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INDUSTRIAL SAFETY IN POST-WAR KUWAIT

TF/KUW/91/002

STATE OF KUWAIT

Technical report: Industrial safety requirements in post-war Kuwait*

Prepared for the Government of the State of Kuwait
by the United Nations Industrial Development Organization
under the Inter-agency Plan of Action for ROPME
(Regional Organization for the Protection of the
Marine Environment Region)

Based on the work of D. J. Lewis, UNIDO consultant

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* This document has not been edited.

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EXPLANATORY NOTES

CTA	Chief Technical Adviser
EPA	United States Environmental Protection Agency
EPC	Environmental Protection Council, Kuwait
EPD	Environmental Protection Department, Kuwait
KNPC	Kuwait National Petroleum Company (KSC), Kuwait
KOC	Kuwait Oil Company (KSC), Kuwait
KISR	Kuwait Institute for Scientific Research, Kuwait
LPG	Liquefied Petroleum Gas (Propane, Butane or Mixtures of these with minor amounts of other unsaturated hydrocarbons)
PCB	Polychlorinated Biphenyls
PIC	Petrochemical Industries Company (F.P.), Kuwait
ROPME	Regional Organization for the Protection of the Marine Environment
SAA	Shuaiba Area Authority, Shuaiba, Kuwait
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization

ABSTRACT

UNIDO organized a short mission to Kuwait by an expert in Industrial Safety under project TF/KUW/91/002 as part of the initial survey and assessment phase of the UN Inter-Agency Plan of Action for the ROPME Region approved in March 1991 and co-ordinated by UNEP. The objective was to assess the current post-war Industrial Safety position and to prepare proposals to deal with the immediate rehabilitation phase risks as well as aiming to ensure that the medium- and long-term future industrial risks in Kuwait are kept at an acceptable level.

The approach followed in Kuwait has been to see where safer methods of working could be adopted and effectively enforced. This follows the principle that, by reducing the risk of accidents, both the safety of people and the state of the environment in the ROPME region will be improved. It also included some of the problems of existing wastes and other continually produced industrial wastes as these were also of concern within the ROPME region.

The mission covered the period 26 January to 18 February 1992, during which 17 visits were made to industrial establishments and other organizations in Kuwait dealing with various aspects of industrial safety. Eight of the industrial establishments visited were working to various degrees of design capacity.

It was found that in Kuwait, standards of industrial safety were highly variable, with the more routine guarding of machinery and prevention of falling accidents being generally of a poor standard. The actual wearing of correct appropriate personal protection equipment (headgear, footwear, face and hand protection, etc.) was not being effectively enforced and in many places, requirements for the use of such personal protection were not called for. This meant that all those working on industrial installations were generally exposed to unnecessary hazards and risks of personal injury.

Kuwait was observed to have considerable potential for major accidents involving the large amounts of toxic and flammable liquefied gases in storage. It did not appear that these major hazards had been adequately studied in depth, with the result that the risk was probably not adequately countered by appropriate safety actions (including land use planning).

A number of conclusions are given on pages 26 to 33 from which four specific proposals in which UNIDO could assist have been given. These are set out on pages 37 to 48. In addition, there are two recommendations for action that can be taken by the Kuwait authorities independently which could improve the present and future environmental conditions in Kuwait. The following paragraphs briefly summarize the four key proposals recommended for consideration by UNIDO.

1. It is recommended that Kuwait develop a Modern National Safety Policy, as well as the means to enforce it at all levels of industrial activity throughout Kuwait. To achieve this, Kuwait is recommended to set up a Study Group of about four key Ministerial Representatives for which UNIDO could arrange visits to authorities and suitable industrial activities in Denmark, the Netherlands, the United Kingdom and the United States of America to examine their current practices in Industrial Safety, Waste Management and the Transport and Storage of Dangerous Goods. Alongside this, nominated safety specialists from Kuwait could be assisted by UNIDO in the examination of techniques for the assessment of Major Hazards with assistance in setting up such expertise within Kuwait. A further related activity could be the assistance by UNIDO of an in-depth hazard study and full reliability analysis of critical processes and activities involving

major hazards on the Salt and Chlorine Complex operated at Shuaiba by Petrochemical Industries (F.P.) Kuwait. Additional justification for changes in Safety Policy could be provided by further UNIDO safety review missions looking at the four key activities: crude oil production, oil refining, liquefied gas production and also natural gas distribution.

2. Since the question of how to dispose of arsenic-containing solutions and arsenic-treated mild steel scrap was raised during the missions, it is recommended that UNIDO could assist in dealing with this in methods of concentrating and changing the form of the arsenic contamination so that a smaller volume has to be disposed of in a safe waste depository with considerable quantities of liquid and scrap mild steel being released for normal disposal as safe materials.

3. The present position in Kuwait is that quantities of waste lubricating oil and waste solvents need to be disposed of. It is recommended that waste recovery units for these two classes of liquids should be considered by the Kuwait authorities and UNIDO could assist in preparing proposals for such plant units.

4. As there is a regular production of petroleum type sludges at various stages in the activities of Kuwait Oil Company and Kuwait National Petroleum Company, it is recommended that Kuwait should consider a dedicated incinerator to deal with these sludges (excluding specialized wastes such as used catalysts and iron sulphide containing sludges). UNIDO could assist in this by providing expertise in the area of refinery type incineration units which have proved of value at many locations. The aim would be to provide a simpler and more economic incinerator than would be required if it was specified to cover a wide range of difficult waste materials.

The proposal on developing a Modern National Safety Policy is elaborated in a draft project document, while the others are described in a more narrative way. All proposals are to be forwarded for consideration and inclusion in the Consolidated Rehabilitation Programme for the ROPME Region after being finalized by UNEP in co-operation with other UN agencies.

The other two recommendations made for the Kuwait Government related to a suggestion that future supplies of catalysts and similar materials that have created waste disposal problems should be purchased using contracts that stipulate that the original supplier takes back the used catalysts and is responsible for their recycling or safe disposal and also to a suggestion to improve the burning of excess natural gas in the oil fields by steam generation and injection into the temporary flare stacks. The latter recommendation is aimed at minimizing the smoke production whilst the oil fields are being rehabilitated.

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INTRODUCTION

Kuwait has current safety and environmental problems which have been of major concern to ROPME and other organizations since the liberation of Kuwait in early 1991. Many of the major environmental concerns, such as the burning of the oil wells, crude oil pollution of the Arabian Gulf in the ROPME sea area and oil lakes in the oil field area, have been well highlighted world wide.

At the same time, liberation also exposed problems in the area of hazardous wastes. A previous review of hazardous waste problems in Kuwait was made in 1991 for UNIDO which identified problems of hazardous waste storage that were present in Kuwait already prior to the invasion by Iraq in August 1990. Difficulties were found in identifying the nature of many of the hazardous and other wastes in the post liberation months as not only had records of materials been destroyed or lost, but in many cases the owners, operators and other staff of small businesses had left as part of the exodus of non-Kuwaiti residents during and subsequent to the Iraq invasion.

As part of the UN Inter-Agency Plan of Action for the ROPME region, UNIDO organized the mission reported here with the aim of conducting an assessment examining how industrial safety improvements could assist the present and future conditions in Kuwait. There are two basic philosophies in this approach which are:

1. The greater usage of safety technology can reduce the frequency and scale of industrial accidents. Substantially all accidents or unsafe activities produce larger environmental consequences (e.g., fire, toxic gas or vapour releases, plus liquid and solid wastes) than will arise through normal and fully safe operation of activities.
2. If the potential problems of the safe disposal of hazardous wastes are introduced into hazard studies of activities, ways can be identified whereby waste production can be minimized as part of the design of an overall activity. Wastes can be concentrated wherever possible (to minimize the demands on safe burial or other final disposal methods) and, where logical, the hazardous wastes should be treated to become innocuous or incinerated as an integral part of the activity. The final step can be done at maximum efficiency if the treatment or incineration is specifically designed for a limited range of materials.

This mission is accordingly directed towards the assessment of medium- and long-term safety improvements and waste minimization opportunities plus associated concerns where they interact with the above aims. One such concern is the general policy to be adopted in respect of land usage planning, both for reconstruction and future developments.

This mission was undertaken by Dr. D. J. Lewis, an Industrial Safety Expert during January and February 1992 covering a period of 18 full days spent in Kuwait. The job description and the duties identified therein in establishing the mission are as set out in Annex I. The mission was identified as an exploratory mission whose duration was strictly limited by other factors.

At the time of the mission, the Kuwait Authorities were strenuously working towards the restoration of a major part of the industrial activity (power plants, oil and gas gathering systems, refineries and the large petrochemical activities) which previously had contributed a large part to the Kuwait economy. The result was that only selected installations were able to be visited when in the operating state, with many significant installations being under repair as a result of the hostilities or awaiting the availability of feed supplies from other units or the restoration of product distribution

arrangements. The conditions accordingly did not allow a thorough assessment to be made of all the industrial sectors in Kuwait.

The limited duration of the mission, plus the need to obtain access to a number of sites which were security-monitored to a high level, only allowed very short visits to be made to individual parts of the industrial sector.

The main counterpart was the Kuwait Environmental Council which arranged the schedule of visits made and discussions held. Discussions were held with the Kuwait Ministry of Social Affairs and Labour plus the Kuwait Environmental Protection Department to make some assessment of past and present Kuwaiti activities in respect to industrial safety.

It is considered that the results given in this report are a starting point for consideration by the ROPME Executive Council and UNIDO. The recommendations and proposals outlined will be forwarded to UNEP for inclusion in the Consolidated Rehabilitation Programme for the ROPME Region, currently being finalized. Various specific recommendations are made arising from this mission following a number of different approaches. Further missions should be considered in order to extend the examination of the industrial sector in Kuwait and produce additional recommendations. There is also the desirability of more time being made available during further missions to examine Kuwait national policy and planning activities in respect to industrial safety in the context of the interactions with surrounding activities, emergency planning and the minimization of undesirable environmental interactions.

I. ACTIVITIES

The activities carried out during the mission covered short visits to a number of operating and inactive industrial facilities plus visits to a number of Ministries, Departments and other organizations active in Kuwait. Some of the problems existing before the war were examined and also the industry-related environmental pollution produced by the Iraq occupation, the subsequent liberation and efforts to resume normal operations. The level of general medical supervision of personnel employed on industrial plants was seen and examined where this had an industrial safety impact. Activities on the industrial sites visited were compared with other general activities within the Kuwait City area which had a safety implication.

A. Crude Oil Production and Handling

One gathering station and one tank farm in the Al Magwa oil field were visited following discussions on the activities of the Fire and Safety Division of Kuwait Oil Company.

Damage had been caused by the Iraqi forces at both sites which were partly operational at reduced rates whilst repair and reconstruction work was progressing as rapidly as possible. The main engineering standards being followed were good in respect of design, installation and maintenance.

Different standards of storage tank fixed water protection (spray systems to cool the tank walls and also to extinguish fires) were noted on newer tanks that had been installed alongside older ones. It was considered sub-standard practice not to have upgraded the protection system on the older tanks to a higher standard after the installation of more modern systems.

Whilst appropriate personal safety precautions such as the wearing of hard hats and hearing protection were in many places called for by appropriate entry notices, it was observed that these were not being enforced at the gathering station visited.

Certain temporary supporting of operating pipework whilst other work was in hand was considered to be inadequate as it was jacked up from the desert alongside excavations. It was also noted that significant amounts of pipe work did not have lateral and lengthwise restraint systems to allow expansion under temperature variations whilst preventing excessive movement. This was also considered to produce unnecessarily high risk of pipe movements and failures.

The problems of inspecting the major buried oil and natural gas pipeline systems in Kuwait were discussed in terms of effective isolation in times of failure/leakage and also the time taken to trace leakage positions (day and night) in order to limit the environmental pollution that resulted. This was currently done by using helicopters on loan to avoid the problems of land vehicles traversing the route; but this situation was stated to be temporary. The time taken to cover a line route by land vehicle from each end with two vehicles was stated to be about three hours in some cases and the problems where parts of the desert had not been cleared of mines and sub-ordnance were considerable at the present time and likely to be for some time into the future. The condition of the pre-war cathodic protection systems on pipelines was not known with confidence and it was agreed that there would be more risks of corrosion and pipe leakages now than before the invasion.

The sites seen had adequate fire water pumping arrangements although it was identified that water supplies in some field areas were not adequate at present. It was stated that KOC had

proposed the installation of larger diameter fire water ring mains around some fields and sites to improve the flow rate of fire water to provide adequate fire-fighting capability.

The tank farm visited had experienced two successive tank boil-overs of one large tank set on fire by the Iraqis. This had produced the predictable fire area expansion which had overwhelmed the bund area and engulfed at least one fire truck.

The inter-tank spacing distances used and also the spacing of tanks from other items that had been adopted were larger than current European standards and represented an intelligent use of the lower constraints on land usage that exist in Kuwait.

B. Salt and Chlorine Complex

The salt and chlorine complex of Petrochemical Industries Co. at Shuaiba was visited. Most of the unit was inspected whilst it was operating although the caustic soda evaporating, finishing and packing plant was not visited as it was not operating.

The general standard of the plant installation (later understood to be about five years old) was high, with modern equipment and extensive usage of corrosion resistant materials. No signs of the effects of corrosion or its consequences were observed.

The general standard of plant safety in respect of the major hazards of brine electrolysis and the usage of the products was high and acceptable; but there were some serious lapses in both design and operation in the less specialized safety area. These were as follows:

- (a) The absence of interlocks on the doors of the two salt centrifuges which were seen in the open state with the machines running. There were no signs that any interlocking systems had been fitted at any time in the history of the plant.
- (b) Many glass rotameters in the cell room were fitted with the normal outer protective shields; but a significant number were seen in operation where the outer shields had been removed for some reason.
- (c) Unsafe operator access was observed during a period when attention was being given to a blockage in the magnesium carbonate feeding hopper and conveyor system at a point which was high above the floor level of the salt silo.
- (d) The guarding of the belt drives for the air compressors was well below modern safety standards.
- (e) The chlorine line isolating valves immediately below the relief system on each of the four liquid chlorine stock tanks (each of 100 ton capacity) were easily accessible from an operating platform over the tanks and they were not locked open. Accordingly, the relief system on any one (or more) of the chlorine stock tanks could be easily isolated from the tank by unauthorized closure of the isolating valve, which is a very unsafe and potentially hazardous situation.
- (f) At the 20 ton road tanker liquid chlorine filling point, there was no system of interlocking the road barriers at each end of the articulated tanker (no barriers installed) with the valves on the liquid chlorine and vapour chlorine lines. This system of interlocking is now accepted as an essential safety feature of any filling system over road or rail vehicle with liquefied gases and especially with toxic gases.

(g) The complex did not have any radio communication sets which are essential for handling emergency situations on plants of this type. It was understood that units held on the site had been taken by the Iraqis and not replaced.

(h) Whilst the final evaporation of caustic soda to dryness was not examined, the drum filling position was walked past. This did not appear to have an adequate guarding system to protect operators and others passing nearby from splashing by hot molten caustic soda.

(i) The tanker filling positions for caustic soda liquor and aqueous hydrochloric acid were not seen, but it was felt that there probably were safety concerns there by analogy with the other filling stations seen.

It was claimed that adequate face and hand protection was available for the site; but not enough operators were observed to see how well this was being carried and used where required.

On the other hand, the emergency hypochlorite chlorine absorption tower system was well designed and maintained. Both the DC stand-by caustic pump (used to cover the run up time) and the stand-by diesel driven alternator set were tested weekly. This was considered to be an excellent emergency installation.

The wide mixture of hazards on this plant and the considerable variation in the observed safety standards in operation (plus the considerable potential hazards during maintenance) led to the view that this plant required an in-depth hazard study and reliability assessment of key parts of the system if it was to comply with modern safety standards. The individual size of the units were not too large and with a quite new plant, one would expect the documentation relating to design to be available for such a study - see recommendations and project document.

C. Ammonia and Urea Complex

This complex was made up of a number of large-scale ammonia and urea production units operating on natural gas feedstock to the reformers. The size of the plants (designed for the export of urea and liquid ammonia in addition to Kuwait's requirements) can be judged from the liquid ammonia storage facility. This was made up of a 30,000 ton double-walled tank (used as the main storage) plus two smaller single-walled tanks positioned in a single bund. The three tanks were empty at the time of the visit and undergoing various stages of inspection and overhaul prior to be recommissioned. One of the smaller ammonia tanks had been found to be unsuitable for further service and it was stated that it was going to be dismantled. It was intended that the other single-walled tank would be repaired as necessary and returned to service as a stand-by tank.

One of the ammonia units was in the process of being prepared for start-up whilst various items of the other ammonia units were under maintenance. The urea units had been operated during the Iraqi occupation to use up the large stock of liquid ammonia held at the time of the invasion. Further work on the urea units awaited the start-up of one or more ammonia units.

A short tour was made of this very large complex (mainly at ground level) as time did not permit a detailed inspection. When a plant is being prepared for start-up, it is very difficult to assess the overall safety standards on a plant due to many activities such as opening up vessels and purging out which are quite different to normal operation.

It was reported that liquid ammonia will not be able to be exported for some time as the specialized loading pier has to be reconstructed.

The general safety standard being followed on these large plants appeared to be good and in line with the normal safety standard for specialized high-pressure and high-temperature processes. The design technology appeared to be up-to-date and specifically, the adoption of a double-walled tank with integral flare for vented material was in line with up-to-date practices for liquid ammonia storage.

Personal safety protection was in use at a level appropriate to the different hazards on this large complex and some of the measures were seen to be enforced to a limited extent. Provisions for safe refuge for personnel which incorporated installed compressed air bottle feeds to air masks were shown and found to be up to modern standards and fully satisfactory.

Whilst it was impossible to cover more than a small portion of the overall complex, a few aspects worth noting were as follows:

(a) A considerable number of process pipes were being examined at bends for thickness reduction due to corrosion and/or erosion. It appeared that appropriate steps were being taken to avoid local pipe failures, but to what degree the inspection was being based on previous corrosion/failure history or based on random sampling was not ascertained.

(b) Ear plug protection was available to personnel working or present in noisy areas, but it was acknowledged that enforcement of the use of such devices was a major problem where the Arab Gitra/Chaf-Fiah is worn.

(c) The belt conveyor for urea located at the bottom of the urea prill tower was inadequately guarded, particularly on the vertical belt tensioning section.

(d) A number of guards around machinery drive couplings, etc., were inadequate to meet modern safety standards.

(d) Whilst adequate and suitable protection for personnel protection against gas releases were shown, it was not clear how the start of releases was detected and the appropriate warnings sounded to advise those on the plant to take precautions.

Due to the location of the PIC site at Shuaiba, there was the potential for immediate interactions with the adjacent refinery and the Shuaiba dock area in the event of toxic gas releases. The programme of this mission did not permit the detail and adequacy of on-site and off-site emergency planning arrangements to be examined in detail.

D. Health in Industry and Environmental Protection Activities

As this mission had been arranged by the Environmental Protection Council in Kuwait, the work carried out in the areas of the health of those employed in industry and the environmental consequences of industrial activities formed a key part in the mission. This was the result of the guides for the various mission visits being drawn from within those working in the health of employees and the environmental pollution fields. The various establishments from which the counterpart guides were drawn were visited (at Shuaiba and Shuwaikh) and the work they normally carried out was discussed at some length.

The activities in this area come under the Environmental Protection Department of the Kuwait Ministry of Public Health and from these discussions, the following understanding was gained as to how industrial safety (in the broadest sense) is approached in Kuwait. The problems of enforcement of established general safety principles were also dealt with to a limited extent.

(a) Organization of Labour

The labour force in Kuwait appears to be divided into at least three sectors which are covered by different legislation and key ministries in respect of ultimate responsibility. The identified sectors are:

The Oil Sector
The Government Sector
The Private Sector

The oil sector was understood to cover all the activities strictly relating to oil production, refining and export so that it is made up of KNPC, KOC and the Kuwait Oil Tanker Company (all owned by the parent company, the Kuwait Petroleum Corporation). The government sector includes employees of the various ministries involved with government activities and services in Kuwait and as such is mainly outside the industrial sector. The private sector includes all privately owned or partially owned industrial activities in Kuwait which included Petrochemicals Industries Company.

One significant industrial activity in Kuwait is electricity generation and associated large water desalination plants which use exhaust steam from the turbines. This activity was not classified into the above three sectors.

(b) Ministerial Responsibilities

Various Kuwait Ministries have responsibilities over different activities which involve many safety considerations. There did not appear to be a general system of effective inspection and enforcement of safety standards across the country as a whole. Whilst certain Ministerial Decrees allowed for 'inspections' to be carried out and also set broad requirements for precautions to be taken when handling dangerous processes and substances, first aid and medical examination requirements, medical services to industry, etc., it was not found that these were implemented to the same degree in different industries. Whilst Kuwait has uniformity in defining industrial injury or impairment of health arising from industrial activities in terms of a comprehensive scale of compensation without any need to prove that an employer or his representative was at fault, this was considered to lift a lot of safety responsibility from employers as they were not being enforced to take safety measures as in other countries and could avoid expensive litigation and publicity as a result of accidents.

The main ministries involved in safety considerations are as follows:

Ministry of Social Affairs and Labour - now has responsibility for the 'Private Sector Labour Law' and associated Decrees plus a new responsibility to centralize the organization of safety with other ministries.

Ministry of Oil - mainly concerned with the KNPC and KOC areas of activity.

Ministry of Electricity and Water.

Ministry of Public Health - has the general responsibility of providing medical services to industry and also to consider the effects and implications of environmental pollution.

In addition, other Ministries such as those of Planning, Interior, Commerce and Industry and also Civil Defence (who now have responsibilities for Municipal Fire Brigade) will have some interaction with certain safety considerations.

(c) Environmental Protection Council

This Council is under the Ministry of Public Health and is understood to be vested with a co-ordinating role in the broad field of environmental pollution. It does not appear to have significant back-up resources and has to rely on other ministries and departments for assistance. It has taken some initiatives in establishing a Committee to look at the problems of dealing with the oil lakes issue (on which no decision has yet been reached) and prior to the Iraqi invasion, was involved in preparing proposals to deal with the Kuwaiti accumulation of solid toxic wastes and future problems from continual production of wastes in general. It also has the responsibility of formulating national environmental pollution projects and in considering some aspects of emergency planning.

(d) Industrial Medical Centres

Forming part of the services of the Ministry of Public Health to industry, a number of industrial medical centres have been provided for the routine examination of employees together with the treatment of persons involved in industrial accidents or developing an impairment of their faculties as a result of their employment. The largest unit seen of this type was at the Shuaiba Industrial Areas and it operates in association with the Shuaiba Area Authority's Environmental Protection Center.

(e) Environmental Protection Department

Part of the activities were co-ordinated with the Shuaiba Area Authority's Environment Protection Center where the interests of environmental protection with the designated area were carried out by the Shuaiba Area Authority. Outside this area, the Environmental Protection Department operated its own laboratories and specific interests seen therein were the examination of atmospheric pollution levels plus the levels of pollution of ground and sea water. Other work undertaken was the study of specific pollution problems and work in considering the nature of waste materials present in Kuwait.

The Department has a small section that is involved in the evaluation of environmental impact assessments in respect of the normal operations of a considerable number of small private industrial activities. The available locations were those already designated as industrial areas and some concern in the presence of some activities in the Shuwaikh Industrial Area in respect of their potential effect on areas outside the industrial area was commented upon.

(f) Shuaiba Area Authority

This Authority was originally set up in a limited form in 1975 and has had its role strengthened by various Decrees since then so that it now has responsibilities for monitoring pollution in the Shuaiba East and West Industrial Areas. These large areas include considerable areas used or reserved for oil activities as required by KNPC and KOC. In this Shuaiba area, the Authority effectively carries out the responsibilities exercised by the Environmental Protection Department in other industrial areas.

They have limited authority to licence plants, (claimed to include all aspects of safety), but it was observed during this mission, when plants in this area were visited, that any enforcement actions appeared to be limited to ascertaining that a company's policies as stated complied with the broad safety requirements of the Law. The expertise available in the specialized safety field appeared to be very limited and in the context of enforcement, they stated that the action would be to issue reports to the organization involved and the ministry concerned. No indication was given that they play any role in the investigation of accidents or carry out any broad assessments of the major accident hazard potential of the plants in their areas.

(g) Specific Comments Made Relating to the Observed Activities in This Area

Much of the regular work seen, related to the assessment of the effects of industrial activities on industry employees. Comment was made that many showed signs of loss of hearing, but nothing seemed to follow this in ensuring tighter enforcement of hearing protection being worn when on the industrial sites.

The routine monitoring of the standards of water distributed in Kuwait, the state of the marine environment in nearby waters of the Arabian Gulf and waste water quantities used for irrigation purposes were being carried out routinely and adequately. Likewise, the monitoring of stack discharges from selected power station stacks and other sites were carried out by the various organizations involved (EPD and SAA).

Some assistance had been provided in assessing what are the various wastes found since the liberation and they had been involved in preparing long-term hazardous waste incineration and safe site dumping proposals prior to the invasion. They also claimed that they were monitoring the medical effects caused by the exposure to the heavy environmental pollution that was present when the oil wells were on fire and also by the effects of the oil pollution in the Arabian Gulf.

As part of the EPD activities, the Shuaiba Area Authority has completed Phase I of a project to provide central wastewater treatment facilities for the sanitary and industrial waste water that is generated at the Shuaiba Industrial Areas. Phase II of this project (which is the preparation of design and tender documents) is expected to commence in July 1992. The levels of toxic materials that are allowed in the design waste water flows are quite low, i.e., it is clearly aimed at dealing with only lightly contaminated industrial waste water flows. It will produce as a byproduct, water for irrigation purposes.

The medical and other examination rooms seen together with the laboratories appeared to be adequate for the stated objectives although some equipment shortages arising from the hostilities have been previously reported and were again pointed out. In addition, there was a shortage of trained laboratory staff and appropriate technical reference documents.

Assessing both the laboratory working conditions and also the practices followed by accompanying staff members on visits to other establishments of an industrial nature, certain comments in the safety field need to be set out:

(a) There appeared to be a very low level of laboratory safety precautions taken by staff members when they were handling acids and other dangerous chemicals.

(b) When out on sites of an industrial nature, staff did not have their own personal protection equipment.

(c) No laboratory was seen that was suitably equipped with fume cupboards and storage arrangements for handling quantities of flammable solvents, petroleum crude and products plus combustible materials.

(d) It was apparent that current waste problems were calling for work which was outside the previously handled areas for which staff had received safety training.

(e) It appeared that the current wave of post-liberation waste problems was overwhelming resources and this could be responsible for some safety considerations being pushed into the background.

There appeared to be good potential within the Environmental Protection Department for the various waste problems to be sensibly tackled without any unjustifiable over-reactions to the hazards presented by low-level toxin problems. Pre-conflict plans for incineration and the use of remote desert dumping sites now have been radically upset as a result of the effects of the mines and sub-ordnance now in many remote areas of Kuwait.

If the EPD was going to become effective in the general area of waste material problems, one would expect them to need to develop a mobile sampling laboratory equipped with suitable personal protection equipment for the persons who will operate it. One would expect a lot of useful experiences to be available from the US Environmental Protection Agency in this context.

It was noted that the Shuaiba Industrial Medical Centre operated a comprehensive survey system for analyzing injuries resulting from industrial accidents. How much of this is returned in a way that is of direct safety value to the industrial organization concerned is not clear as many of the visits (particularly to the large organizations) proved to have some difficulty in their arrangement and certainly the guides from the EPD appeared to be seeing safety in industry in detail as a different experience to the normal activity. For the activities of EPD as a whole to attain maximum effect, one would expect a close relationship to the various installations involved to be part of the necessary training and background work at higher levels.

E. Power Stations and Desalination Plants

Visits were made to the East Doha power station and desalination plant and also to both the North and South Shuaiba power stations and desalination plants. At both Doha and Shuaiba sites, the whole complexes were still only partially operational.

Operational units and some of the damaged sections were toured as time permitted and discussions held on various aspects of safety with the operating staff. The general standard for the steam boilers, turbines, alternators, electrical transformers and switchgear was found to be high and in accordance with sound power generation practices. Likewise, the large desalination plants and the incoming brine treatment were of the appropriate standard for large water handling and purification equipment.

Of the transformers that had been damaged, only one was PCB cooled and this had created a pollution problem at East Doha. It was stated at both sites that Kuwait has placed a contract for all transformers known to contain PCB's to be removed and replaced with equivalent units free from PCB's.

The systems in use for oil storage at both sites were considered to be requiring safety improvements. At the East and West Doha stations, the tanks storing fuel oil, diesel oil and gas oil are located between the two generating buildings and extended to within about 100 metres of the station buildings (with fuel oil pumping stations in this space). The tank bund walls are only about 2m high with sloping facings whilst the 25,000m³ capacity tanks were about 20m in height. This situation means that any catastrophic tank wall failure can involve the power station buildings and also the boiler units to the north of them. At Shuaiba (where the fuel was normally natural gas), the gas oil tanks were situated well away from the power station buildings but were considered to be capable of improvement in respect of water fire-fighting facilities.

It is suggested that a higher bund wall is desirable on the sides of the tank farm at Doha (of the order of 10m in height) plus an effective large drainage gully on the power station side to protect the power stations in the case of major spillages.

In the case of both power stations, the tanks were considered to require more extensive water cooling of the vertical side walls and also the roofs with cone roof tanks. Some foam systems are also desirable to assist in fire-fighting and it was learnt that when a pipeline fire had taken place at Doha, fire-fighting vehicles had to be summoned some distance from the nearest municipal fire stations.

Both power stations were short of personal protection equipment (hard hats, hearing protectors, etc.) and this resulted in a low shortage of such equipment in areas where it was desirable.

At Shuaiba, the safety arrangements for handling chemicals at the desalination plant were considered inadequate for hydrochloric acid, caustic soda and liquid chlorine. However, safety training of all personnel on a once yearly basis was practiced.

Minor improvements to safety standards on small equipment were noted as desirable and the only waste materials involved were stated to be chemicals used for cleaning and desludging purposes (which had to be stored in drums as no organization willing to accept the used material has been found).

The two sites visited received key supplies by pipeline (petroleum liquids, natural gas and liquid chlorine - at Shuaiba). The question of liaison with the despatching stations in the event of any local problems or pipeline leakages appears to require careful assessment. The large 52" diameter natural gas line at Shuaiba has been found difficult to close off completely at the scrubbing plant isolation valves. This problem can be difficult between industrial sites which are the responsibilities of different ministries and any delay in effective action could have major accident potential.

Control rooms and the routine reporting of the state of plant systems were found to be of a high standard. Senior staff and supervisors were well in touch with many operating personnel and it was felt that they obtained a good assessment of their plant's condition.

F. Bechtel Petroleum, Chemicals and Industries Ltd

A discussion was held with the Manager of Fire and Safety at Bechtel which allowed some knowledge to be gained of the general safety level of the employees that they had engaged in the

problems of extinguishing of the oil well fires and the current activities of recommissioning parts of the oil field operations. This highlighted the problems now found in using Far East labour to replace labour sources from other Arab countries from whom recruitment was now banned by the Kuwait Government. A balance had to be maintained in that safety personnel and all supervisors have to be fluent in the language of the group they dealt with plus English (or Arabic) in order to liaise with the plant management.

It had been found that the existing permit to work systems (hot work, cold work and freeing of all process materials) as in general use in the oil fields was not up to modern standards and had to be strengthened by a second system introduced by Bechtel.

In the field of accident knowledge dissemination, it had been found that even within certain companies in the Middle East, full details were rarely circulated for safety benefit in learning from past accidents.

The inclusion of more than one stock tank within a single bund was unsatisfactory and also that many improvements to the water cooling of tank and sphere walls against the effects of thermal radiation were desirable above even the best standards seen in Kuwait.

G. Kuwait Institute for Scientific Research

The Kuwait Institute for Scientific Research was considered as one of the most prestigious centres for scientific research in the Middle East and operates independently of Kuwait University. It has been engaged upon the consideration of the problems posed by the oil lakes which followed the burning and extinguishing of the oil well fires and has carried out some research work in this area. KISR has a report awaiting authorization and issue "Programme for Remediation of Oil-Contaminated Soil in Kuwait" following the receipt of a large number of proposals to deal with this problem from many countries. One of the first steps is to pump out the oil lakes and recover as much of the material as possible and it was stated that a number of costly tenders to do this have been received in Kuwait and a decision had been taken for this work to be done by KOC jointly with the Bechtel organization currently assisting the rehabilitation of the oil fields.

Knowing from a previous visit to KOC that they propose to improve the fire water ring mains around gathering areas to improve the flow of fire water when required and also to set up water reservoirs in key locations, it seemed that there is a need for co-operation in any work on cleaning up the oil lakes. It was not apparent that KISR had been closely in touch with proposals being considered by KOC.

KISR stated that they are targeting for some biological field trials in April 1992 and it was suggested that UNIDO might be able to assist in setting up and monitoring of the safety standards appropriate to this project and also in the acquisition of a suitably equipped mobile sampling and test laboratory that KISR deemed desirable. To what degree they have considered the problems raised by other organizations in respect of the mines and sub-ordnance that may be within the oil lakes was not made clear.

The Petroleum, Petrochemicals and Materials Division Director of KISR, Dr. Jassen M. Al-Besharah, is anxious to develop expertise in the field of safety, loss prevention and hazard analysis techniques. As a result of the Iraq invasion, a lot of background material has been lost and help is requested in selecting an appropriate replacement reference collection. It was reported that many minor failures in the natural gas pipeline distribution system in Kuwait have taken place during the past four to five months.

It is considered that a suitable training safety study/hazard analysis project would be the salt and chlorine complex of Petrochemical Industries Company at Shuaiba. If this was carried out, the next priority for such studies would be the liquefied petroleum gas production, storage and shipping facilities at Shuaiba followed by the liquid ammonia handling and storage. The hazard study and reliability analysis of key items on these selected plants would be a suitable introduction to those required for the high pressure and high temperature reaction units seen in the refineries and the ammonia and urea production units. This has been developed as part of the draft project document attached to the recommendations which follow in this report in respect of the initial study of the salt and chlorine complex.

H. G T C Paint and Varnish Plant

This plant was situated in the Shuwaikh Industrial Area alongside many other vehicle repair and similar activities and close to the Fifth Ring Motorway. A range of paints of different types were formulated from alkyd resins, etc., plus powders used for colouring and extender purposes. Resins and solvents (white spirit, xylene and methyl ethyl ketone) are imported in metal drums or plastic barrels. The powders are received in paper/plastic sacks on wooden pallets.

An immediate problem raised was the disposal of the emptied drums and barrels which are not steam cleaned prior to offering them for disposal. They have arrangements for disposing of the paper waste which could conveniently be used as fuel in an incinerator feed mixture.

The plant mixing and other equipment is washed clean using water or white spirit/alternative solvent after each different batch of paint has been made. The washings run down through gully drains into an underground 3,000 gallon sump which is emptied into a disposal tanker about twice a week. No solvent recovery was practiced in respect of these waste liquids which it was stated were collected by Kuwait Government tankers.

The main safety problem at this site was that it was far too small for safe working on the present scale of activity. A larger site (about 10 times the present site area) would be required to house the production units satisfactorily, the raw material stores and finished product stores. Four external stores were now being used for these purposes as no satisfactory alternative site had been offered over a number of years. This difficulty in finding an alternative site was not satisfactorily explained, but it is considered probable to be associated with labour availability and travelling problems and also because the present site appears to be less affected by sandstorm winds from the northwest than many of the other industrial sites located in Kuwait outside the main city centre of Kuwait.

The present site had unsatisfactory floor surfaces for the movement of people and materials and was extremely congested with drums being stacked up to about five metres high wherever possible.

Operators were however using face dust masks and gloves that were provided and there was a system of local point ventilation ducting and fans to deal with the worst of the solvent vapours from the mixing and other operations.

The site was considered to be a potential fire and explosion hazard of some magnitude and well below modern safe working standards in respect of available operator working and material movement spacings. The sprinkler system appeared to be the standard type for normal occupancies

and not adequate to cover the large quantities of flammable and combustible liquids present. This type of risk is now being considered as requiring a foam sprinkler system for satisfactory protection levels. Any fire developing on this site could be anticipated to involve exploding drums and paint cans flying in all directions once a serious fire took hold. This could produce an undesirable 'knock-on' effect to other premises and a public hazard.

The plant also produces a small additional waste made up of paint sludge which has to be recovered at intervals from the waste solvent underground tank.

I. Oil Refineries and Liquefied Gas Plant

One short visit was made to the Shuaiba Refinery of KNPC which was not operating as a result of damage sustained during the Iraq invasion and liberation. Work was in hand on a pipebridge that had been damaged, but the crude unit that also sustained damage still had to be repaired.

Later, a visit was made to the large 330,000 barrel/day Mina Al-Ahmadi Refinery where part of the refinery had resumed production of refined products from crude. Alongside this refinery and normally operated by it was a plant for the separation of liquefied petroleum gas and a storage area for LPG. The storage section had been partially put into service by bringing in supplies of LPG by road from Saudi Arabia as a one-off operation. The arrangements for despatching LPG in containers or by road tanker were not seen.

Both of these refineries had sound layouts with the spacings between units being larger than those specified by modern European and US standards and more in line with sound insurers' recommendations. Both had sound fixed fire pumps and ring mains for fire water with hydrants at very frequent intervals. Each had an on-site fire station with appropriate equipment. The Mina Al-Ahmadi Refinery had an extensive stock of foam compound which it was planned to build up to 40,000 US gallons.

These two refineries were reasonably close to each other (as was the third refinery Mina Abdulla), but they were operated as separate units with independent staff. Mutual aid arrangements for fire fighting purposes were stated to be operational and satisfactory. There is a fourth refinery south of Shuaiba at the neutral zone between Kuwait and Saudi Arabia which was also damaged during hostilities and no information was gained concerning this refinery at Mina Saud.

However, the Fire and Safety Sections of the two refineries visited operated independently of each other and the degree of sharing of key loss prevention knowledge and reference material between them appeared to be in need of significant improvement. Both refineries had experienced tank farm fires as a result of the Iraq invasion and sabotage. They also showed variable standards of fire water protection on both fixed roof tanks (depending on when they were built).

One kerosene tank that was set on fire during the Iraqi withdrawal burnt in such a way that firemen had to expose themselves to high levels of radiation in climbing up onto adjacent tanks so that water could pour down and cool the external wall surfaces. This problem had been identified at an earlier fire at the same Shuaiba refinery tank in 1981 when a number of tanks were burnt out. Insurers concluded from this earlier incident the key role that fixed water cooling systems for vertical tank walls can play in controlling tank fires and preventing them spreading. This latest fire endorses this view.

It was stated that there is a greater degree of interaction between the separate refineries than between them as a whole and KOC as their supplier of crude. It was stated that the slops from tankers coming for loading are emptied into a separation system using Dorr Oliver separators to recover crude stock and to discharge adequately pure sea water into the Arabian Gulf.

Floating roof tanks are fitted with rim seal foam dispenser units which are connected to foam producing systems located outside of the bunds. The provision of fire water ring main hydrants was very good.

Two reformer units controlled from a local control room were toured at ground level whilst operating at Mina Al-Ahmadi. The units appeared to be operating in a safe manner and well controlled.

During the visit to Mina Al-Ahmadi Refinery, it was noted that quite different structural fire protection was applied to different units without any clear standardization of what was required. Some units had the cross bracing and key load carrying brackets fire protected whereas other units had these items unprotected as bare steel. This is not what one would have expected within a major organization such as KNPC.

The Mina Al-Ahmadi Refinery has a new central control room for the operation of a number of units and capacity for more to be controlled therefrom. In this control room, details of a well prepared emergency evacuation plan were seen and discussed which seemed to deal with all the likely on-site problems which might arise.

The role of the Fire and Safety Section of the Mina Al-Ahmadi Refinery in respect of its day-to-day involvement with all operations and maintenance activities did not appear to be as well organized as one would have expected as members of the Fire and Safety Section stated they were involved in mainly major repair work and modifications where some operations management had said that they should be consulted. They were not as knowledgeable about all regular operations on the refinery as one would expect and they also said they were not consulted about new project designs. The single clearance form at present in use on the refinery is in the process of being changed into three different colours to identify the different categories of hot work, cold work and entry clearances.

The LPG storage area at the east of the main refinery units was toured and the refrigeration units control room visited. A damaged refrigerated liquid propane tank was seen that had been set on fire at the base connections and also at the top vents by sabotage in 1986. This had created a very intense thermal radiation zone extending as far as the LPG storage control room whilst it burnt for six or seven days before all the contents could be pumped out. The damaged tank was awaiting replacement which was stated to be in hand prior to the invasion. It was also stated that consideration was being given to resiting the LPG storage control room to a more remote position. Following this incident, various high sandbag walls had been built at a distance from each tank (outside the bund) which were now acknowledged to be virtually useless.

The account given of the liquid propane tank fire in 1986 endorses the known major hazard character of a fire that involves just one LPG double-walled tank that contains about 50,000 tons of liquefied hydrocarbon material. No opportunity was given to examine the system for distributing the LPG and filling it into containers and transport vehicles.

Available time during the visits did not permit full coverage of either refinery site and, if this had been carried out, it is possible that other safety considerations could have been noted and recommendations made accordingly. The refineries obviously warrant more extensive safety surveys being made on them.

At the Shuaiba refinery, it was stated that there was a considerable amount of wastes in storage as sludge, solid wastes, used catalysts and used corrosion inhibitors. The used corrosion inhibitor contains arsenic from a previous period when this was used to inhibit storage tanks and other items against corrosion by acidic and CO₂ rich fluids. A definite figure for the arsenic concentration was not quoted, but reference to the use of arsenic as an inhibitor gives the level of arsenic in the solution as used in the range 70 to 2,000 ppm as arsenic with the compound being sodium arsenite (also known as sodium meta-arsenite) which can also be made up as a bulk solution of about 50% strength in water. Whilst this inhibition treatment is no longer used, the old solutions remain to be disposed of plus a secondary problem in that quantities of scrap mild steel plate are now on site where the oxide surface film is arsenic contaminated. Both of these problems were raised as where assistance was required. They have been developed as a recommendation and a project outline attached to the recommendations herein. It was not ascertained if any other refineries and crude oil activities in Kuwait also had similar inhibitor solutions and waste mild steel problems.

J. Kuwait Insulating Material Manufacturing Company

This factory was located in the Mina Abdulla Industrial Area where the present spacing of the various industrial activities was good. This compared favourably with the very congested nature of the Shuwaikh Industrial Area (see item H above).

Part of the fibreglass process involves the preparation of a phenolformaldehyde resin that is used for the coating of the spun glass fibres. The plant was not operating during the visit, but the equipment and procedures described for resin manufacture were considered to match the hazards involved. All feedstocks were received in drums which were stored under cover to protect them from direct sunlight.

The factory was well laid out with adequate space inside, but the units examined showed the usual problems of poor mechanical drive guarding seen elsewhere in Kuwait. Also, a pit in the floor beneath the fibreglass production line was not properly fenced off.

The company were stated to have a newly appointed safety officer who was at present said to be organizing the repair of the damaged sprinkler system, updating key drawings of the plant and also acting as the link person between the company and the municipal fire brigade.

K. Gulf Paper Manufacturing Company

This plant had partly resumed production after being badly damaged during the Iraqi invasion. Their raw materials are recycled cardboard cartons collected in Kuwait, Saudi Arabia and the Emirates plus imported cellulose pulp for the manufacture of tissue paper.

One line used to make cardboard was not operating and of the two lines used to make tissue paper (by Carcano of Italy) one had been recommissioned whilst the other one was being reconditioned for reuse. One of the major problems had been that all their 5,000 spare items had been taken to Iraq or destroyed by fire and this was a limiting factor in the present operating state.

The employees are mainly from Asia and a secondary school is operated by the company to educate them and provide a source for persons to promote. Whilst the company is trying to enforce safety standards, they stated that their workforce showed reluctance to comply and also to use personal protection.

Once again, this factory showed poor standards of machinery guarding and a lack of guard rails over access points to pits in the floor close to the pulpers. In the tissue packing area, the machines were being operated with the roll guards raised and the protective switches disconnected plus drive guards missing over the high speed drive mechanisms. This situation was stated to be due to the poor state of repair of the machines due to lack of spares (which requires frequent operator adjustments and emergency repairs).

Waste water (containing a trace of ammonia) at a pH of seven to eight is collected and dumped by a tanker although the factory had found it to be suitable for irrigation purposes.

The 20 ton mixed propane and butane LPG storage tank was fitted with water sprays, but the use of a long tanker flexible hose for discharge whilst the tanker was positioned outside of the provided spray protected area was considered to be a situation requiring safety improvements. The location of the LPG tank relative to key site features was not up to the latest UK standards.

There was an absence of personal safety protection being used when moving heavy spindles of paper rolls by crane away from the paper-making machine which was considered to be a bad practice.

L. Kuwait Chemicals Manufacturing Company

This installation had been left by the Iraqis with a major part of the plant items and associated equipment having been taken away. The location of the plant was on the Mina Abdulla Industrial Area and prior to the invasion it had operated to make a range of alkyd resins, emulsion bases for paints and a range of unsaturated polyester resins.

Most of the plant had been constructed of stainless steel items and had been left with only about 20% of the initial equipment in respect of process vessels together with no services, control units, etc., although the main storage tanks appeared to be untouched.

This plant is included in the survey primarily because what was still left showed a very good standard of guarding with the general usage of flameproof electrical units. The large storage tanks for white spirit, styrene and other raw materials on the site presented a major fire hazard. Only some of these tanks had a system of external wall water sprays, but even these were not considered to be fully capable of adequately wetting the walls.

M. Fire Prevention and Fire Fighting in Kuwait

Most residential and commercial buildings in Kuwait were of solid concrete or dense block or brick construction with a considerably greater degree of non-combustible material in construction than in similar buildings in the UK and USA. This was partially noticeable in the form of floor and ceiling construction. Kuwait has a set of Fire Rules and Regulations relating to buildings and industrial units which broadly follows the principles used in modern fire standards in Western countries. The normal fire resistance is set as two hours for walls, floors, ceilings and roofs, but this

may be relaxed if an 'approved' fire fighting system is installed. This is taken to be the normal type of commercial building type of sprinkler system although these did not seem to be used very extensively.

As noted in the coverage of the refineries visited, there was a variation in the interpretation of structure fire resistance which has been found in other countries to defeat the objectives in applying fire resistance to the lower parts of key supporting structures. The smaller industrial units appeared to be in a light form of construction with no fire protection of structures as a general rule. The Fire Rules and Regulations recognize the higher levels of hazard with many industrial activities using flammable and combustible materials, but lack any clear guidance as to how the fire precautions should be increased to compensate for the additional hazards. Where sprinkler installations were seen in the smaller industrial units, they appeared to be a standard building type and not adequate to deal with some of the enhanced hazards in the factories.

In a considerable number of industrial sites, there are fixed fire water pumps and sound hydrant systems. Some smaller sites have fire water pumps and it was not able to be established how comprehensive a water distribution system with adequate hydrants and water pressure is available in Kuwait as a whole. It is known that a steady distribution of water by tankers is in hand to various destinations and this must imply that full coverage by water mains is not operative. Hence, it is considered that at least some of the industrial areas in Kuwait could be inadequately covered by fire water supplies and as KOC implied in the context of the oil fields, water supplies for use in any fire emergency require some potential improvement.

How well the municipal fire brigades are trained to deal with industrial fires was not able to be determined. The system of road access to the main industrial sites in the Shuaiba area can be difficult due to the systems of security fencing around individual sites for security reasons with Kuwait soldiers also forming an outer screen to entry to key sites. To move from one site to the one alongside often meant quite a long journey and the emergency plans for escape from within the Mina Al-Ahmadi Refinery confirmed this.

The degree of co-operation in training and other matters between the on-site fire brigades of KOC and KNPC with the municipal fire brigades is a matter that warrants attention as some of the experiences in major fire problems within refineries could obviously be of value in dealing with other industrial areas and their fire potentials if given to the municipal fire brigades.

II. COVERAGE OF INDUSTRIAL SAFETY IN KUWAIT

Certain points of safety concern have been included in the preceding ACTIVITIES section of this report as EXAMPLES of points noted that were significant in arriving at general assessments of safety standards. Only a few of the items noted are quoted as the time available did not permit an extensive and thorough listing of what was of concern in detail. Only selected items have been included as otherwise a more extensive listing MIGHT have led readers of this report to mistakenly conclude that the items given are a FULL list of the safety concern points at each site. The points quoted should be considered as TYPICAL EXAMPLES of the points noted and only SOME of the complete list of all safety concerns noted during the visit.

Whilst many of the points covered in this report were discussed briefly with the relevant Plant Guides and Supervisors during each visit, it was obviously not possible to cover all the issues raised adequately and in-depth. Nevertheless, it is considered that enough items in the safety area were observed to make general recommendations, but other equally relevant and additional recommendations on matters of safety concern would be expected to arise if a more extensive coverage of the sites and plants visited was made.

In preparing this report, the author has noted many aspects of industrial safety that were not able to be investigated fully in the available time. Accordingly, this report should be regarded as a PRELIMINARY survey with many points of detail and potential hazard not being able to be followed up even to the limited extent as would happen during a survey carried out for insurance purposes. However, it has been concluded that enough activity was seen in order to make preliminary recommendations on many points and in particular on the question of the current Safety Policy as effective in Post-War Kuwait.

Many relevant matters tend to be brought to mind when a visit is reviewed afterwards. In all sound safety studies, this has to be followed up by return visits to the same site to discuss the items and carry out further investigations. Very often, these matters of concern are found to be of no consequence in safety, but a specific proportion will lead to the uncovering of aspects of real safety importance.

III. CONCLUSIONS

Whilst the short duration of the mission and the urgency with which it had been arranged did not permit a thorough and wide-ranging assessment of safety problems in Post-War Kuwait, a number of conclusions were able to be reached.

Safety Standards in Large Units

The general safety standards in use for major large-scale units such as power station boilers, turbines, alternator sets, refineries, desalination plants and crude petroleum product gathering and handling were sound and appropriate for such specialized large activities.

Safety Standards in Ancillary Activities

The less demanding safety standards called for in applications such as drive guards, access to small valves, control of key safety shut-off valves, pumping and transfer of corrosive/toxic liquids, access platforms, guarding of pits in floors, and many other 'typically standard' industrial safety situations were not being satisfactorily met. In many cases, it was apparent that it was not just that items had been damaged or destroyed during the hostilities, but that the design had been lacking in the correct safety approach at the outset. All these are safety matters which are well covered by many established standards, codes of practice and working practices which would not require an excessive amount of modification work, additional training or require much supervision to correct.

Personal Safety Protection

In many situations (other than the most demanding ones) there appeared to be a shortage of personal safety protection. The key examples are head protection (hard hats), goggles, gloves, safety footwear and hearing protection. It was acknowledged that the enforcement of those safety requirements shown on area notices was poor, but it was unclear to what extent the present limited availability of items and the specific start-up work contributed to this. It was stated that there was a reluctance from some workpeople to use such safety items and/or a lack of supervisory enforcement due to labour shortages and difficulties with labour.

Safety Preparation for Maintenance

The work observed mainly centred on major repair, general shut-down overhaul work and precommissioning. The adequacy of permit to work/clearance certificate systems could not be checked, but these were stated not to be as good as they should be to match modern safety standards.

Potential Major Toxic Releases

On the large-scale ammonia synthesis plants, the senior personnel were fully aware of the potential effects of releases of large and small quantities of stored refrigerated liquid ammonia. Whilst the chlorine plant was well organized for emergency chlorine absorption, the chlorine stock tanks were inadequately safeguarded because a valve on each tank could easily be hand closed when the tank's key relief system would be isolated.

The potential for leakage from the chlorine line to the Shuaiba desalination plant was not properly appreciated and also the chlorine road tanker filling point was not adequately safeguarded.

Further study of the whole toxic material quantities used within the State of Kuwait appears necessary by following the routes taken by all toxic consignments all the way from the producer or dockside right up to the final usage point.

Major Petroleum Liquid and Natural Gas Pipeline

Events prior to the invasion by Iraq have demonstrated the vulnerability of the key pipelines of 50km to 100km in length to damage (by accident or intent) and also to leakage due to corrosion effects. At present, KOC has two helicopters on short-term hire which allows rapid surveying of pipelines, etc. The provision of specifically fitted-out helicopters with a powerful light to cover the ground and also with heat-seeking/infrared/night vision equipment would greatly increase the potential to rapidly respond to suspected problems thus reducing the safety hazard posed by flammable leakages with the consequential contamination problems to the environment.

A further improvement to the safety of these pipelines would be the provision of isolation valves at about 10km intervals along them so that the likely inventory escape from a leakage point could be reduced (particularly desirable in the case of pressurized natural gas pipelines).

Fire Prevention and Fire Fighting

Whilst the major installations have their own fixed fire water pumping and main/hydrant systems, it was stated that an additional one or more water centre(s) for fire fighting at the oil fields

in West Kuwait area plus larger diameter fire water ring mains are required around various oil gathering areas as these are put back into operation. These may require additional water sources and reverse osmosis plants.

Some of the larger installations also have their own fire fighting vehicles and trailer units specifically for their use and the assistance of other sites who have mutual aid agreements. How extensive these mutual aid agreements were could not be determined nor whether the foam stocks held were adequate for all types and sizes of potential fires (particularly where alcohol resistant foam is required). This applies in the case of a really large full open-top fire on the largest crude tanks in the areas concerned.

Many petroleum product and crude storage tanks require to be upgraded to the latest standards of fixed fire water protection, fixed foam units, tank farm monitors and fire detection systems.

The Municipal Fire Brigades in Kuwait did not appear to be satisfactorily integrated with the fire fighting units at large industrial installations with the result that a full effective response to an industrial fire involving chemicals in an industrial area (Mina Abdulla, Shuaiba, Subhan, Shuwaikh, etc.) was not predictable.

Manpower Supply

The situation in Post-War Kuwait is that many activities are affected by shortages of suitable labour. This will undoubtedly reduce safety standards and impede the effective enforcement of safety procedures. The problem extends into the areas of waste disposal of items created during the occupation and liberation, the reactivation of pre-invasion improvement plans and also in the tackling of regular sources of waste production. The last item is now of environmental concern in the ROPME region as a whole.

Whilst senior management and superintendent grades are filled by Kuwaitis or Arabic-speaking personnel, the current recruitment policy is to bring in workers from the Far East, so creating additional communication, training and enforcement problems in the safety field.

Accident Analysis Details

A number of large organizations are collecting accident data within their own sphere of operations inside Kuwait and also exchanging data within certain industrial safety organizations (mainly within the chemical and petrochemical spheres).

However, it was found that there was not a detailed knowledge of some accidents known to have happened in other Middle East countries and the impression was gained that there was a tendency within Kuwait industry to underestimate the seriousness of many incidents that have happened and also a reluctance to freely circulate full details of them and the lessons learnt therefrom.

Safety Information and Technology

Some of the safety information in the hands of various safety professions was clearly of considerable assistance to them in their work, but it was not necessarily up-to-date by Western standards. No evidence was seen of an effective co-ordination of safety information and

technologies across company boundaries and between the large industrial organizations and other smaller organizations. This does not need to be formalized provided the customary confidentiality rules of different organizations are relaxed between nominated key safety personnel in the full range of organizations who can benefit from such interchanges.

Sources of Waste Production

A number of sites within the petroleum industry have waste materials stored therein and are continually producing waste materials. For the medium- and long-term approach, a three-pronged method of dealing with wastes would be:

1. The insistence in purchasing contracts for materials such as catalysts and similar materials that the initial supplier agrees to accept the used materials back as part of the 'overall hazard responsibility concept' on the part of the manufacturer.
2. All industry-generated wastes should be concentrated by distillation or other means to release the bulk of the waste as initially generated for further use and thereby reducing the volume of the bulk of the residual waste.
3. One or more specific petroleum industry incinerators should be provided and run by the industry itself so that all readily destroyed petroleum type wastes are regularly dealt with 'in-house'.

The proposed general incinerator for toxic wastes for Kuwait should be restricted to the limited materials that require very high temperatures for destruction that cannot be dealt with by the techniques outlined above. These toxic wastes are likely to require sophisticated scrubbing and flue gas cleaning units which will themselves produce smaller quantities of waste materials that will have to be buried as highly toxic materials. These specialized incineration duties should preferably be separated from the simpler petroleum waste incineration which can be carried out within the industry itself by proven practical techniques with lower operating costs and less waste transportation than to a selected specialized unit's site.

Responsibility for Industrial Wastes

An organized and properly managed industrial waste treatment system requires the governing authorities to define the responsibility for industrial wastes. This should be along the lines that whosoever produces, manufacturers or uses any toxic materials whilst carrying out industrial activities (including commercial and other trading activities) should bear the responsibility and costs of organizing the correct final disposal of the wastes that are created in the activity. Disposal could be by authorized incineration, specified controlled land-fill, etc., or by return to a supplier or alternatively to an authorized waste disposal operator. This is the modern approach towards avoiding future industrial waste problems in the environment as a whole.

Waste Lubricants From Automobiles and Other Applications

Many advanced countries now have public and trade collection systems for used lubricants to avoid excessive demands on the treatment of sanitary waste water systems. These are used in association with recycling plants where a large proportion of the incoming used lubricant supply is

usefully recovered as stock materials for reblending into fresh lubricants. There will be a relatively small proportion of waste material which is drummed off and can be suitably fed into a petroleum industry incinerator. This approach both conserves useful resources at the same time as providing a useful reduction in the quantity of waste for disposal in a country such as Kuwait.

A State Safety Policy and Its Enforcement

Kuwait does not have any strict equivalent to the Factories or Safety at Work Legislation that covers all those in employment such as the Health and Safety At Work Act in the United Kingdom or even less rigorous legislation such as the Occupational Safety and Health Act in the United States of America. These items of legislation also empower inspectors to enforce compliance with the laid down standards in respect of safety at work and in both the UK and the USA, there are provisions for both Criminal and Civil Court cases to be taken in respect of industrial accidents. In Kuwait, the fixed basis for compensation in respect of a wide range of defined accident injuries received at work works against any legal action for compensation and also Kuwait does not have an independent Safety Inspection and Enforcement Section within a single ministry which has powers of action in safety matters across all the industrial activities in Kuwait. The conclusion reached was that the present Safety Policy operating in Kuwait (and prior to the invasion by Iraq) does not work towards the adoption of modern safety standards in all branches and scales of activity in industry, whether the industry is State-owned, part State-owned or fully privately owned.

To effectively apply safety requirements, a number of inspection agencies have to be trained to inspect and assess the safety of practices as they normally take place and also to investigate all accidents of a serious nature. It is quite normal for the inspection agencies to be split up into a number of sections where specific detailed expertise is required. For example, general safety in factory operations is somewhat different than waste management and disposal and the problems arising with gaseous and liquid effluents which have environmental damage potential. The other area which is treated somewhat differently is the case of major accidents and the effects outside the factory site which closely interact with land use planning and emergency planning on the scale of involving evacuation of population, etc. The inspection agencies require to be given powers of access in line with those held by Policy and the Military.

Enforcement of safety improvements need to be set out in a set of powers at different levels ranging from legal prosecution of companies, responsible officials and individuals for permitting unsafe practices to be followed, down through powers to stop production activities immediately until safety changes are made to the issue of notices requiring specific changes or improvements to be made within stated periods of time.

The activities of such a section of a Kuwait ministry should at the same time have powers to regulate the transport and storage of dangerous goods within Kuwait in line with the United Nations Recommendations on the Transport of Dangerous Goods (the so-called 'Orange Book').

Such a Safety Policy would be in line with those in current use in developed countries and bring Kuwait in compliance with the various recommendations made by the International Labour Organization in Geneva. The adoption of such policies has been found not to be in conflict with free enterprise principles when the application of Safety Policy is seen to be sensible and in accordance with the modern approach of safeguarding the world environment as a whole.

Planning Controls for Hazardous Activities

Whilst a number of industrial activities in Kuwait have to be located to suit the locations of oil fields and port locations as key items and a number of other activities are located at satisfactory distances from residential, recreational and commercial premises, a number of sites where industrial operations are carried out were found to be close to housing. The industrial activity was considered to be such that there was potential to involve houses if a major accident occurred. These were seen at the Western side of the Shuaiba Industrial Area and also around the Ray and Shuwaikh Industrial Areas - these are within the boundaries of Kuwait City. Other industrial sites were not able to be visited, but the location of the Subhan Industrial Area just to the east of the international airport could also be considered as having potential interactions with other key activities IF hazardous activities are carried out there.

Current approaches to these problems in Europe, Australia and elsewhere are along the lines of assessing the potential of major hazard activities as a zone or area which could be potentially affected by the specific activities in the site. This interacts with the Safety Policy and enforcement dealt with above in that the details of the activity are related to the zone/area size. The policy is then to ensure that any planning developments in this zone or area are controlled to the extent that the 'risks' to sensitive sections of the population are not allowed to become unacceptably large. The alternative to the detailed assessment for each site and planning development control is to adopt a 'Cordon Sanitaire' of suitable size around each activity within which development is not allowed. The full approach of assessing major hazard potentials for each site has also to take into account possible interactions between adjacent industrial activities.

The principle of controlling developments around major hazard sites is an extension of the long established approaches to explosives factories and magazines where these have to be prescribed distances from housing, public roads and even other buildings containing explosives. This more detailed approach based on specific analysis of what effects could develop is in line with the siting policies development in many Western countries in respect of nuclear installations.

The main concerns in this major hazard field are of toxic releases (e.g. methyl isocyanate at Bhopal and the commoner cases of releases of chlorine) where techniques for dispersion estimations are now well known for such materials as ammonia, chlorine and hydrofluoric acid. These three materials are likely to be present in Kuwait now or in the near future. The other major concern relates to the intense thermal radiation and also blast effects that can arise from the release of LPG (e.g. Mexico City, Qatar, Port Hudson, etc.) As the industrial activities in Kuwait diversify, there are other substances which are well recorded as having given major accidents of which ethylene, ethylene oxide and vinyl chloride can be noted as examples.

Concern is also required in respect of the smaller distances around smaller installations such as LPG distribution depots and factories dealing with many drums of flammable materials where they are frequently much closer to residences, etc., than larger installations. Currently, concern in this respect is being extended in Western Europe to the hazards of transport depots where loaded tankers may be stored overnight and also to storage yards and docksides where a collection of loaded container units of mixed non-hazardous and dangerous goods can be stacked.

A general safety policy can be extended with ease to control at different levels the variety of industrial and distribution activities (including lorry routes) in small industrial areas, etc., so that any potential for accident does not become large and affect a key area nearby.

National Emergency Planning

The Kuwait accident record involving major industries has not shown major incidents involving many deaths plus injuries including transportation accidents. This does not mean that such events are unlikely as reported incidents have had the requisite potential for such event if they had developed slightly differently. Hence, such possibilities should be planned for as no plant or activity is 100% safe at all times.

The large incidents which happened in the Shuaiba Area in the 1980's will call for a major national co-ordination of efforts to deal with them. This will cross company and ministerial boundaries in calling for the use of all available fire fighting equipment, foam stocks, water supplies, etc.

Acts of sabotage are also a cause for a National Emergency Response Plan especially when they involve buried pipelines which are laid through remote desert or urban areas. The current work by UNEP and others in dealing with the on-going hazards of small ordnance devices left in Kuwait is also relevant to this problem. The UNEP work through APELL (Awareness and Preparedness for Emergencies at the Local Level) could provide a useful guide in this matter.

Such National Emergency Planning allows the role of the safety inspectors/specialists plus those of the Security Forces to be deployed with advantage provided it is ensured that plant management who have detailed knowledge of the activities concerned are also brought into the matter fully.

Flaring of Excess Oil and Gas Quantities

Whilst the elevated refinery flares were operating with clean burning, the ground flaring of material (mainly excess gas) from oil gathering stations was noted to be producing smoke plumes visible for considerable distances. This signifies an abnormal situation but it was considered that this was likely to occur at intervals after the present rehabilitation phase. A system where there were transportable low pressure steam boilers at hand which could be used to give clean burning at the sites where flaring would be continued for some time would allow cleaner burning by steam injection and reduce the atmospheric pollution caused. The increased thermal radiation found when clean burning is carried out may require the flare to be elevated by about five or 10 metres above ground level which should be easily attained with transportable units. The boilers would require fresh water supplies by tanker to replenish the boiler level.

Safety Involvement with Routine Plant Activities

A wide variation was observed in how different organizations and different sized plants dealt with routine safety considerations. In some areas, safety standards had been lowered due to the need to restore production with limited spares availability and where excess capacity of some production was present over a balanced demand. In many locations, safety was dealt with directly within the operations management with only the required fire precautions being dealt with by a separate section or organization (the fire brigade). At some sites, the recommended level of fire precautions were not considered to be adequate, probably because the Municipal Fire Brigade could not correctly appreciate the industrial risks involved.

At the larger organizations visited, some had separate fire and safety organizations staffed by specialized safety engineers or other staff. The degree to which these separate safety organizations were involved and familiar with the day-to-day operational and maintenance activities appeared to vary considerably. In some cases, knowledge of the detailed activities carried out by the operational side was assessed as being considerably less than the desirable level for adequate safety involvement.

For any safety advice to be effectively adopted and practiced, it is necessary that those preparing and giving it should be an integral part of routine activities with an understanding of many of the other factors involved in routine operation and maintenance. Safety advice should be regularly sought and given and not just requested when major issues such as modification or large shutdowns are involved. It is also desirable that the safety personnel should be fully involved in collective safety matters such as safety committees where staff and personnel involved with normal operations are also involved. They should also be involved in all investigations of accidents, large and small plus 'near misses'.

The personnel that give safety advice should preferably be as experienced in operational and maintenance matters (by previous experience in such posts) as those receiving the advice.

Laboratory Facilities

The laboratory facilities seen were concerned with minor environmental pollution assessment and ones where inorganic chemistry techniques were being applied on the bench. There were (or had been prior to losses) sophisticated equipment to assist in analyzing for trace materials in samples.

Only a few cases did one note that strong acids and alkalis were being handled only within fume cupboards. The availability of fume cupboard facilities did not appear to be as high as one would have expected.

Compressed gas cylinders inside laboratories were common and there did not seem to be any attempt to keep dangerous gases outside the main building with piped supplies to usage points. Clearly, all cylinders require protection from sunlight and need to be kept cool to a degree, but this could easily have been arranged in a dedicated room with plenty of ventilation to the outside which was away from the laboratories where people were working.

Of all the laboratories visited in the EPD and industrial sites, only one was seen that had adequate fume cupboard services for analyses where organic and flammable liquids are used. Dedicated storage in laboratory areas for flammable liquids and waste solvents is also a feature that is required to improve laboratories up to modern standards. Laboratories within the refineries were not visited and their standards cannot be commented upon.

IV. RECOMMENDATIONS

In formulating recommendations, due regard has been given to the environmental sensitivity of the ROPME region and also that the State of Kuwait is engaged upon a major restructuring following liberation. The following recommendations are made:

A. Development of a Modern Safety Policy in Kuwait

There is at present no centralized safety planning and enforcement agency applying uniform safety standards across the whole of the industrial activities in Kuwait. A limited review is incorporated in the licensing of some plants once every four years whilst other major companies are charged with having their own fire and safety organizations without external monitoring.

A Modern National Safety Policy should cover the following:

- (a) The establishment of a comprehensive set of minimum safety standards.
- (b) The establishment of an effective enforcement agency.
- (c) A set of procedures for land use planning in order to minimize the effects of any major or significant industrial accident.
- (d) A means of ensuring that safe procedures are followed in the movement of crude oil, natural gas, petroleum products and all other hazardous materials across Kuwait by any method of transportation.
- (e) A system for controlling the generation, collection, concentration and safe disposal of all forms of industrial waste in Kuwait and regularly formed there.
- (f) An integrated system of response to any emergency within Kuwait that involves all the emergency services plus expertise within industrial organizations.

It is recommended that UNIDO consider a proposal to assist Kuwait in developing an effective modern safety policy. A group of about four Kuwait ministerial representatives could go on a UNIDO-assisted study tour of safety legislative and enforcement agencies in Denmark, the Netherlands, the United Kingdom and the United States of America which could also include tours of both large and small industrial activities to examine how safety enforcement is carried out. At a different level of detailed involvement, nominated safety specialists from Kuwait could be assisted by UNIDO to obtain major expertise in assessing the consequences of major flammable and toxic releases from industrial and transportation activities so that regular assessments and implementation of the results in land use planning and all stages of emergency planning can be considered for incorporation in a new Modern Safety Policy for Kuwait.

To complement the above study and major hazard assessment activities, UNIDO could at the same time arrange for a full-scale in-depth hazard study and reliability assessment (for key items) to be carried out on the Salt and Chlorine Complex operated at Shuaiba by Petrochemical Industries (F.P.) which is a key plant where such study and assessment work is considered to be urgently required. Another assistance that could be offered by UNIDO is the sending of a safety expert on four further missions with the specific aims of studying in more detail the present safety systems in use within the whole of the crude oil production and handling, crude oil refining and product handling, liquefied gas production, storage and distribution and also the Kuwait system of natural gas distribution.

The above activities can all contribute to the background information that is required if Kuwait is to develop a Modern National Safety Policy. Fuller details of the proposed activities are given in the draft project document attached to these recommendations.

B. Disposal of Arsenic Containing Corrosion Inhibitor Solutions and Arsenic Contaminated Mild Steel Items

The safety expert was advised that at least one of the refineries of Kuwait National Petroleum Company has a quantity of drum stock of arsenic containing corrosion inhibitor solutions and also quantities of mild steel scrap which has arsenic contaminated scale on surfaces. The disposal of these materials in a safe way has been considered and a project outline attached sets out an approach that could be considered by UNIDO to assist in dealing with this one-off situation (as this corrosion inhibition technique is now obsolete). The objectives are to concentrate the arsenic into small volumes for disposal in a hazardous waste safe burial site whilst releasing as much as possible of the volume of liquid and mild steel for disposal under normal methods. Dealing with these stocks of arsenic contaminated materials which are on refinery and similar sites will have a direct effect on improving the safety in that they would not be then in a position to set up 'knock-on' or 'domino' effects from a significant industrial accident.

C. The Establishment in Kuwait of Recovery Systems for Waste Liquids

The present position in Kuwait appears to be that waste lubricating oils and waste solvents are having to be disposed of without any recovery of useful components therefrom. The pre-war lubricating oil blending plants are not operational and it could not be established that Kuwait had operated an effective waste lubricating oil collection and recovery system.

Techniques for the recovery of constituents from both waste lubricating oil and solvents (as used in the paint manufacturing industry and elsewhere are well developed and should be considered by Kuwait in its reconstruction programme as they have advantages in reducing the potential environmental problems of disposing of considerable quantities of waste liquids (by volume reduction of final wastes) and also providing supplies of usable materials at low cost. A proposal along these lines is given in an attached project outline, in which ways in which UNIDO could assist Kuwait are set out.

D. The Establishment in Kuwait of an Incinerator Unit Specifically Dedicated to Petroleum Type Waste Materials

Whilst Kuwait had been developing proposals prior to the recent conflict to install a special incinerator unit to deal with a wide range of hazardous wastes, these plans have not been reactivated and the whole problem of suitable long-term burial sites in unoccupied areas of Kuwait has suffered a major setback in that many of these areas are difficult to fully clear quickly of mines and subordnance. Certain types of petroleum sludges and other wastes were confirmed as being a regular part of the activities of Kuwait Oil Company and Kuwait National Petroleum Company. There are in addition some stocks and problems with spent catalysts from the refinery activities and also pyrophoric iron sulphide sludges which are periodically produced during cleaning activities. These last two types of sludges are considered outside the range of petroleum type sludges dealt with in this specific recommendation.

It is considered that as the technology exists for the regular incineration of petroleum type wastes within refinery boundaries (to avoid the need to contract for transportation and destruction), the present problem of wastes as a general concern in Kuwait could be lessened by UNIDO

providing assistance in the assessment of a suitable dedicated incinerator within the operations of KOC and KNPC to deal with such wastes independently of any longer term specialized incinerator project. The way in which UNIDO could assist is set out in a project outline attached.

E. The Disposal of Waste Refinery Catalysts

An earlier survey by an expert from UNIDO covered by report TF/KUW/91/001 identified problems in Kuwait in connection with the safe disposal of waste catalysts from refinery and similar operations. This problem was raised during this mission and it is recommended that Kuwait should only buy future supplies of catalysts that could present disposal problems on a contract basis where the original supplier agrees to be responsible for taking back used catalysts and disposing thereof. This is in line with the modern basis of dealing with hazardous materials that the original creator of materials has a degree of responsibility for ensuring their safe ultimate disposal. One would expect the original contract price to reflect the ultimate costs of disposal, but the advantage is that they would not need to be considered for disposal within the State of Kuwait.

F. The Burning of Excess Natural Gas at Gathering Stations and Other Points

It was noted that the present practice of burning off excess natural gas at gathering stations and other points was carried out using temporary short flare stacks in the oil fields. These produce smoky flames and can be seen for considerable distances and must contribute to the environmental pollution of the ROPME region as a whole. As there is a supply of fuel readily available at the sites concerned, it is recommended that Kuwait Oil Company invests in a portable low pressure steam boiler unit which could be located close to the flare that it is required to operate and enable clean burning to be obtained by steam injection into the stack (as done on refinery flare stacks).

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Draft Project Document

Title: Development of Modern Industrial Safety Policies and Procedures in the State of Kuwait

Total UNIDO Budget: Approximately US\$400,000
(excl. support costs)

Total duration: 1 year

BACKGROUND AND JUSTIFICATION

Kuwait is presently engaged in reconstruction following the war with Iraq. A UNIDO mission by an expert in industrial safety to assess the immediate and long-term industrial safety problems in Kuwait, was undertaken in 1992. The primary problem identified and elaborated in the resulting report (TF/KUW/91/002) is that there is at present a lack of a modern national safety policy and effective enforcement resulting in very uneven standards of industrial safety and a considerable potential for major accidents. Also the risk for smaller work place related accidents were, in many cases, found to be high due to low standards of equipment guarding and personnel protection gear. It was considered that the benefits of uniformly applying modern standards of industrial safety in Kuwait would, by far, outweigh the costs.

The proposed project aims at enabling the establishing of a modern national industrial safety policy in Kuwait by a series of inter-related technical co-operation activities at the policy, planning and plant level. It provides for study tours for policy makers and planners, on-the-job training for safety specialists at the planning and plant level as well as high-level advice on major hazards in key industrial sectors. A concluding workshop bringing together all relevant actors will be geared towards formulating a national industrial safety policy that meets Kuwait's needs, customs and culture.

Development objective

Decrease the risk for industrial accidents down to a level in accordance with modern standards.

Immediate objective, outputs and activities

Immediate objective

To enable the establishment of a modern industrial safety policy in Kuwait.

Output 1

Four key Ministerial representatives with increased knowledge about modern safety policies and procedures, enforcement thereof, and applicability in Kuwait.

<u>Activities for output 1</u>	<u>Responsible</u>	<u>Month</u>
Recruitment of study tour co-ordinator, selection of participants, etc.	UNIDO/ Counterpart	1
Study tour for four Ministerial representatives responsible for industrial safety in Kuwait. The study tour will visit organizations responsible for legislating and enforcing industrial safety in Denmark, the Netherlands, the United Kingdom and the United States, as well as examine safety enforcement in selected large and small industries in those countries.	Co-ordinator	3-4 (6 weeks)
In-situ assistance at the policy level.	Co-ordinator	6-11
Workshop for policy-makers, planners and plant level national safety specialists geared towards formulating a modern industrial safety policy that can be effectively enforced.	Co-ordinator	12

Output 2

Establishment of a specialized unit in Kuwait capable of identifying and analyzing major hazards arising from industrial and transport activities and employ the results obtained in land use planning, emergency planning and enforcement/inspection. This will require at least eight Kuwait safety specialists at the planning level with increased knowledge about the latest techniques for the assessment and effective management of major hazards.

<u>Activities for output 2</u>	<u>Responsible</u>	<u>Month</u>
Recruitment of study tour co-ordinator and expert in industrial safety (same as above), selection of participants, etc.	UNIDO/ Counterpart	1
Study tour for eight Kuwait safety specialist to visit various United Kingdom establishments to examine the latest techniques for the assessment of major hazards	Co-ordinator	5 (3 weeks)
In-situ assistance in establishing a specialized unit for industrial safety at the planning level	Co-ordinator	6-11
Workshop for policy-makers, planners and plant level safety specialists	Co-ordinator	12

Output 3

A report containing a full-scale in-depth hazard and operability study (HAZOP) for the Salt and Chlorine Complex operated at Shuaiba by Petrochemicals Industries (F.P.) Kuwait. The report should contain a series of recommendations for reducing risks based on the findings of the hazard study. For key items, risks will be quantified, tolerable levels chosen and fitting reduction measures selected.

<u>Activities for output 3</u>	<u>Responsible</u>	<u>Month</u>
Recruitment of HAZOP expert (same as above)	UNIDO	1
Selection and training of HAZOP team	Co-ordinator/ Counterpart	6-7
Carrying out the HAZOP	HAZOP- team	8-9
Compilation of the report	Co-ordinator	10

Output 4

Five Kuwait safety experts with practical experience of conducting a full-scale in-depth hazard study, including also quantified risk analysis, selection of risk criteria and selection and implementation of appropriate reduction measures.

<u>Activities for output 4</u>	<u>Responsible</u>	<u>Month</u>
Recruitment of HAZOP expert (same as above)	UNIDO	1
Selection and training of HAZOP team	Co-ordinator/ Counterpart	6-7
Carrying out the HAZOP	HAZOP- team	8-9
Compilation of the report	Co-ordinator	10
Workshop for policy-makers, planners and plant level safety specialists	Co-ordinator	12

Output 5

A report containing preliminary hazard analyses covering all stages of operation (normal operation, maintenance, start-up, modification, etc.) of the following industrial sectors:

- Crude oil production, initial treatment, pipeline transfer, storage and ship loading.
- Crude oil refining, storage of intermediates and refined products and ship loading.
- The liquefied petroleum gas plant (LPG), LPG storage, LPG container filling road distribution and sales depot handling and storage facilities.
- The Kuwait system of natural gas distribution.

<u>Activities for output 5</u>	<u>Responsible</u>	<u>Month</u>
Recruitment of expert (same as above)	UNIDO	1
Carrying out the study and compiling the report	Co-ordinator	8-11

Inputs

(a) Government inputs

The Government is required to appoint a full-time national project co-ordinator to act as counterpart for the entire 12 month period of the project, and provide suitable facilities and logistic support for the workshop and for the work of the Co-ordinator.

Output 1 will require approximately 7 man months split on four Kuwait policy makers.

Output 2 is expected to call for approximately 10 man months split on eight Kuwait planners from state or other organizations involved in safety issues. The Government is expected to make suitable arrangements for access to data banks relating to major accidents and the acquisition of any specialized computer programs, literature, etc., that may be found relevant to the subject.

Outputs 3 and 4 will also require the Government to establish links with suitable data banks and to allocate approximately 10 man months, split on five Kuwait safety specialists, to the HAZOP study of the Salt and Chlorine complex.

Output 5 will require the Government to provide back-up services and clearances for access to all parts of the installations being reviewed at the request of the safety expert.

(b) UNIDO inputs

UNIDO would handle the financial arrangements for the study tours (travel and daily subsistence allowance) and for the project co-ordinator, preliminary estimated to US\$400,000.

Disposal of Arsenic Containing Corrosion Inhibitor Solutions and Arsenic Contaminated Mild Steel Items

A Project Outline

BACKGROUND

The mission of a safety expert to Kuwait in January/February 1992 to Kuwait on which report TF/KUW/91/002 was written included a visit to the Shuaiba Refinery of Kuwait National Petroleum Company (KNPC). During this visit, the question of the safe disposal of arsenic containing waste materials was raised as an issue giving the plant management some concern.

It was stated that KNPC refineries have in the past used proprietary corrosion inhibitor solutions containing arsenic which are now not further required and this treatment has now been superseded. There is a considerable drum stock of these solutions awaiting a suitable disposal method and in addition there are mild steel items which have in the past been corrosion inhibited with these solutions and still have arsenic present in the surface coating.

Corrosion references state that the use of inorganic inhibitors such as sodium arsenite (ca. NaAsO_2) to inhibit carbon dioxide corrosion was not very effective and required frequent retreatment. The result is that a range of organic formulations are now available which are more effective. Arsenic compounds are stated to decompose readily on heating, and in the case of sodium arsenite (which is very soluble in water) it produces (from the solid) fumes of arsenic and sodium oxide. This indicates that incineration is not an easy solution to the disposal of these solutions.

THE PROJECT

The proposed project would deal separately with the problem of the waste treatment solutions and the contaminated mild steel items. It is suggested to:

1. Concentrate the arsenic compounds at present in solution (assumed to be in the aqueous phase) into sludge or other semi-solid forms which can then be disposed of in safe ground hazardous waste depositories.
2. Release the bulk of the aqueous phase in a form that is safe to discharge to waste water systems.
3. Release cleaned mild steel that can be recycled as normal scrap with only a very minimum arsenic contamination that is acceptable.
4. Concentrate the arsenic scale from the mild steel into a solid form for safe disposal in ground waste depositories.
5. Release the drums or other containers of the arsenic solutions in a form permitting re-use or safe disposal.

A survey is required of all KNPC and Kuwait Oil Company (KOC) past and present activities to locate and list all new and used arsenic containing corrosion inhibitor solutions in Kuwait. Representative analysis should then be carried out to establish the full make up of the solutions involved.

Proposals for concentrating or precipitating the arsenic as sludge (possibly using calcium carbonate or calcium chloride) should be prepared so that the sludge can be separated and the bulk of the present solution safely disposed off to water systems. The sludge or precipitate should be washed with water and drummed off for disposal in a hazardous waste dump.

The degree of arsenic surface contamination of mild steel items should be established by careful examination of surface layers to detect the level of penetration of the arsenic. This is likely to be small in view of the reported need to frequently retreat mild steel to inhibit corrosion. Once the thickness of the contaminated surface layer has been established, planning for its removal by physical means (e.g. sand blasting in a well filtered system) or by chemical means can follow. Once again, the arsenic contamination removed will require safe disposal in a hazardous waste ground depository whilst the bulk of the mild steel can then be disposed of through normal scrap channels for subsequent recycling/reuse.

The Kuwait authorities should be responsible for the initial survey of the amounts of arsenic solutions and contaminated mild steel at present in Kuwait that need to be dealt with. They should also carry out the initial sampling and analysis of the arsenic solutions that they locate.

UNIDO efforts should be directed towards the preparation of proposals for the satisfactory concentration of the arsenic containing solutions and also towards investigations of alternative methods of removing the required amount of arsenic contamination from mild steel.

These activities are likely to involve supervised laboratory investigation of alternative techniques of concentration and surface contamination removal. Also included should be the consideration of the safest way to dispose of the containers that at present have (or have had) arsenic solutions therein.

The Kuwait personnel involved need to speak English and they must have appropriate authority to enable the full co-operation of all necessary KOC and KNPC staff to be obtained.

The results of this project will enable the Kuwait organizations involved (KNPC and KOC) to put in hand various recommended procedures to safely dispose of all arsenic containing solutions and other arsenic contaminated items at present in Kuwait.

The Establishment in Kuwait of Recovery Systems for Waste Liquids

A Project Outline

BACKGROUND

The mission of a safety expert to Kuwait in January/February 1992 on which report TF/KUW/91/002 was based found that the pre-war Kuwait lubricating oil plants were not in operation. As part of the mission was to link in with the previous expert report on wastes in Kuwait, TF/KUW/91/001 and it could not be confirmed that there had been a comprehensive system of recovery of valuable components from waste liquids, it was considered that various environmental hazards could be reduced by appropriate methods of dealing with waste lubricating oils and waste solvents.

At present, post-war Kuwait is having to dispose of waste lubricating oil and waste solvents representing the loss of valuable component materials and also an extra drain on waste disposal arrangements which have been curtailed as a result of the Iraq invasion and liberation which has left many desert areas contaminated with mines and sub-ordnance. Thus, there is at present a potential for harming the environment in the ROPME region which could be reduced.

Techniques for waste lubricating oil collection and treatment to recover a proportion of re-usable lubricant basic stock are now well established. The commercial viability is however dependent on the availability of large quantities of waste oil. For smaller quantities energy recovery with or without prior treatment may be a better alternative. The options for dealing with lubricating waste oil could be considered for adoption in Kuwait with the advantage of reducing the amounts of final waste that has to be disposed of.

Likewise, batch recovery processing of waste solvents is well established and can usefully be applied to the waste solvents being formed and collected for disposal from the Kuwait paint manufacturer seen in operation. It is considered likely that there will be other industrial activities restarting in post-war Kuwait generating waste solvents from their operations.

Distillation, followed in some cases by filtration, are the main process used to recover usable solvents to an agreed specification. To maximize the recovery of waste solvents, it has been found desirable to avoid mixing different solvents as much as possible in a single 'waste' tank with different solvents being separately stored for collection. At present, much of these solvent materials need to be imported into Kuwait.

THE PROJECT

The proposed project would investigate the possible establishment of two independent waste collection and recovery systems for Kuwait. One will be concerned with used lubricating and similar oils whilst the other would deal with waste solvents from all identified producers of waste solvents in post-war Kuwait. The latter are known to involve the paint industry in Kuwait, and there are potentially other industrial activities producing quantities of waste solvents.

The lubricating oil supply in pre-war Kuwait came from two lubricating oil plants in Kuwait. It is understood that these did not carry out much activity in recovery of used materials of

value, although some collection system from some sources was claimed to be active at that time. No present collection system appears to be operating to avoid the contamination of surface water collection systems and the sanitary drainage system by such waste materials.

A survey is required of all the automotive type repair installations (and similar activities) to assess the waste lubricating oil quantities being produced per month and how best arrangements could be set up for efficient collection thereof. The survey should also pay attention to opportunities to minimize the generation of waste oil and give recommendations for immediate implementation of such opportunities. Once the amounts of waste lubricating oils are determined, recommendations on cost-effective recovery of values and subsequent feasibility studies can be elaborated.

It is known that quantities of white spirit, toluene, xylene and methyl ethyl ketone are used in the manufacture of paints and collected for disposal as mixed waste solvents (mixed with water and paint residues). The particular plant concerned has a 3,000 gallon waste storage tank which has to be emptied about weekly. Other post-war industrial activities likely to restart in Kuwait should be reviewed to establish a potential total production of waste solvents for which plant capacity as batch operations should be planned. These should also establish the different solvents involved, the quantities of each and the feasibility of separation at the point at which the wastes are generated. In keeping with a cleaner production approach, before any firm estimates are made, a waste audit should be conducted to pinpoint waste minimization opportunities in advance of examination of recycling or disposal possibilities. Once all this has been established, batch plants to recover the solvent based on experiences in developed countries can be called for as design proposals. The system of collection to be used in Kuwait must of course take into account the specific requirements in Kuwait.

The carrying out of the surveys of present activities and the projection to include future industrial development as the post-war restructuring attains completion is clearly the responsibility of the Kuwait Government both as regards waste lubricating oil production and potential waste solvent generation. The collection tanks and operating systems for transporting the waste liquids to selected sites for recovery plants is also a Kuwait Government activity.

The Kuwait Government should also allocate suitable locations for possible recovery plants.

The results of this project are the reduction in demand for alternative methods of waste disposal together with the value of the materials recycled and the benefit to the environment of the ROPME region as a whole.

UNIDO could provide assistance in the supply of expertise relating to operating experiences in the collection and recycling/energy recovery of both waste lubricating oils and waste solvents. An important aspect is the safe transportation of such materials where the properties are different to those of the unused liquids in each case.

The results of this project should be the preparation of firm proposals for Kuwait to set up systems for (a) waste lubricating oils and (b) waste solvents from all industrial sources generating the same including proposals for plants to recover useful materials from the wastes collected and reduce the volume of residues requiring final disposal.

The final waste quantities from the recovery plants will either require burial in designated hazardous waste areas (together with other sludges and materials not suitable for partial recovery operations) or alternatively in suitable incineration systems. The key advantages from this project will be in the reduction of waste volumes and recovery of valuable materials for re-use.

The Establishment in Kuwait of an Incinerator Unit Specifically Dedicated to
Petroleum Type Waste Materials

A Project Outline

BACKGROUND

The mission of a safety expert to Kuwait in January/February 1992 on which report TF/KUW/91/002 was based reviewed some operational facilities in the areas of crude oil production and oil refining. No dedicated incineration unit within the refinery and crude production facilities was identified as part of the Kuwait Oil Company (KOC) and Kuwait National Petroleum Company (KNPC) operations. It was clear that a continual production of some amounts of petroleum type waste sludges, slops tank material, etc., is associated with all refinery and crude oil activities independently of specialized wastes such as high sulphur sludges from some parts of the systems and waste catalyst materials. The nature of the simple petroleum type wastes is such that it was considered worthy of specific treatment as part of KOC and KNPC activities to reduce the amounts of wastes having to be otherwise disposed of in post-war Kuwait. Some of the waste disposal problems are dealt with in report TF/KUW/91/001.

By operating a specific waste incinerator as part of their activities, KOC and KNPC would have the means to deal with current waste generation so minimizing waste storage and the overall potential for contaminating groundwater systems and also the Arabian Gulf. The technology for a refinery type incinerator has been well developed and is known to be considerably less demanding in its construction and operating requirements than other incinerators which have been specifically designed to handle a wide range of hazardous wastes as produced by a wide range of industrial activities where many heavy metals and corrosive gases are produced in the incineration process.

THE PROJECT

Further study of the operations of and KNPC in the oil fields, refineries and ship loading operations should be carried out to establish the quantities and types of wastes produced on a regular basis. These should exclude waste catalysts and similar specialized materials which are anticipated to require other approaches than a dedicated petroleum type incinerator.

The study should project the present situation to that representing the full restoration of Kuwait's industrial capacity and should include provision for any similar waste materials that may be produced by other activities such as waste lubricating oil recovery, etc.

Existing petroleum proven incineration units will be assessed in respect of their operating performance and especially in respect of their environmental performance. This will result in recommendations on suitable designs and specifications to be forwarded to Kuwait.

The survey part of the project to identify potential present and future sources of petroleum type wastes (leading to the estimation of future requirements for a specialized petroleum waste incinerator) needs to be carried out by the Kuwait Government with assistance primarily from, KNPC and others. Again, waste, environmental and energy audits should be considered, and further recommendations made in light of their results. The characterization by analysis of the waste sources will also need work by suitable Kuwaiti organizations in order for the specification of types of wastes and quantities to be prepared.

The UNIDO input would initially be in the assistance in the collection of the waste survey information by the Kuwaiti representatives assigned to do this. This will be accompanied by advice as to what classes of petroleum wastes it can be assumed will be satisfactorily incinerated. In other cases, indications will be provided where other methods of waste disposal are more suitable.

Working on the basis of the survey data, UNIDO could assist Kuwait in obtaining and selecting suitable proposals for incineration units and in the evaluation of them for regular incineration duties that meet acceptable environmental emission standards.

The results of this project should allow the Kuwait Government to consider a specific incinerator unit designed to handle the regularly produced petroleum type wastes. This could be expected to be more efficient and cheaper to operate than any incineration unit designed to handle a broad range of hazardous waste materials where corrosion resistance will have to be of broader nature than for petroleum type wastes only. Again, the scrubbing and particulate separation systems for a dedicated petroleum type waste will be less difficult to design and maintain.

As the incinerator will have a steady load of waste materials with the majority of the sources in the Shuaiba and Ahmadi areas, transportation will be minimized if the locations of the incinerator is somewhere in this area.

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ANNEX I

Job Description

Expert in industrial safety visiting Kuwait.

Purpose of the project: To assess industrial safety needs at the plant level in, primarily the refining sector of post-war Kuwait, and to prepare recommendations to be included in the Inter-agency Rehabilitation Programme being assembled for the consideration of the ROPME Executive Council.

Duties: Specifically the expert's duties will be as follows:

- (1) Assess the condition of the industrial sector in Kuwait, in particular of plants functioning (or not functioning) in the oil refining and the petrochemical sector;
- (2) Survey and assess existing institutional arrangements for industrial safety at the plant level including present data gathering activities;
- (3) Survey immediate industrial risks relevant to the rehabilitation phase and assess the need for special equipment, international expertise, etc., for keeping these risks at an acceptable level;
- (4) Assess immediate and future information management capabilities and needs relevant to industrial safety in Kuwait;
- (5) Examine efforts at plant, sector and national policy and planning levels to address industrial safety needs in preparation of resumption of plant operations;
- (6) Identify future industrial safety issues likely to emerge in Kuwait;
- (7) Produce a report containing:
 - (a) An outline of the institutional arrangements needed at the plant level in primarily the refining and petrochemical sectors, for maximizing industrial safety during as well as after the rehabilitation phase;
 - (b) Recommendations on how the immediate industrial risks relevant to the rehabilitation phase can be mitigated; the need for special equipment and international experts; immediate and future information management needs relevant to industrial safety in Kuwait, etc.;

(c) Identification of future industrial safety issues likely to emerge in Kuwait, and inclusion of a plan complementing other industrial safety initiatives at the plant, sector, industry and national policy and planning levels;

(d) Outline of projects to be incorporated in the Plan of Action based on the recommendations and assessments under (a), (b) and (c) above.

Duration of mission: 24 days, specifically 26 January 1992 until 18 February 1992 inclusive.

ANNEX II

Senior Counterpart Staff

Mr. Ibrahim M. Hadi
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Director of Environment Protection Department
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Dr. Ali Al-Huwail
Director, Shuaiba Industrial Medical Center
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Dr. Ali Al-Huwail was responsible for making the detailed arrangements for the various visits made during this mission and also for providing support services.

ANNEX III

List of Senior People Met

- Dr. M. El-Desouky
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- Dr. M. Shaban
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- Mr. Abdul Karim Alrashid**
Deputy Director
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Shuaiba
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- Mr. W. Batty Smith**
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