken a number of steps to deal with these problems. However, the lack of local expertise in these highly specialised fields have prompted the SAA to request UNDP for technical assistance.

2. Official Arrangements

To assist the Shuaiba Area Authority in carrying out some of its functions, it requested the United Nations Development Programme (UNDP) for assistance in the areas of:

- Industrial Safety;
- Chemical Analysis;
- Corrosion Prevention;
- Industrial Plant Organisation; and
- Fuel Technology.

The project document was signed in January 1981 for a duration of one year. It is 100 percent Government cost-sharing. The Shuaiba Area Authority was designated as counterpart agency and the United Nations Industrial Development Organisation (UNIDO) as executive agency. Field work began in December 1980 with the arrival of two experts in the field, the Corrosion Prevention Expert and the Chemical Analysis Expert. In January 1981, the Consultant in Industrial Plant Organisation was recruited for a duration of three months. Later on the Government informed UNDP that it no longer requires a consultant in Fuel Technology. The contracts of the Industrial Safety Expert and the Chemical Analysis Expert were extended on an ad hoc basis on the occasion of expiry of their respective contracts. In March 1982 the Industrial Safety Expert joined the project. After two years of operation, it was decided by all concerned that the project design needed revision to reflect the new outputs and activities which the experts are expected to perform. The Project Revision was signed in June 1983.

Subsequently, the SAA decided to terminate the project at the expiry of the current contracts of the respective experts, i.e. Expert on Corrosion - 30th November 1983, Expert on Chemical Analysis - 12 December 1983 and Expert in Industrial Safety - 20th March 1984. The SAA wishes to reassess the need for expertise in the light of a possible restructuring process.

3. Objectives

The main purpose of the project was to assist the SAA to develop capabilities in some vital areas which are necessary to ensure long life and safety of its own and other installations in the area and to control local ecology and health of persons working and living around the industrial area so that the SAA can continue to play a leading role in the industrialisation process of Kuwait.

The immediate objectives of the project were:

a) Prepare a code of safety on the problems of fire control, explosion prevention and industrial safety in general for the existing and new industries and make recommendations on the most appropriate solutions for these problems;

b) Study the present guidelines and methods used by the Corrosion Control Laboratory at the Environment Protection Centre and formulate recommendations on the guidelines and methods which would enable the laboratory to perform duties with the utmost satisfaction and assist in establishing the selected set of guidelines and methods;

c) Prepare a study on the chemical analytical methods used at the Environment Protection Centre and formulate recommendations on the test methods which would promote the work of the Centre in the fields of air and water pollution monitoring and assist in establishing the selected set of guidelines and methods.

PROJECT ACTIVITIES AND FINDINGS

GENERAL

To achieve the immediate objectives of the project in the fields of industrial safety, corrosion prevention and chemical analysis the experts produced various codes, regulations, guidelines and manuals, investigative reports, institutional reorganisation proposals, training programmes and teaching materials. In addition discussions were held with various persons concerned, and assistance was provided in the introduction of various recommendations by on-the-job training, work planning, preparation and review of specifications for upgrading the available facilities and existing standards. A list of the technical reports and other supporting documents prepared by the experts and submitted to the authorities concerned is given in Appendix II.

The management of SAA was kept informed about the progress and regular discussions were held with the immediate supervisers about the progress and the planning of work. The work plans of the experts were approved by the officials concerned and by UNIDO. Many of the suggestions and recommendations made have been accepted and some are already being implemented. The following is an analytical account of the activities and findings of the experts in each of the three fields in question.

I. INDUSTRIAL SAFETY

Safety Code

Preparation of Codes, Regulations and guidelines for industrial safety and fire protection was one of the important activities of the expert. Six comprehensive codes and regulations for industrial safety and fire protection were prepared. These were tailored to the needs of the SAA's own installations under its direct control and also for some of the industries in the SIA.

The codes are:

1. Fire safety regulation for SAA;
2. Fire protection code for SAA;
3. Industrial safety regulations for SAA;
4. Safety code for handling and storage of liquid sulphur;
5. Recommended practices on static electricity;
6. Guideline on safety and health.

Training

Safety training is of vital importance in raising the standards of industrial safety within production facilities resulting in increased productivity and prevention of accidents.

Some large companies with wide-spread operations have their own safety courses to be given. In the majority of small industries, however, the awareness of the management and workers of safety and occupational health hazards is not adequate. Only recently had the SAA introduced a well organised safety training programme. This aspect was therefore given utmost importance in the expert's activities.

A basic training programme tailored to the needs of the industries and for various levels of safety personnel was prepared. To assist the SAA Safety Section in initiating training courses, lectures on industrial safety and fire protection have been prepared and advice on planning of courses provided.

The Training Department of SAA is at present being reorganised and is expected to take the lead in this direction jointly with the Safety Section in developing and implementing the safety training programme.

Co-ordination of Safety Activities

To review the existing situation of industrial safety in different industries of SIA, the expert paid visits to a number of organisations.

In th large industries such as KNPC and PIC industrial safety and fire protection have been given due importance and both managements are continuously trying to improve the standards of safety in their respective installations. However, in some smaller private industries within the SIA, sufficient importance is not generally given to safety aspects and there is considerable scope for improvement.

The North and South Power Stations in the area apply to a certain extent their own safety regulations but these require some further improvement consistant with international practices.

In the majority of small industries the workers do not always use protective equipment and apparel. This aspect is not strictly enforced by the respective managements. There are no special safety officers and safety standards are below the desired level. There is also no system for proper maintenance of records and for documenting accidents and injuries.

In the course of study, the expert produced two reports highlighting the fact that investigation of accidents is an important measure of industrial safety. Of special importance in such investigations is the systematic approach to these problems and recording the information is vital for current and future use.

For continuous updating of safety measures it is essential that small industries should start keeping proper records of safety regulations and accidents. The manual prepared by the expert for this purpose and sent by SAA to all industries can form the basis for such a recording system.

Safety Laboratory

Under the industrialisation programme of Kuwait, it is likely that use is made of new materials which are hazardous and about which there is limited local experience. The use, transportation and storage of these materials can make the task of fire prevention and occupational

health much more complex. Therefore, such new materials, before being introduced in industrial processes, should be tested in order to take adequate safety measures in the planning stage. For this it will be necessary to organise a Safety Laboratory in the Safety Section of SAA. This Laboratory would also undertake testing for noise, vibration lighting, respiratory protection, etc. and help other departments of SAA and the local industries, when required.

Safety Investigation

The SAA has a large concentration of hydrocarbon-based industries, along with many medium and large engineering, paper, cement and other industries. The expert spent considerable time in studying the level of industrial safety in many of these industries by examining accidents.

It was noted that in some cases even in the large industries there is some misunderstanding on sources of potential hazards. In the two refineries of Shuaiba and Mina Abdullah this has led to explosions in the liquid sulphur storage tanks. The investigation showed that fault and irregular checking of the earthing resulted in explosions due to build-up of static electricity.

The study at the cement plant showed that occupational health and safety measures should be improved. It is well-known that during cement processing the main hazard is dust. Other hazards encountered include high ambient temperature especially near furnace doors, and platforms radiant heat and high noise levels in the vicinity of the ball mills.

In the course of these studies the expert prepared three reports highlighting the possibilities of accidents and describing the safety situation. Contents of the reports including recommendations for safety practices and safety codes were discussed with the specialists of the concerned industries and copies were given to them.

Safety Legislation

Visits to different industries in the Area were made. The general situation in the SIA is that no industry in the Area is under the jurisdiction of the SAA and the Safety Section of SAA has no authority in enforcing its safety regulations.

The SAA renders services in co-operation with the other public bodies operating in the Area, such as Ministry of Electricity and Water, State Fire Brigade Department, Ministry of Communications, Ministry of Interior, etc.

SAA has no direct control over the safety functions of various industries in the SIA. The Ministry of Oil is concerned with petroleum and petrochemical industries, while other industries come under the Ministry of Trade and Industry. The Ministry of Social Affairs supervises labour relationship and Kuwait Municipality (Fire Brigade Department) checks fire protection aspects.

As regards industrial safety there is no specific national legislation which is binding on all industries. In such a situation corrective measures are subject to discussions, mostly on a subjective basis and acceptance or otherwise of any step is left to individual industries. Furthermore, the dispersion of responsibilities and lack of means of enforcing regulations result in failure to induce adequate corrective measures.

This drawback in the existing situation was recognised by the authorities and for the co-ordination of safety matters in all the industries within the SIA, a special Safety Committee was formed but this Committee had stopped functioning since 1976.

Such a situation can be rectified only by having a unified industrial safety law for the whole of Kuwait. This is all the more important for Kuwait having a large concentration of large-scale industries handling materials prone to fire, accidents and other safety hazards. The expert has prepared a note on this aspect for follow-up action.

Organisation of Safety Section

The Safety Section of SAA is headed by a qualified specialist and is comprised of qualified staff who successfully carry out their duties on all aspects of safety in co-ordination with the concerned governmental authorities. However, it is the opinion of the epxert that this Section will require further strengthening in the future when its activiites are expected to increase considerably. Training programmes for the staff should continue to be an impcrtant feature of the work of the Section.

II. CORROSION PREVENTION, CONTROL AND INSPECTION

As a first step, the existing situation was studied through visits to various locations, discussions with the corrosion staff, heads of various departments and SAA management and also the programmes of corrosion control and monitoring being practiced. SAA management desired that the expert should also assist, where necessary, the other industries and organisations in Kuwait in general and SIA in particular. Based on these studies and subsequent reviews, revised work programme along with the areas to be covered under different activities were drawn up.

Standards and Costs

One of the important activities of the expert consisted of preparation of codes, guidelines and specifications on corrosion control measures. The SAA needs to establish its own codes based on local conditions and experience in order to deal with foreign engineering consultants and suppliers' salesmen.

Two codes, one on protection of steel reinforcement in concrete structures and the other on painting of structural steel against atmospheric corrosion were therefore prepared as a guideline for design, preparation of specifications and tender documents. In addition, a number of specifications were prepared for coating and welding for repair of piles and support structures of oil pier, painting of steel in sea water, chlorination enclosure, salvaging of corroded sea water

valves, repair of spalled concrete pump base, etc. Many of these codes and specifications have already been adopted.

Codes on materials for handling of sea water could not be completed within the present term of the expert.

Inspection and Monitoring System

Inspection and monitoring form the basis on which the effectiveness of corrosion control measures and extent of corrosion damage can be established. Except for occasional monitoring of cathodic protection systems, no systematic inspection and monitoring was being practiced. A comprehensive inspection and monitoring system for SAA installations was developed. This included different check lists, history cards along with the periodicity of inspection and monitoring for different installations. Through this system it will be possible to centralise the corrosion inspection and monitoring functions of all departments, for both new projects and maintenance activities. The system has been accepted for implementation.

Developmental Studies

The expert spent considerable time in identifying problematic areas in SAA which need experimental studies. The need for updating codes and specification based on inspection/monitoring and developmental studies and the necessity of carrying out a study of corrosion failures were also considered in detail. To enable the Corrosion Control Laboratory to perform these and other activities, detailed test procedures were prepared for both laboratory and field studies. The projects included were: (a) Atmospheric corrosivity in different areas within the SIA and evaluation of various paint systems as affected by level and type of pollutants; (b) Factors affecting corrosion of reinforcement in concrete and methods to minimise the same; (c) Effect of different pollutants discharged into Shuaiba shore water on current requirements for cathodic protection; and (d) Corrosion of materials in circulating water systems of centralised air conditioning plants. Five reports were

prepared in this connection. Work programmes for two of the projects, which were decided to be taken up in the first instance, were prepared and assistance provided in setting up the facilities. The actual test programme has, however, not yet started because of shortage of staff in the Corrosion Laboratory and delays in setting up of the air monitoring stations.

Test Facilities

At the start of the project, the Corrosion Control Laboratory had limited resources of both facilities and manpower. Very few laboratory and inspection and monitoring instruments and equipment were available. One of the first actions of the expert was to recommend procurement of some basic minimum facilities. Later when different projects were planned and inspection and the monitoring system accepted for implementation further upgrading of instrumental and equipment facilities was planned and,based on the expert's recommendations, most of these have been procured and are now operative. Facilities for undertaking microscopic studies, necessary for undertaking failure analysis and investigative work are in the process of being procured.

To build up the reference facilities, books and periodicals on corrosion were recommended. Most of the books have been received in the SAA library, and it is urged that action for subscription for journals be taken.

Corrosion Control Committee

The expert's visits to various SAA departments and other large and small industries in SIA and also in other parts of Kuwait showed the seriousness of the corrosion problems being experienced. It was also evident that while larger hydrocarbon-based industries do have well-organised corrosion groups, such in-house capability is non-existant in others. Furthermore, the experience remains with the individual industries and is not available to others. In such a situation heavy dependence is placed on foreign consultants who are not familiar with the local conditions and experience. To formulate corrosion control

measures for the national good and to help the different organisations to reduce losses due to corrosion by pooling of experience and by providing services, the expert put forward the idea of forming a Corrosion Control Committee. Three background papers were prepared in this connection which were discussed with the representatives of different organisations and a decision to constitute the Committee was taken. SAA agreed to have the Secretariat of the Committee on its premises. Nominations from most of the industries and organisations have been received for the Committee to be constituted. Once this step is taken, the Committee can undertake tasks to prepare a code of practices, specifications and a conduct survey of corrosion problems in different industries. Through the participating members, the Committee will also provide direct help and advice to industries, whenever required.

Failure Investigations

A number of corrosion failures were investigated by the expert, both for SAA and other industries in Kuwait. Nine investigation reports dealing with corrosion in distillation units, boilers, air conditioning units, street light poles, reinforced concrete structures, water wells, etc. were prepared naming the causes of corrosion and corrective action needed to rectify the situation. The other studies carried out involved preparation of new painting and welding specifications, procedure for salvaging corroded valves, coating of concrete structures against deterioriation, etc.

The investigation studies of the failures highlighted the importance of corrosion control measures in increasing life and reducing breakdowns, the role of a well-planned inspection and monitoring system and intra-organisational transfer of experience. Another aspect which the expert highlighted during these studies was the important role played by economic aspects in finding solutions to corrosion problems.

Organisation of Corrosion Control Laboratory

As already mentioned, the Corrosion Control Laboratory, at the beginning of the project was in a nascent state of development. In addition to augmenting the testing facilities, the expert prepared three reports on its organisational structure. These reports gave three alternate organisations, depending on the final decision of the SAA management regarding the role which the Laboratory is expected to play in the future. The present strength of two staff members is inadequate. With the general agreement to expand the role of the Laboratory in assisting the various SAA departments through developmental studies, preparation of codes and specification, centralised inspection and monitoring and also the major reponsibility it has to take in conducting the activities of the Corrosion Control Committee, the manpower of the Laboratory should be increased to 15, consisting of 9 engineers/chemists, 4 technicians and 2 secretarial staff.

The reports on organisation give job descriptions and minimum qualifications and experience of persons at various levels. For implementation purposes the minimum immediate requirements will be 4 engineers/chemists, 2 technicians and 1 secretary, with the total recommended strength built up over a period of 3 years.

Training

The development of a Corrosion Control Laboratory in SAA has been accepted in principle, not only to cater to the needs of SAA but also to help industries in Kuwait through the Corrosion Control Committee. Considering these activities, the effectiveness of the personnel will depend not only on their qualifications but on the experience, constant updating of knowledge and techniques and interaction with personnel in related fields.

Based on these requirements, on-the-job training was given the utmost importance for the limited staff at present. Assistance was provided, wherever necessary, in finalising and setting up test procedures, operation of instruments, interpretation of data, etc. It was kept in mind that each individual in his own area of activities would require a multi-disciplinary approach in studying any problem.

The staff were therefore also constantly involved in the study of industrial problems and investigative studies and report writing. This gave them an understanding of the practical approach to the problems. The short term training of the staff, arranged by SAA in different industries gave them an opportunity to get an on-the-spot idea about the type of problems experienced in practice.

However, on a long term basis an established training and career development programme for the staff will be required. Such training will have to be tailored to the needs of the individual and the job he is expected to perform. This will consist of on-the-job and in-plant training, participation in project and maintenance activities, attending plant shut downs, basic and advance training on corrosion, inspection and management and attending seminars and conferences in related fields. Some of this training can be organised locally through the Corrosion Control Committee and the Training Department of SAA. The expert has prepared a background paper on a training programme on this subject for appropriate action.

III. CHEMICAL ANALYSIS

The expert's work started with the collection of background information on the following subjects and practices:

- Analytical methods and procedures used at the EPC's;
- Sampling programmes implemented by EPC;
- Application on the elements of quality assurance;
- Laboratory facilities, e.g., instrumentation, glassware, chemicals, etc.;
- Data collected during the monitoring of quality characteristics of sea water, Shuaiba's industrial waste effluents and air;
- Data handling and interpretation;
- Organisational structure of EPC;
- Skills of staff and level of their knowledge.

Methods of collection of background information were:

a) Preparation of questionnaire and request for filling out;

b) Personal observations in the laboratories and in the field during performance of sampling at the wastewater outfalls.

Based on the background information collected, the expert evaluated the working conditions and the available facilities and prepared a preliminary working programme for immediate action. This was later reviewed and modified after the experience of the first year.

Instrumentation and Other Facilities

The basic equipment, glassware, chemicals in the laboratories for chemical analysis were partly available at the beginning of the project. After an inventory of the available glassware, chemicals and basic equipment a list was prepared by the expert regarding the future needs and recommendations were made to purchase these items and also to establish about a one-year stock of the basic glassware and chemicals. In spite of the improvement in providing the basic laboratory facilities, the permanent shortage of various types of glassware (different flask joints), equipment (drying oven, analytical balance, etc.) and temporary shortage of chemicals (hydrochloric, sulphuric acids, solvents - hexan, standards) have caused delays in the implementation of the work plan. This is why it is necessary to have on hand a stock of this equipment and chemicals. The basic instrumentation of the chemical analysis laboratories were also partly available at the beginning of the project. After reviewing the conditions of the existing instruments and the need for new instrumentation for measuring newly selected characteristics as well as upgrading the performance of the routine analytical test methods, recommendations were made for procuring missing accessories and new instruments. The main instruments recommended for purchase were the following:

fluorescence spectrophotometre, high pressure liquid chromatograph, gas chromatograph, (at a later stage) total organic carbon analyser (TOC), toxicity metre, Kjeltec autosystems, COD autoanalyser and infrared spectrophotometre.

So far the gas chromatograph, highpressure liquid chromatograph and fluorescence spectrophotometre have been installed. The infrared spectrophotometre is under delivery. The expert also recommended the purchase of a TOC analyser, toxicity metre, Kjeltec autosystem and COD analyser. It should be noted that there are problems relating to the long lead time required for procurement, inadequate facilities for repair of sophisticated instruments in Kuwait and delays in the setting up of these instruments.

Sampling/Monitoring Programme

The routine monitoring of water and air quality for selected parametres has been implemented mainly according to the Cremer & Warner Consultants' recommendations prepared in 1976. The objective of that monitoring programme was of a general nature aimed at the overall assessment of the water and air pollution in SIA. This programme is out of date as new industries have been established with additional effluent discharging into the sea and in some cases the selected parametres are not characteristic any longer due to the change in the industrial processes. This monitoring at present is being used mainly for inspection purposes at EPC.

The expert had revised this sampling programme and prepared proposals for a new routine monitoring programme intended to satisfy different purposes such as inspection, general assessment of pollution level, data base for waste management, etc. The implementation of this programme means higher work load for the laboratories. For this reason the initiation of this programme will be delayed.

During the project duration there were several other sampling parametres implemented at EPC's laboratories for different purposes.

Three of the most important ones, were in connection with the following projects implemented by other institutions (KISR, MPH) in collaboration with EPC:

- Feasibility study of Industrial Waste Water Treatment in Shuaiba Industrial Area (KISR project - BT 2). The objectives of this sampling programme was the assessment of massload from SIA caused by industrial effluents and also the characterisation of the quality of these effluents. Based on the data obtained by this monitoring programme, the feasible alternative waste water treatment procedures were studied.

  The expert participated in the preparation and implementation of this programme.

- Study of micro-pollutants in the Industrial Waste Water Discharges in the Shuaiba Industrial Area (KISR project - EES 39). One of the objectives of this study was to establish a sampling programme including the selection of the sampling points, frequency of sampling and selection of the parametres to be determined. This monitoring programme covers only the measurements of selected inorganic and organic micropollutants. The sampling programme was on the basis of results obtained by a preliminary sampling programme.

  The expert assisted in this work, during the whole duration of the project by participating in discussions and also in finalisation of the proposals.

- Kuwait Action Plan: This is a joint project between the Environmental Protection Council, Ministry of Public Health, Kuwait Institute for Scientific Research and the Shuaiba Area Authority for the assessment of baseline level of oil and non oil pollutants in the territorial waters of Kuwait.

  The expert assisted in the implementation of this programme at EPC.

A few additional sampling programmes were prepared and proposed by the expert. One of these is the monitoring programme for silica determination in Shuaiba's water. This is a one-year programme which is still under implementation.

A second is "Monitoring programme to protect Shuaiba inshore water against Iranian oil slick". This programme is an early warning monitoring programme for observation of the movement of the Nowruz oil spillage and/or other oil spills. It may be mentioned that the results of different sampling and monitoring programmes implemented at EPC's laboratories should be evaluated and utilised for a comprehensive and long term sampling and monitoring programme.

The development of the automatic water and air quality monitoring network represents a special feature of the sampling and monitoring programme.

In the preparation period, the expert suggested and participated in a special study aimed at identifying water sample intake positions in the stream lines.

Taking into account the complexity and the importance of these systems, the interpretation and utilisation of their results need experimental verification. Parallel laboratory tests using identical analytical methods should therefore be run at least for half a year. A programme for this experimental work was prepared by the expert and approved by the EPC management. Due to the delayed installation of the automatic monitoring system, this programme started at the time of the writing of this report.

Adaptation of methodologies

One of the main objectives of the project was to review and up-date sampling and analytical methodologies applied by EPC's laboratories. The major activity of the expert was to select and adapt analytical methods for the most important quality

characteristics as required by the EPC management. The selection of the methodologies was based on literature review. For the adaptation of the selected methodologies, laboratory tests and experimental work were carried out. Taking into account the special conditions (high salinity, composition and concentration of pollutants) in Shuaiba's effluents special attention was paid to some characteristic pollutants e.g. ammonia, urea, sulphide, cyanides, etc., the analytical procedure of which is highly influenced by interferences and, hence, the standard methods are not fully applicable. The establishment and adaptation of methodologies for petroleum hydrocarbon determination were also handled with special attention. In most cases, alternative procedures were selected to be applied to different waters. Based on tests carried out in the laboratories, the methodology for the selected parametres by applying the available instrumentation was adapted. However, it should be noted that the adaptation of methodology for several parametres are still in progress and will not be finalised before the end of the project. A manual on the adapted sampling and analytical methods for a number of selected parametres was prepared by the expert to be applied in the every day analytical work of EPC.

Quality Assurance/Quality Control

At the beginning of the project it was recognised that the majority of the elements of quality assurance had been ignored. After moving into the new laboratories significant improvement was achieved, though some problems remain, such as the purity of distilled water, instability of instruments due to the lack of professional maintenance, etc. Moreover, problems arose in the calculation of results and data reporting, e.g. rounding off the results to the significant level in the determination and application of detection limits, as well as in the periodical checking and correcting of the calibration curves.

Significant improvements have been achieved during the last two years. The EPC's laboratories participated in intercalibration exercises with industrial and governmental laboratories. After

discovering the problem areas and reasons for discrepancies, corrective measures were taken. The expert has also participated in intercalibration exercises for EPC and taken part in the development of corrective measures based on the results achieved.

In spite of the considerable improvement in the internal quality control elements, further efforts should be made by providing the facilities (distillator for high purity distilled water, glassware washer, analytical balances, 'A' category calibrated glassware, etc.) and systematically follow an internal quality control programme which includes the basic necessities such as, e.g. recalibration of instruments, analysis of spiked samples, etc.

The expert prepared a chapter on Quality Assurance/Quality Control included in the "Manual on Examination of Waters in the Shuaiba Industrial Area", which summarises the most important quality control elements.

It was also recognised that several industries carried out analysis of their effluents and the results should be comparable with those measured by EPC. Considering the future requirements for a comprehensive effluent monitoring programme in the Shuaiba Industrial Area and a possible request to the industries for developing their own self-control system, the importance of organised intercalibration exercises has been recognised.

Because of the volume and the special nature of the Quality Assurance/Quality Control work, the establishment of a quality control group at the EPC is strongly recommended.

Training of Personnel

The reliability of analytical results depends not only on the instruments and equipment or even the qualification of personnel but also on the experience in this special environmental analytical field.

Most of the environmental analytical activities would require a multidisciplinary approach and for this reason training plays an important role.

Regular guidance, consultation and on-the-job training of the EPC staff have constituted an important activity of the expert. As the possibilities for other types of training are limited at EPC, mainly on-the-job training was stressed. The practical training methods of the expert were tailored to the existing conditions and took into account the level of experience of different staff. On-the-job training was a continuous activity of the expert's daily work.

Whenever new instruments and systems are being set up there is a need for training because of the complexity of operation and interpretation of the results. Training on instruments has in some cases been arranged by the manufacturers.

The expert assisted in the special training programme on such specific analytical techniques as organic and inorganic micropollutants which was carried out in collaboration with KISR. Such exercises should be continued periodically in future to keep the level of staff at par with latest developments. Senior staff should also be encouraged to attend seminars and conferences.

Guidelines for training personnel for chemical analysis in environmental laboratories in general and in the EPC's laboratories in particular were summarised in a report prepared by the expert.

Organisation

At the start of the project all the laboratories of EPC, water, air, biology, special, corrosion, were in one section. When the EPC laboratories moved to new premises soon after the start of the project, a considerable improvement in staff along with the expansion in

activity was observed. Taking into account this development in the conditions, the organisational structure had to be adjusted to the new circumstances, the expert has worked out a new structure of the EPC, including alternatives taking into account the possible future development of EPC's activities and the level of experience of the available personnel. On that basis, it was recommended that preference be given to that alternative which proposes to divide the laboratory section into two parts. It was also recommended to revise the organisational structure after about two years of operational experience as environmental protection is a rapidly growing area in Kuwait and adjustments of the organisational structure should be made to suit the prevailing circumstances, including the availability of Kuwaiti manpower.

RECOMMENDATIONS

I. INDUSTRIAL SAFETY

Safety Code

A comprehensive code for industrial safety and fire protection, tailored to the needs of the SAA's own installations and areas under its direct control, has been prepared. It is recommended that this code be implemented and periodically updated based on experience and results of investigations of industrial accidents.

Training

Training on various aspects of industrial safety is essential to increase technical capability and awareness at all levels of personnel, starting from field personnel to management. It is recommended that training courses suitably tailored for diverse types of industries in the SIA be continued and further extended to include all levels of personnel, specially those in the smaller industries having inadequate training facilities of their own. Training of personnel in smaller industries would also enable them to participate in emergency plans at the time of major accidents.

Co-ordination of Safety Activities of Small Industries

For continuous updating of safety measures it is essential that small industries start keeping proper records of safety regulations and records of accidents. It is recommended that steps be taken to co-ordinate and unify safety systems.

Safety Legislation

There is no unified industrial safety code or law in Kuwait. Each industry, especially heavy and large scale industries, follow their own codes and are often reluctant to part with the information on accidents and also on technical details.

Thus control and monitoring by any Government Authority is not possible under the present condition. It is recommended that a national safety code for factories to incude all aspects of industrial safety be drawn up and promulgated into law. Until such time as such a law becomes operative, the special Safety Committee of SIA should again be reactivated. It is also recommended that SAA should obtain an authorisation to monitor the safety aspects of all industries within the SIA.

Safety Laboratory

Under the industrialisation programme of Kuwait it is likely that new industries will be using hazardous materials about which there is limited local experience. Under the circumstances, it is essential that these are properly tested before being introduced and for this it is recommended that a Safety Laboratory be set up in the Safety Section of SAA. It is also recommended that this laboratory should undertake testing for noise, vibration, lighting, respiratory protection, etc. A list of equipment needed for the laboratory was given to the authorities.

Organisation of Safety Section

To fulfil its role, it is recommended that the Safety Section should be continuously strengthened with qualified staff.

II. CORROSION PREVENTION

Standards and Codes

Standards and codes form the backbone for providing built-in corrosion preventive measures of new construction, equipment, etc., and for maintenance of old ones in the most economical manner. At present this is dependent on foreign consultants and material suppliers. Based on local exposure conditions and information available on performances, codes and specifications have been prepared and some of these have already been utilised.

It is recommended that the codes and specifications should be strictly followed and periodically updated based on experience and results of field and laboratory studies, where possible. Attempts should also be made to prepare other regulations, especially on the handling of sea water.

Inspection and Monitoring System

For proper supervision of maintenance work and for long life of various installations and equipment, periodic inspections and monitoring are absolutely necessary. In addition, if the inspection and monitoring data and performance history are not properly recorded timely action against sudden and costly damages cannot be taken. Such a systematic inspe tion and monitoring programme has been prepared and accepted by SAA.

It is recommended that the full introduction of the proposed inspection and monitoring system should be expedited. For better evaluation and co-ordination of the activities, the inspection and monitoring for the whole of SAA should be centralised.

Corrosion Control Committee

To formulate corrosion control measures for the national good and to help the different organisations to reduce losses due to corrosion it is necessary that experience and help of the various industries and organisations in Kuwait are pooled. This will not only help in reducing dependance on foreign expertise but will also help in increasing self reliance. To achieve this objective formation. of a "Corrosion Control Committee", consisting of members from different organisations with SAA as a Convener has been finalised. It is recommended that this Committee should start functioning without delay.

Long Term Developmental Studies

A number of serious corrosion problems bieng experienced by SAA and requiring detailed studies have been identified and reports on field and laboratory experiments needed have been prepared. The results of these studies would not only be useful to SAA but also to other organisations within SIA and in Kuwait. Combined with inspection and monitoring data the test results will help in updating of codes and specifications and maintenance practices.

It is recommended that long term developmental studies should be undertaken in a phased manner depending on priorities and resources. Some of the larger projects, which cannot be handled by the Corrosion Control Laboratory alone can be done with the help of other interested organisations like KISR, Kuwait University and WRDC.

Organisation of Corrosion Control Laboratory

With its present structure the Corrosion Control Laboratory cannot fulfil its role in corrosion control of the SAA installations and also co-ordinate the activities of the Corrosion Control Committee because of the serious shortage of staff. A new organisational chart with job descriptions,functions and desired qualifications of staff members concerned has been prepared.

It is recommended that this be implemented as soon as possible.

Training

For proper functioning of the Corrosion Control Laboratory not only the manpower will have to be increased, but continuous efforts will have to be made to up-grade the skills of staff by training and exposure to handling of practical problems.

It is recommended that the personnel in the Section be involved during the various stages of project implementation and maintenance activities. Once the Section is fully established, it is recommended

to seek the assistance of one outside expert for a year or two for on-the-job training, organising developmental activities and to put the functioning of the Corrosion Control Committee on a sound footing. Measures must be taken to attract persons with good qualifications and experience.

III. CHEMICAL ANALYSIS

Instrumentation

A detailed review of the future needs was carried out at the beginning of the project and a list of additional instruments and accessories needed was prepared. These are at present being progressively purchased. It is recommended that each instrument should have a working programme, should be regularly calibrated and special analytical techniques adapted where needed.

Sampling/Monitoring Programme

One of the first assignments of the expert was to revise and modify the existing system. Subsequently the expert participated in the preparation and implementation of special sampling and monitoring programmes connected with other projects.

It is recommended that the present sampling programme be revised based on the findings of the special projects (EES-39, BT-2, KAP) and of subsequent studies, as necessary. It is also recommended that the sampling techniques given in the "Manual on examination of water in SIA" be followed. It is recommended to establish a representative sample at the automatic monitor stations which will be used for a comparative study between the automatic system and the manual method.

Automatic Quality Monitoring System

When the establishment of the automatic water and air quality monitoring system was taken up, the expert assisted in the selection of water sample intake positions as well as preparing a six month

programme for comparative study between the monitors and identical manual procedures. The programme is being implemented.

It is recommended to complete the six months comparative study between the automatic monitors and relevant manual tests to be able to take corrective measures, if necessary, and to gather information for future interpretation of the results provided by the monitors.

Adaptation of Methodologies

After reviewing the applied methodologies at the beginning of the project, the sampling and analytical mehtods for a number of quality characteristics were selected and tested in the laboratories. A manual was prepared for sampling and analysis of Shuaiba's waters.

It is recommended that the methodologies given in the "Manual on examination of waters in the Shuaiba Industrial Area" be followed. However, these methodologies should be periodically reviewed and modified/completed, if required.

Data Acquisition and Quality Assurance

Collection of meaningful data required adequate control of various steps involved in the analysis starting from cleanliness of glassware to purity of chemicals, distilled water, etc. and calibration of instruments used.

It is recommended that basic elements of quality assurance should be followed through regular intra and periodical inter-laboratory programmes amongst concerned laboratories. Regular analysis of standard reference materials available from NBS of US EPA should also be included in such tests. It is also recommended to establish within EPC a group who will deal especially with such quality assurance programmes including the organisation and execution of interlaboratory comparison exercises among industrial laboratories in the Shuaiba Industrial Area.

As an extension to this approach, the development of the computerised data bank and data processing systems are also recommended.

Training of Personnel

The training of laboratory staff had been recognised as a first priority and a significant percentage of the expert's working time was requested and allocated by the EPC management for on-the-job training of laboratory personnel.

It is recommended that basic on-the-job training including orientation, demonstration and supervision be provided to each new employee before he takes up the work independently. At least two members of the team should be familiar with each designated technique. It is also recommended that a career development plan be prepared and followed-up for each staff member on a regular basis as outlined in the expert's report on training.

Organisation

On the basis of the review of the existing organisation at the beginning of the project as well as by taking into consideration the requirements, the expert prepared recommendations for alternative organisational structures. One of the alternatives was implemented in the middle of 1982.

It is recommended that the organisational structure of the EPC's laboratory be reviewed in 1984 on the basis of the experience gained during the last two years and modified, if necessary, by taking into account the expert's earlier recommendations made in 1982.

Future Recommendations

During the work at EPC, the expert had the opportunity to study the overall environmental protection requirements of the Area, and the gaps existing in some of the important fields. The following

recommendations are made for future consideration:

a) The Environmental Protection Council of Kuwait is in the process of developing water, air and soil pollution standards. These should include emission standards for discharges and also ambient quality standards taking into account the environmental quality criteria, assimilative capacity of recipients, etc. It is recommended that a proper legislation based on these standards should be promulgated and SAA given the authority to take all necessary steps to oversee the application of the law in SIA. Until such a legislation is promulgated, a self control system and co-operation amongst the major industries should be developed under the overall guidance and supervision of SAA.

b) It is recommended that the capability for testing hazards such as: toxicity, reactivity, corrosivity and flamability, etc. from solid, semi-solid and liquid waste should be developed. Some of these tests can be carried out in co-operation with the existing Corrosion Control Laboratory and the proposed Safety Laboratory. Toxicity bioassy test facilities can be provided in the existing biological laboratory.

c) Because of extensive uninhabited desert area in Kuwait, land disposal of wastes is quite commonly followed. It is recommended that regular monitoring of leachate/ground water at the vicinity of the disposal site should be carried out along with leachate testing for toxicity.

d) The Gulf has a number of off-shore oil fields and has a high degree of oil tanker movement, which makes the area highly vulnerable to oil spillage, of which the recent Iranian oil slick is a serious example. There are verious sources of crude oil in the area and it is recommended that laboratory capability for oil spill finger-printing/identification should be developed and the data bank built up.

e) Desalination plants are most vulnerable from the point of view of oil spillage. It is recommended that contingency plans should be developed for an early warning monitoring programme and preventive measures necessary to prevent ingress of petroleum hydro-carbon into the system in the case of major oil spills.

APPENDIX I

LIST OF PROJECT STAFF

1.	Field	: Industrial Safety
	Name of International Expert	: F.A. Shikhaliyev
	Starting date	: 21st March 1982
	Concluding date	: 20th March 1984
	Name of counterpart	: M.I. Moawad
	Starting date	: 27th March 1982
	Concluding date	: 17th March 1984
2.	Field	: Corrosion Prevention
	Name of International Expert	: A.K. Lahiri
	Starting date	: 1st December 1980
	Concluding date	: 30th November 1983
	Name of counterpart	: F. Dourgham
	Starting date	: 6th December 1980
	Concluding date	: 27th November 1983
3.	Field	: Chemical Analysis
	Name of International Expert	: M. Puskas
	Starting date	: 13th December 1980
	Concluding date	: 12th December 1983
	Name of counterpart	: A.M. Al-Husseini
	Starting date	: 26th December 1980
	Concluding date	: 28th February 1983
4.	Field	: Organisational Development
	Name of International Consultant	: W. Holmgren
	Starting date	: January 1981
	Concluding date	: March 1981

APPENDIX II

TECHNICAL REPORTS

Industrial Safety

1. Recommendations of safety in industries.

   Technical report on identified problems needing detailed safety and fire protection studies have been prepared and some organisational problems of safety in SIA have been discussed.

2. Report on investigation of accidents.

   The main purpose has been to prepare a unified system for documenting injuries and accidents in small industries of SIA.

3. Report on explosion in liquid sulphur storage tanks at Shuaiba and Mina Abdulla Refineries.

   There have been numerous incidents of explosions in the tanks for liquid sulphur storage. This report gives results of a case study and recommendations for preventing explosions in the future.

4. Safety code of handling and storage of liquid sulphur.

   Gives guidelines for prevention of explosion in handling and storage of liquid sulphur.

5. Recommended practices in static electricity.

   The inspection carried out in the refineries in SIA showed that there is no regular check-up of the earthing of the storage tanks and static electricity has not been given its due importance. This technical report gives guidelines for prevention of explosions due to static electricity.

6. Report on results of safety investigation in Kuwait Cement Company.
   The report discusses industrial safety and occupational health condition in the company and recommends steps necessary for improving working conditions.

7. Safety training lectures in 5 parts for use in training seminars for employees in the SIA:

   Part I - Organisation of industrial safety, industrial accidents and occupational diseases

   Part II - Sanitary facilities in the industries

   Part III - Welfare in the industries

   Part IV - General problems of industrial safety

   Part V - Fire protection and prevention.

8. Text of lectures for seminar on industrial safety for plant managers.
   Gives the materials for the seminar on industrial safety for plant managers and safety staff.

9. Industrial safety code and regulations in SAA.
   Gives guidelines for industrial safety within SAA.

10. Fire safety regulations and fire protection code in SAA.
    Gives guidelines for fire protection within SAA.

Corrosion Prevention

11. Programmes of corrosion studies in SAA - 5 reports
    Technical reports on identified problems needing detailed laboratory and field studies have been prepared. The topics include atmospheric corrosion, painting, concrete

reinforcement corrosion, C.P. current requirement affected by level of pollutants, etc. The reports deal with test procedure, parametres to be studied and work programme.

12. Corrosion Monitoring and Inspection System.

A detailed system for corrosion inspection and monitoring for SAA installations have been developed. The system gives different check lists along with data and history cards, list of instruments, inspection and monitoring procedures, etc.

13. Corrosion problems in process and power steam boilers in KOC. - 2 reports

Two problems, one dealing with rupture of boiler tube and the 2nd with deposition of acidic smut on the steam raising tubes of process boilers have been investigated and corrective measures and line of action have been recommended.

14. Reorganisation of Corrosion and Inspection Group in SAA. - 3 reports

Three alternate organisations to expand the existing group, along with staff strength and qualifications of technical personnel have been developed and submitted for decision of SAA.

15. Corrosion of casings and riser pipes in ground water wells of Ministry of Electricity and Water, Kuwait.

The report discusses corrosion of deep well casing and riser pipes and projects the probable life of fresh and brackish water wells on the basis of available data. The report further deals with immediate inspection needs and recommends alternate corrosion preventive methods along with their economic appraisal.

16. Code of practice for protection of concrete reinforcement in marine environment.

This code deals with protection of concrete reinforcement against corrosion and is intended for the design, preparation of tender documents and job execution along with other engineering codes and standards.

17. Report on failure of street light pole in Shuaiba Industrial Area.

Collapse of a street light pole leading to an accident resulted in a detailed investigation to determine causes and to predict the conditions of others in the whole area. Studies showed that failure was due to corrosion of the galvanised poles embedded in concrete. Based on the inspection of a number of other poles in the SIA, immediate corrective measures and change in the future design of poles in the SIA were recommended.

18. Corrosion in vacuum overhead system at KNPC - Mina Abdulla Refinery.

Frequent failure of overhead air cooler of vacuum column was investigated at the request of the Refinery. The report discusses various design and operation factors and based on life and economic considerations recommends a new neutralisation system to control corrosion within reasonable limits.

19. Failure of reinforced concrete caisson at KNPC Mina-Abdullah Refinery.

Failure of reinforced concrete caisson due to corrosion of rebars was examined. The report discusses the problem and recommends repair methods to make the structure safe.

20. Training activities of corrosion group in SAA.

Gives broad approach to training of personnel of various levels in the corrosion and inspection group. Recommends a programme consisting of in-plant training, participation in design and execution stages, on-the-job training and short and medium term courses conducted by different organisations. A selective list of training courses in different parts of the world is included.

21. Corrosion control in air-conditioning circulating water system in various SAA buildings - 2 reports

Studies corrosion of corrugated louvres in the air-conditioning circulating cooling water system, outlines causes and recommends corrective measures to reduce corrosion.

In the 2nd report details of long term laboratory and field studies have been given to control and monitor corrosion.

22. Corrosion of carbon steel pipe in fresh water service at the Gulf Paper Manufacturing Co.

Rapid perforation of fresh water supply header was investigated and corrective measures consisting of changes in material or operating conditions were recommended.

23. Manual for painting of structural steel against atmospheric corrosion.

The Manual gives details of type of surface preparation and paint to be used under different conditions of exposure. It also includes supervision and inspection necessary during execution of any painting job. This Manual has been designed for use as a guideline to the preparation of paint specifications and tender documents

24. Failure of MEA reclaimer tube bundle for natural gas treatment.

Investigation of failure of stainless steel tube bundle in the MEA reclaimer of hydrogen plant of Petrochemical Industries Co. was carried out. The report discusses causes of failure and concludes that the failure is due to sheil design near the tube sheet end including the location of the shell inlet combined with operating conditions.

25. Repair of corroded cast iron valves in sea water fire fighting system of oil pier.

C.I. valves with stainless steel trim start leaking after 3 - 4 years of service. A number of valves were involved and as these were discarded a method to salvage them was recommended. The repair procedure consisted of providing eutectic weld around the trim/C.I. interface, which not only sealed the leak but also shifted the point of galvanic attack from the threaded area to thicken the main body.

26. Protection of piles and support structures of oil pier against corrosion damage.

Discusses the existing condition of the H and tubular piles of oil pier and recommends steps necessary for further protection of tidal and splash zones against corrosion. Gives technical details which can be used to prepare specifications and tender documents.

Chemical Analysis

27. Evaluation of the existing situation in the Environmental Protection Centre with respect to chemical analysis. - 2 reports

In the reports the situation in EPC at the start of the project was evaluated, based on which an initial work plan and short term recommendations were prepared.

28. Recommendations for analytical methods. - several reports

Alternate methods were selected for analysing: Dissolved Oxygen (D.O.), Chemical Oxygen Demand (BOD), Total Organic Carbon (TOC), Ammonium, Nitrite, Nitrate, Total Kjeldahl Nitrogen (TKN), Urea, Phosphorus forms, Silica, Cyanide, Phenols, Sulfide and its forms, Petroleum hydrocarbons, Chlorinated hydrocarbons, Organic micro-pollutants and oil slick.

The comparative study of the alternative methods will help in the selection and adaptation of methodology suitable for the purposes of environmental pollution control in the Shuaiba Industrial Area, and for the analysis of different types of waters and for the identification of oil pollution.

29. Guidelines for storage and preservation of water samples.

Storage and preservation of water samples are essential to get meaningful results during the analysis of various constituents because of possible changes occuring between collection of samples and their analysis. Factors to be

taken into account during storage are discussed and a summary given of the circumstances and techniques to be considered and applied when handling of water samples between collection and analysis.

30. Proposal for reorganisation of the EPC laboratories.
The report reviews the existing organisation of EPC and suggests reorganisation which is necessary for optimum utilisation of available resources to meet the needs of the centre. Detailed justification of the new organisational structure has been given.

31. Study of the automatic water quality monitoring system.
Sampling and analysis programme for a comparative study between the automatic water quality monitors and laboratory tests have been prepared. After the implementation of this proposed programme and the evaluation of the results, it will be possible to establish the suitability of the system.

32. Training activities in chemical analysis at EPC.
The report broadly reviews the present and future training activities of different levels of staff in the EPC and recommends the desired approach for training staff of different levels.

33. Development of pollution control standards for Kuwait.
The report gives a general review of standards along with a workplan for consideration by the Standard Committee set up under the Environmental Protection Council of Kuwait.

34. Sampling programme for water pollution control at SAA.
The report gives sampling programmes for the outfall/intake of treated water in SAA as well as for the inshore waters for implementation by EPC. The programme includes the selection of quality parametres, the techniques and frequency of sampling.

35. Workplan for laboratory experimental study for the determination of various constituents in Shuaiba's industrial effluents. - several reports

Workplans for laboratory experimental studies were prepared in order to adapt selected analytical methods such as for COD, ammonia, urea, petroleum hydrocarbons, silica, etc. The experiments performed in the laboratories, will help in the standardisation of analytical test methods tailored for Shuaiba's conditions.

36. Monitoring programme for the protection of Shuaiba inshore water against the Iranian oil slick.

The damage of the Iranian offshore oil wells resulting in the formation of a massive oil slick in the Gulf, created a situation whereby the possibilities of oil pollution of Kuwait inshore water has increased. The report recommends a monitoring programme for water and sediment analysis (petroleum hydrocarbons) and for beach survey (tar balls) to protect the desalination plants and the industries.

37. Air quality measurement methods.

The report reviews the currently used analytical methods for air quality measurements. Based on the evaluation of these methods, recommendations have been given for future applications for the selected constituents, such as NO_x, OS_2, Ammonia, Urea and dust.

38. Manual on examination of waters in the SIA.

As a result of review, adaptation and development of analytical methodology for Shuaiba's waters, a Manual has been prepared which summarises the methods tailored to Shuaiba's water for the analysis of the selected and most significant constituents. The Manual is mainly concerned with those constituents, of which the analytical examination is influenced by specific, local conditions, e.g. interfering materials, etc.

The Manual contains guidelines for the determination of the following constituents: dissolved Oxygen, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonia, Nitrite, Nitrate, Total Kheldahl Nitrogen (TKN), Urea, Phosphates, Sulfides, Cyanides, Phenols, Petroleum Hydrocarbons, Chlorinated Hydrocarbons.