Audit Report

January 1998

Integrated Environmental Audit of ICI Chemicals & Polymers Limited, Runcorn 3-9th July 1997

ENVIRONMENT AGENCY

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EXECUTIVE SUMMARY

The large number of environmental breaches, coupled with two major incidents at ICI's Runcorn Site became a serious concern to the Environment Agency during 1997. The Agency took formal enforcement action, including two successful prosecutions, but identified a need for a complementary site audit to consider possible root causes of incidents. The audit targeted specific site activities that the Agency surmised might be contributing to the poor performance.

In July 1997, a six-person team carried out the audit over five days, inspecting plant, interviewing staff and consulting documentation. They paid particular attention to ICI's Safety, Health and Environmental (SHE) Management System and its application.

ICI makes clear statements about achieving high SHE standards and these are delivered through a set of Site Instructions (SIs) which undergo internal compliance auditing. The general quality of SIs and the level of compliance were acceptable in most respects. However, some SIs would benefit from a revision to include more emphasis on the environmental impacts and firm action is needed where non-compliance is found. Some newer SIs have not been fully implemented yet. The Agency recommends that clear guidance is given in these SIs on the date by which full implementation is expected.

Specific site findings were:-

- **Inter-plant Piped Transfer Systems**: Generally to a good engineering standard, but controls less satisfactory on those older plants which were inspected.
- **Plant Overhauls**: The SI was rigorously applied and the 1997 overhaul of the Per/Tri Plant incorporated learning from previous overhauls.
- **Alarm, Trip and Interlock Systems**: The level of implementation of the SI was variable. There were deficiencies on older plants.
- **Registration, Inspection and Maintenance of Tanks**: The SI is appropriate but implementation has been slow.
- **Registration, Inspection and Maintenance of Bunds**: This is an important issue on the site, there is a comprehensive SI. Implementation is very limited and the main progress has been a pilot study.
- **Tank Filling Operations and Dealing with Spillages**: There is a heavy reliance on alarm systems rather than secondary containment.
- **Maintenance Systems**: Generally good but the proportion of reactive maintenance should be reduced.

Observations were made of the general plant housekeeping. This was found to be good in most areas, but one plant section got a poor rating.

A trial survey of staff showed a high level of environmental awareness.

There is no evidence to suggest that the recent more significant environmental incidents are attributable to a common cause.

The Agency expects ICI to remedy any deficiencies identified by this Audit and will follow up actions arising from this audit in its routine regulatory IPC inspection work.

1.0 INTRODUCTION AND AUDIT PLANNING

The Environment Agency was formed on 1 April 1996 and is responsible for the regulatory controls previously exercised by Her Majesty's Inspectorate of Pollution (HMIP), the National Rivers Authority (NRA), and the local authority Waste Regulation Authorities (WRA).

1.1 Integrated Pollution Control (IPC)

Integrated Pollution Control (IPC) was introduced by Part 1 of the Environmental Protection Act 1990 (EPA90) and was enforced by HMIP until 31 March 1996. IPC applies to the most potentially polluting, or technologically complex, industrial processes in England and Wales. This relatively new approach to pollution control considers releases to all environmental media so as to minimise the overall effect (i.e. having regard to the Best Practicable Environmental Option - BPEO). This is achieved by setting operating controls which prevent and minimise releases at source, before rendering harmless any unavoidable releases. Operators are required to use the Best Available Techniques Not Entailing Excessive Cost (BATNEEC) and this involves not only the process equipment, but also how it is operated.

Part I of EPA90 requires those who wish to operate a process prescribed for IPC by SI 1991 No 472 (The Prescribed Processes and Substances Regulations 1991) to hold an authorisation. The Environment Agency must ensure that the combination of the commitments made by the applicant in the application, and the conditions placed in the authorisation, meet the objectives of EPA90.

There are about 2000 IPC authorised processes in England and Wales. The South Area of the North West Region has a large proportion of the total number with about 300 authorisations. There are 18 authorised processes on the Runcorn Site, and 13 of these are operated by ICI.

Prescribed Processes are split into six separate sectors by the regulations. Most of the processes on the Runcorn site fall in the Chemical Industry Sector, in particular Section 4.4 (Processes involving halogens). An up to date list of the current site authorisations is included at Appendix 1.

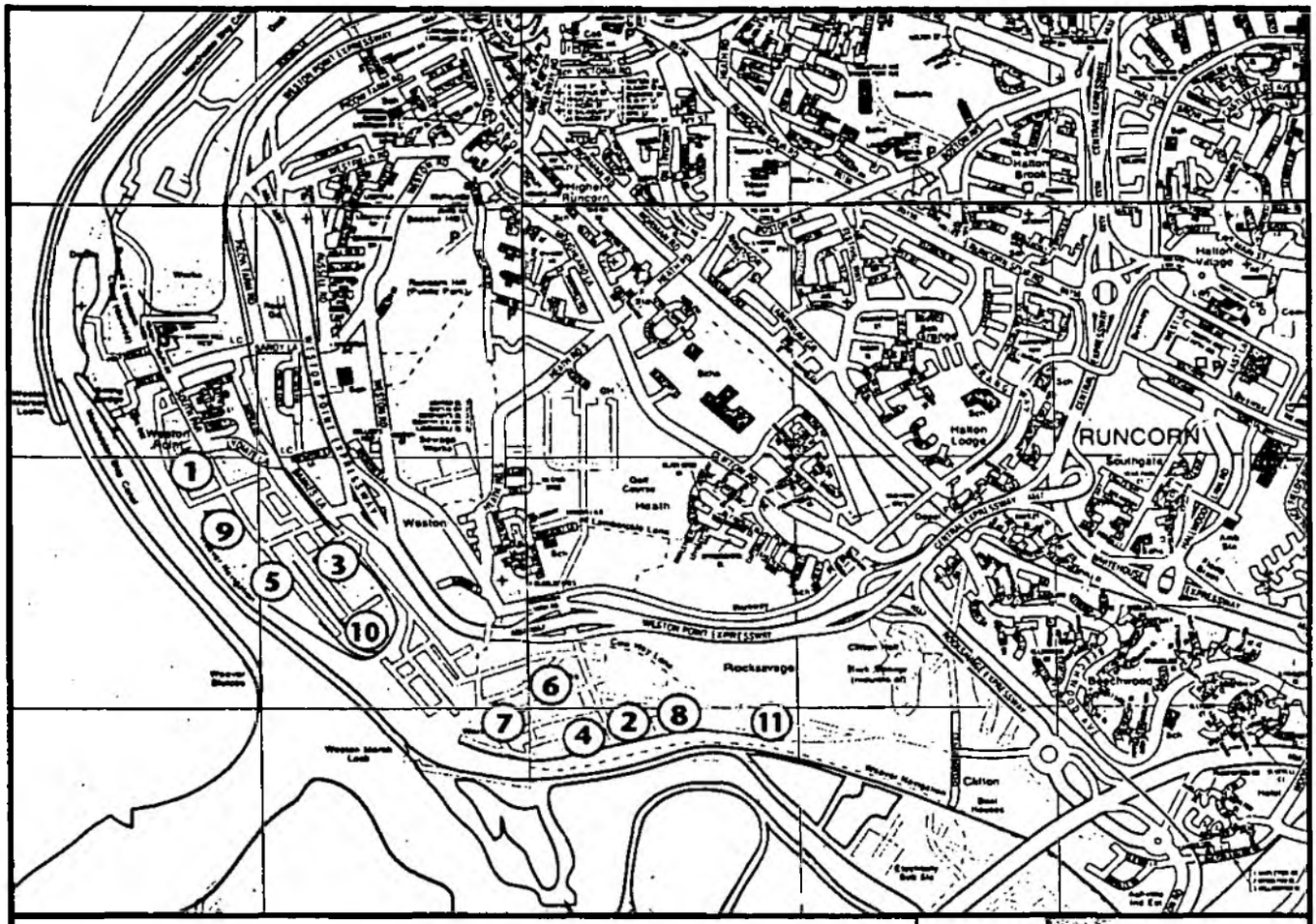
1.2 The ICI Runcorn Site

ICI Chemicals & Polymers was formed in 1987. It operates in the UK as ICI Chemicals & Polymers Limited, a wholly owned subsidiary of ICI plc, and operates the Runcorn Site. There are other UK manufacturing sites at Wilton, Billingham, North Tees and Severnside.

The Runcorn Site is one of the UK's biggest manufacturing complexes. It occupies about 100 hectares on a 4km long site bordering the Weston Canal (Fig 1).

Figure 1

Location Map
ICI Chemicals & Polymers Ltd
Runcorn

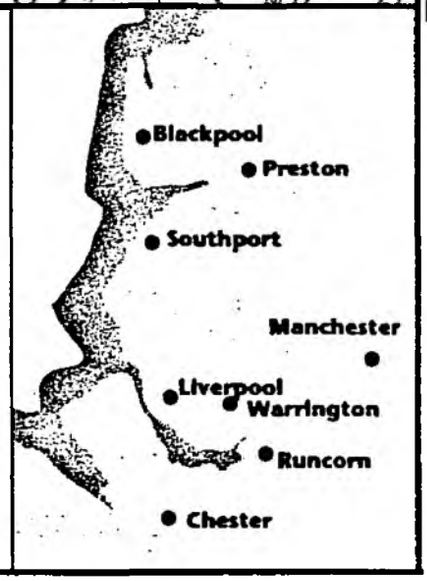


100 metres 1000 metres

Scale 1:25,000

Key to processes

1 Chlorine
2 Fluorochemicals
3 Chlorinated Ethylenes
4 Chloromethanes
5 Cereclor
6 Sulphuric Acid Complex
7 Hydrogen Chloride
8 Hydrogen Fluoride
9 Power Stations
10 EIP
11 CTF



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Historically it was two separate works (Rocksavage and Castner-Kellner) which date back to the 1850s. Now with the trends to divestment, another large company, European Vinyls Corporation (UK) Ltd (EVC), operates the vinyl chloride and polyvinyl chloride manufacturing processes. Intergen and Scottish Hydro-Electric will be operating two new power stations supplying power and steam to the site. A small American company (Mercury Recovery Services) is also temporarily located on the site.

The site operations are highly integrated and this means that raw materials, by-products and waste streams are fed between numerous operational units. The prime activity is the electrolysis of brine to produce chlorine and caustic soda. It is by far the largest chlorine producer in the UK with a capacity of around 750,000 tonnes per annum, and is one of the largest in Europe. Most of the chlorine is used on-site in the manufacture of vinyl chloride (now by EVC) and other chlorinated organics.

ICI's Runcorn plants for the manufacture of trichloroethylene, chloromethanes and chlorinated paraffins are amongst the biggest in the world. Other major activities on site, such as the production of sulphuric acid and hydrogen fluoride, are linked to the manufacture of fluorinated organics.

There are several thousand discharge points to atmosphere (although many are only used infrequently for pressure relief). There are 28 IPC authorised aqueous discharge points to the Weston Canal and a further six discharge points covered by the Water Resources Act 1991.

The need to improve the site's environmental performance has been highlighted by the controls required by IPC Authorisations and receiving water Environmental Quality Standards (EQS). Over £40 million has been spent on mercury removal systems from the waste brine. This has produced a considerable reduction in mercury discharges with the consequential downstream benefits, especially in the Mersey Estuary. More recently over £50 million has been spent on an Environment Improvement Project (EIP) designed to incinerate organic vapours from production plants and also organics which have been air stripped from aqueous effluents.

1.3 Environmental Regulation of the Site

Prior to 1996 there were separate environmental bodies, (HMIP, NRA, and Cheshire Waste Regulation Authority) who controlled releases from the site. These regulators had regular contact with each other but close co-operation was always limited by organisational boundaries.

One of the early initiatives of the Environment Agency was to create a "One Stop Shop". In this case the IPC Inspector for ICI Runcorn Site became the Agency's 'Account Manager' and assumed a co-ordinating role for Agency involvement with the site.

During 1996 there have been serious incidents on the site which have led to prosecutions by the Environment Agency under the Environmental Protection Act 1990.

i) A release of 320kg of ethylene dichloride from the VC3 Plant (now owned by EVC) on 7 July 1996 resulted in a successful prosecution on 20 March 1997 with a fine of £15,000 and £5,000 costs.

ii) A catalogue of errors caused a release of vinylidene chloride (VDC) from the VDC4 Plant on 4 October 1996. Prosecution on 2 July 1997 resulted in a fine of £34,000 with costs of £6,000.

Prosecutions are also pending for the loss of 147 tonnes of chloroform on 9 April 1997, and 56 tonnes of trichloroethylene on 4 May 1997.

There has been a large number of breaches of IPC Authorisations limits with 254 notifications being made to the Agency in 1996. The majority of the breaches were of minor significance but they prompted the Agency's directorate to express concern about the environmental performance of ICI at a national level. At a resultant meeting between ICI and Agency Directors, an agreement was made whereby ICI Chemicals & Polymers Limtied has engaged independant consultants to review its SHE Assurance procedures and further develop a risk screening methodology.

At a local level, the Agency's North West Regional Manager met with ICI Senior Management in May 1997. The Agency used this meeting to explain the reasons for its earlier decision to carry out a selective audit of some site activities.

1.4 Audit Planning

As an initial assessment of the audit scope, the Environment Agency reviewed the incident notifications submitted by ICI and investigations carried out by Agency officers. From this we identified a number of common themes and areas of concern which were deemed worthy of detailed audit. These topics were:-

i) Inter-plant piped transfer of materials.
ii) Tank filling operations and methods of dealing with spillages.
iii) Procedures for the design and inspection of storage tanks and bunds.
iv) Plant overhauls.
v) Alarm, trip and interlock systems.
vi) Maintenance systems.

In view of the incidents on 9 April and 4 May, it was decided that the team would not pursue these audit topics in any areas which might prejudice legal action.

Five Agency staff were appointed to audit these areas. They comprised the site IPC Inspector, another IPC Inspector with responsibilities for some of the site, an IPC Inspector from the North Area of the Region, a Pollution Control Officer from

the Water Quality function, and an Officer from the Waste function. The team was managed by the South Area IPC/RAS Manager.

Since ICI Runcorn Site has a formalised system of Site Instructions (SIs), it was decided that any operational shortcomings would probably be apparent as non-compliance with SIs. ICI were requested to provide copies of all the SIs relevant to the audit and these were used to further develop the audit scope.

The Environment Agency's Director of Operations visited the site in February 1997 and, in response to his comments on housekeeping, the auditors were instructed to observe the standard of general housekeeping as they audited their specific topics. The audit also included a trial survey of staff environmental awareness.

The site has a very wide range of operations and the audit team planned to cover as many Authorisations as practicable, within the consideration that the site inspection time should be about 25 hours over a four or five day period. Each auditor drew up an outline plan for their particular designated audit topics and this was discussed with ICI management in order to finalise the logistics of the exercise. The dates of 3, 4, 7, 8, 9 July 1997 were chosen for the audit week and this deliberately spanned a weekend so that the impact of staff unavailability could be minimised. Key ICI contacts were identified and from this ICI produced a draft timetable for each auditor matching up time and availability of some 12 ICI managers over the five day period. This was agreed after some minor modifications.

1.5 The Audit Week

The audit commenced on Thursday 3 July with a presentation from ICI on the findings of an Environmental Task Force which they had set up to review the causes of the recent spate of incidents at Runcorn and Teesside. In summary, ICI considered there were a number of common factors such as plant modifications, lessons from previous incidents, instrumentation and communications.

These findings were generally in line with the themes identified by the Agency audit team, and did not warrant amendment of the proposed audit scope.

Each auditor spent between five and eight hours auditing each day. The audit team met every morning to review progress and adapt the scope as necessary. ICI staff were on call each morning to provide further explanations.

The audit week was completed at midday on Wednesday 9 July when the Agency team presented its main findings to a selection of Senior Managers from the site.

2.0 SAFETY, HEALTH AND ENVIRONMENT (SHE) ISSUES

2.1 Objective

The Trial Large Scale Audit carried out in 1995 by HMIP (Ref. 1) audited a number of SHE issues with site applicability. Since then there has been a change in ICI's management structure and a limited re-audit of some of these issues was conducted to establish if there had been any significant impact. *(Note: Since completion of the audit, ICI has informed the Agency that there has been a further re-organisation of senior management on site. Any effects that this may have on SHE issues will be followed up during routine regulatory IPC work).*

The organisational structure at the time of the 1995 audit had Section Managers reporting to Business Managers, who reported to the Managing Director. In addition there was also a Site Services section which reported to the Works Manager (himself a Board Member).

The structure at July 1997 had the ICI Chemicals & Polymers Chief Executive Officer and ICI Halochemicals Managing Director in charge of five Business Managers, and a Technical Director. The Site Manager reported to the Technical Director and had responsibility for site services including SHE, Laboratories, chlorine distribution, power stations and central maintenance. The Site Manager also had accountability for liaison with the local community, regulators and local authorities. SHE accountability lay with the line management, but supported and guided by the SHE section. The SHE section had ten environmental professionals, seven of whom were on a team looking at historical issues connected with ground contamination and the environmental risk assessment of existing processes (Project Pathway). The SHE section also had access to corporate environmental specialists.

2.2 SHE Policy and Procedures

ICI Chemicals & Polymers Limited was formed in 1987 and since the late 1980s has developed a unified SHE management system which was issued as "SHE Standards and Guidance". ICI plc has, in addition to its SHE policy, a set of SHE standards and supporting guidance which are integrated with the ICI Chemicals & Polymers Limited system.

SHE Policy is also emphasised by various corporate statements and business group statements. The most recent is a Halochemicals SHE Charter which states that:-

> "Our products and services will be supplied in accordance with the highest levels of safety, health and environmental compliance".
>
> "Our work is never so urgent or important that we cannot make time to do it safely and with care for the Environment".

This is a signed statement made by the Chief Executive Officer and Managing Director and co-signed by senior management in the division, committing themselves to promoting SHE excellence.

The "SHE Standards and Guidance" book instructs operational managers to have in place appropriate procedures, which they consider necessary to meet the requirements of SHE. At ICI Runcorn Site these are termed Site Instructions (SIs).

The SIs were initiated in the late 1980s, and most of the early ones were derived from existing Safety Instructions. At the time of the Audit, 96 SIs had been issued. (Full list at Appendix 2) Some requirements of the "SHE Standards and Guidance" book are not relevant to this particular site's operations, and have not been effected.

The SIs have been introduced on a regular frequency throughout the last eight years. Although some SIs have been revised since initial issue, others are in need of updating and revision. A programme has been drawn up to revise them in a prioritised way.

Not all Site Instructions include dates by which there should be full implementation. In these cases priority given to their adoption rests with individual production sections. However, it should be noted that when a Site Instruction requires common site-wide implementation, this is made clear at the time of issue, for example, SI 3 and SI 5.

2.3 SHE Communications

The main decisions on SHE policy, strategy and related issues are made by the Senior Management Group, and discussed at their regular monthly meetings. The Group comprises of the Production Section Managers, SHE Manager, Personnel Manager, and is chaired by the Site Manager. SHE is always the first item on the agenda. A Site Management Group and an Engineering Standards Group support the Senior Management Group. There is also a subgroup of the Senior Management Group termed the "Environmental Steering Group" which is chaired by the Site Manager and comprises of the SHE Manager and other Senior Managers. Further *ad hoc* Steering Groups exist to deal with particular needs as they arise (e.g. there are Steering Groups working on the EIP project and Castner Kellner North Containment).

At a local level, all plants have regular meetings at which SHE items are discussed. There is a weekly cascade brief (each Thursday afternoon) when representatives from all the management units meet to share their reports on injuries, incidents etc. Important items are then taken from the meeting and cascaded down to operational teams as soon as possible.

2.4 Internal ICI Auditing

Runcorn Site have a Site Instruction SI 2, which was issued in 1995 and describes the arrangements which are in place for ICI's own SHE auditing of the site. There are three levels of audit.

Level One is an operational audit examining compliance with local plant instructions and Site Instructions. The auditor (who could be a manager, engineer or supervisor) completes a pro-forma and gives a rating from 1 to 5. These scores are 1 ("Very Poor"- immediate and extensive actions needed), through 2 ("Poor"), 3 ("Moderate"), 4 ("Good") to 5 ("Excellent" - no corrective actions recommended). The audit should identify longer-term corrective actions and establish if there are any site-wide problems/actions that are required. Low scoring audits are picked up by the Safety Committee for action. An example of a Level One audit against SI 18 is explained elsewhere in this report.

The 1997 plan for the Level One auditing of the large chlorine production unit was examined in some detail. For the purpose of auditing, the SIs were grouped together covering a common subject (e.g. electrical isolation) so that each audit would cover some aspects of a range of SIs. The plan identified 26 subject areas for audit with a total of 65 audits required. Most of the planned audits were of an engineering/safety nature (e.g. permits to work and isolations) but there were four covering environmental matters and two for incidents/emergencies. For the previous year only about 75% of the planned audits were carried out. The Plant Manager explained that improvement on this is required and that he had been set a target of 100% in his annual objectives. Similar objectives were found during examination of the job description and personal objectives of a manager from a different section.

Level Two audits examine fitness for purpose of SIs and aim to identify areas for improvement of the instruction. This type of audit, which is of a specialist nature, had been carried out on site before the Level One type audit had been firmly established. Level Two audits therefore tended to incorporate operational auditing and this resulted in considerable overlap between Levels One and Two. Some Level Two audits were stopped in 1995 with the intention of developing a new methodology taking into account the changed management structure and responsibilities in Halochemicals Business. Some trial Level Two audits have been conducted on site. At corporate level further work has been done on developing the specialist audit protocol and guidance has been drafted. SI 02 is being re-issued in the third quarter of 1997 and will address any deficiencies in the Level Two audit methodology.

Level Three audits are management audits which assess the implementation of C&P SHE standards; assess progress on improvement plans; and identify opportunities for the enhancement of the C&P system of Standards and Guidance

as a whole. These audits should be conducted every three years by independent ICI staff who have been specially trained. The last Level Three audit was in March 1995 when five auditors were on site for five days. The next Level Three audit is planned for the first quarter 1998.

An important output of Level Three audits is a 'percentage' score, which assesses the degree of compliance with SHE requirements. By the application of weighting factors it can be used to make site wide comparisons. A continuing additional requirement of the Level Three audit is that the SHE manager makes a quarterly check on progress towards full compliance with C&P standards and reports the results to the C&P SHE department every six months. The methodology used in scoring is similar to that used in the Level Three audit with scores derived from the level of implementation, training and compliance auditing. The 1996 score indicates an improvement over 1995.

2.5 Conclusions

ICI continue to make clear statements about SHE policy and performance.

The application of SHE policy has not deteriorated as a result of the changes in management structure.

There has been slow but steady progress on the issuing of site instructions, and they have been introduced in such a way that implementation does not become a burden on plant resources. A programme of revision is in place.

There is a network of groups addressing environmental issues.

There are systems in place for assessing compliance with SHE policy.

2.6 Recommendations

The current review of SIs should be completed as soon as possible taking into account internal/external changes, and any comments made by those implementing/auditing the existing instructions.

The titles should clearly indicate reference to the environment where appropriate.

Consideration should be given to making a clear statement, at the time of SI issue, of the timescale expected for implementation.

3.0 INTER-PLANT PIPED TRANSFER SYSTEMS (SI 13)

3.1 Introduction

On any large complex chemical plant it has long been recognised that transfers of materials between plants located some distance apart are a potential risk for serious incidents. A recent incident at the Runcorn Site had occurred as a result of problems with the piped transfer of materials between plants. For this reason part of this audit has focused on inter-plant transfers of material on four different plants, chosen to represent a typical range of transfers carried out across the site.

The transfers chosen for the audit were :-

- The Transfer of 36% hydrochloric acid from the Hydrochloric Acid Plant to the Quarry Site Bulk Storage Tanks.

- The Transfers of 98% sulphuric acid and 20% oleum from the Sulphuric Acid Plant to the Quarry Site Bulk Storage Tanks.

- The Transfer of Heavy Fuel Oil (HFO) from the Bulk Storage Tanks at Picow Farm to the Day Storage Tanks located at the Castner-Kellner Power Station.

- The Transfer of chlorine from the Chlorine Plant to the Chloromethanes (CM2) Plant and the Per/Tri Plant.

3.2 Objectives

- To examine the procedures used for the design, construction, inspection, and maintenance of long transfer lines across the site.

- To carry out a visual inspection of the transfer lines to check for compliance with good engineering practice and to see if there are any obvious shortcomings which could lead to sudden failures and releases to the environment.

- To examine and comment on the procedures for inter-plant piped transfers of material across the site.

- To examine the level of controls and instrumentation associated with these transfers.

- To determine whether the process operators are aware of the potential for causing harm to the environment from the materials being transferred, and whether they are trained to identify leaks and take appropriate action.

3.3 The Transfer of 36% Hydrochloric Acid from the Hydrochloric Acid Plant to the Quarry Site Bulk Storage Tanks.

3.3.1 The Hydrochloric Acid Transfer Operation

There are two long pipelines used to transfer hydrochloric acid to the bulk storage tanks at the Quarry Site. From these bulk tanks, hydrochloric acid of various strengths is dispatched into road tankers for sale. The older of the two lines dates back to around 1971 and transfers 36% hydrochloric acid from the Hydrochloric Acid Plant to one of the two bulk tanks at the Quarry Site. The second line, commissioned last year, transfers 20% hydrochloric acid from the Chloromethane CM2 Plant. Both lines follow a similar route along a pipe bridge for a distance of over 800 metres.

This audit focused attention on the older of the two lines, the 36% line, but the newer line for 20% hydrochloric acid was also observed for comparison during a visual inspection of the line along the pipe bridge.

3.3.2 Engineering Details. Pipe Specification. and Inspection

The pipeline is registered (Ref WC5005) under SI 13 (Hazardous Pipelines - Assessment, Registration and Inspection) by virtue of carrying a high hazard fluid. As a registered pipeline the requirements for regular inspection are defined in a separate ICI Engineering Department procedure referred to in SI 13. The pipeline does not require any statutory registration.

The line is a 4-inch nominal bore, carbon steel rubber lined (CSRL) pipe. All details of the line itself, including the design codes, temperature and pressure ratings, and fabrication details are contained in the pipeline specification sheets, which were examined. These also contain the detailed specifications of any approved fittings that may be used on the line. Over the years these design specification sheets have been revised in order to incorporate variations brought about by changing standards (e.g. to incorporate EC standards) or where experience has shown that materials or testing methods no longer represent the industry standards. In most cases such changes to the line specification have no implications for the integrity of the existing line, but when sections are replaced in the course of routine maintenance the opportunity may be taken for changing to the latest specification.

Regular inspection of the line against the line specification is carried out by Eutech Engineering (formerly ICI Engineering Department), and is independent of the production site. Eutech Engineering holds recognised national accreditation to carry out such inspection work and offers this service to other companies outside of ICI and its subsidiaries. Eutech Engineering, in compliance with SI 13, sets out the inspection

requirements and frequencies on Form INS/21. When inspections are carried out these are recorded on Forms INS/22 which are held in a central registry at the Runcorn Site and off-site by Eutech Engineering. Inspections are brought forward using a computerised maintenance system (MERLIN) which is now fairly old, but fully functional and well established across the site. It produces lists of required engineering work to enable the engineering planners to organise the work using the site engineering resources, or as in the case of inspections, to bring in inspectors from outside.

A number of inspection reports for the hydrochloric acid line were examined in the Engineering Registry. Records were seen that go as far back as 1976. They confirm that full inspections have been carried out at the required 26-month intervals, and intermediate visual inspections at 12 month intervals. The last full inspection was carried out on 21/7/95, within the required time limit, and was signed off by the engineering inspector and accepted by the Works Engineer. The last intermediate inspection was carried out on 29/9/96. The inspection reports include full isometric drawings of the entire line marked up with the areas noted in the report as requiring attention. This aids identification of the work and allows follow up inspections to ensure that the corrective actions have been carried out. Copies of these inspection reports and isometrics were used in the inspection of the line as part of this audit to check whether previously identified remedial work had been completed.

Records of any modifications and repairs are also held in the registry. The last repair was for a failed 'T' piece and was carried out on 22/5/97. The word "Failed" is used to indicate that a problem was identified which was not part of a routine inspection and that work was initiated to remedy the fault. It does not necessarily mean that the line failed and caused a leak. The report of the repair includes details of the inspection and testing that was done after the repair work had been completed.

Whilst the hydrochloric acid transfer line is clearly the responsibility of the Chloromethanes Plant for all engineering work, the pipe bridge on which the line is supported has a shared responsibility as it passes over a number of different sections of the site. There are three owners, with nominated engineering managers from the Chloromethanes Plant, Sulphuric Acid Plant, and Site Infrastructure, each with their own section of responsibility clearly marked on a diagram of the pipe bridge. This avoids any confusion and ensures that the pipe bridge is maintained in good order for its entire length, without the possibility of any omissions.

3.3.3 Auditor's Inspection of the Line

As part of this audit, the entire 800 metres of the line was walked, and comparisons made with the newer line used for 20% hydrochloric acid which runs alongside for much of the distance. An isometric drawing of the line marked up with a few minor defects noted during the last inspection by Eutech Engineering was checked to determine whether these had been corrected.

The inspection started at the Hydrochloric Acid Plant storage tank. Note was made of the recently installed polypropylene drainage line which has been routed above ground in the Hydrochloric Acid Plant area to segregate acid run off from sample and drainage points and avoid contaminating the general surface water drainage system.

One severely corroded flange and blanking plate was found on a one inch drainage point 'T' piece, but the corroded flange was on the external side of an isolation valve and as the valve was closed would not in itself lead to a leakage. Nevertheless it should be replaced at the earliest opportunity.

In three places along the pipe run, sections of line had been replaced with new sections. These still require external painting. One of these was mentioned in the last inspection, but it is possible that the unpainted sections noticed in this inspection are recent replacements.

On the overhead pipe bridge which passes over North Road, one of the main site access roads, two of the flange protector drainage pipes had become disconnected. One of these was noted in the last inspection, but it may have been repaired and come loose again. It is important that these are replaced as any minor leaks could affect people and vehicles passing underneath.

Other than these minor defects, the line was found to be in good condition, suitably maintained and adequately supported. There are no unusual or obsolete fittings which are likely to lead to line failure. The run of the line is such that it is well protected and unlikely to suffer mechanical damage. However, being fabricated from CSRL there is always the potential for failure of the lining, with age, which will result initially in pin hole leaks, or leaks from flanges, which fortunately are easy to detect because of the fuming nature of the material. If not detected early these can lead to more significant spillages, but the operators are aware of this risk. Replacement of the entire line with alternative lining material may eventually become necessary.

3.3.4 Control of the Material Transfer, Operating Instructions, and Operator Awareness

The control room for the Hydrochloric Acid Plant and the smaller control room at the Quarry Site were visited and the operators responsible for the hydrochloric acid transfer were interviewed.

The Hydrochloric Acid Plant control room was found to be generally untidy and cluttered. The control panels themselves are old and poorly laid out with old disused instruments taped over. Labelling of instruments was poor and inconsistent, for example the level gauge for the bulk stock tank from which hydrochloric acid is pumped to the Quarry has a label showing the level instrument number (5LI622) but no reference to the tank number. The level gauge for the receiving tank at the Quarry has the tank number (CT1104) but not the level instrument number. Both labels are small, and the label for the receiving tank has been supplemented by writing the tank number above the gauge using a felt tip pen. The gauges for the stock tank and the receiving tank are at opposite sides of the control panel and there are no diagrams or markings of any kind to indicate any connection between the two. The level gauges are simple rotary analogue dials, which offer only limited measuring accuracy. There is a second similar level indicator for the receiving tank in the small control room at the Quarry Site.

Hydrochloric acid is normally only pumped to a single dedicated tank CT1104. It is possible to use the neighbouring tank CT1103, but this would require a physical inter-change of the line at the quarry end. Such a change would be recorded in the plant log in the control room.

The transfer of 36% hydrochloric acid from the Hydrochloric Acid Plant to the bulk tank at the Quarry Site is a batchwise operation with batches of around 160m^3 being transferred. The receiving tank CT1104 has a maximum fill level of 960m^3, a high level alarm set at 980m^3, and a high level trip at 1000m^3. There is sufficient ullage in the tank beyond the high level trip to allow the transfer of a batch without overfilling. The number of transfers in a given time depends on the production rate varying from two to three each shift at high production rates, to one every other day at low production rates. The Hydrochloric Acid Plant is a continuous manufacturing plant, but is normally under the control of a single operator working on shifts. If necessary the operator can seek assistance from an operator from the neighbouring CM1 Plant which also has only one operator, and there is a Shift Team Leader covering both plants.

The set of operating instructions for the Hydrochloric Acid Plant in the control room was examined, with special attention to Operating Instruction 14, dated July 1995. This contained sufficient details for operation of the plant but there were no specific instructions relating to the

transfer of hydrochloric acid to the Quarry Site. This operation relies on custom and practice of well trained operators. There is no routine system for reviewing operating instructions unless a new plant item is installed or operating procedures are changed for other reasons. Training of new operators on the plant entails them shadowing experienced operators. When the new operators have been validated as competent by the Plant Supervisor they can then operate the plant alone.

The Hydrochloric Acid Plant operator walks the hydrochloric acid transfer line once each shift if there is a transfer taking place, looking for leaks. There have been a number of instances of minor pinhole leaks over the years but these are easily detectable. They occur as a result of failure of the rubber lining or at flange joints and is a recognised problem. The operator fully understood the actions he needed to take to shut down the transfer operation and make the area safe, but he showed some confusion about the order of contacting the site emergency number, or informing the Site Shift Manager who has overall responsibility for such incidents.

In order to ensure that the quantity of material transferred actually reaches the storage tank there would need to be a comparison of the level increase of the receiving tank with the level decrease of the sending tank. This is not always possible because whilst the bulk tank at the Quarry Site is being filled it may simultaneously be in the process of being off loaded to road tankers. Daily readings of all the stock tanks at the Quarry site are taken at midnight, and stored on a computerised system in the Site Shift Managers office. As a check, the auditor requested sight of the hydrochloric acid bulk stock levels for a given day during the previous week. There was no difficulty in producing the required readings, which were assumed to be correct.

The operator at the Quarry Site was interviewed about his role whenever there is a transfer of hydrochloric acid to the Quarry Site. His view differed to some extent from the views of the Hydrochloric Acid Plant operator in that he placed full responsibility for the transfer operation on the Hydrochloric Acid Plant operator and saw his main responsibility as the off loading into road tankers. If there was a spillage from the transfer operation there would be little he could do other than inform the Hydrochloric Acid Plant operator to shut down the transfer. The Quarry Site is only manned during the daytime for six days a week and the operator cannot be expected to take a significant role in the transfer operation.

3.4 The Transfers of 98% Sulphuric Acid and 20% Oleum from the Sulphuric Acid Plant to the Quarry Site Bulk Storage Tanks.

3.4.1 The Sulphuric Acid Transfer Operations

The Sulphuric Acid Plant is a continuously operated plant supplying sulphuric acid (in various grades), and oleum, for use on site or for external sales by road tanker. The main part of the plant was built in 1972 and major overhauls are carried out every two years. There are plans to upgrade the plant over the next five years in a project which will require significant capital expenditure over and above that for routine maintenance.

There are two transfer lines from the Sulphuric Acid Plant to the Quarry Site Bulk Storage Tanks. One is for 98% sulphuric acid and the other for 20% oleum. They both follow a route along the pipe bridge similar to that used for the hydrochloric acid transfer described previously in this report.

3.4.2 Engineering Details, Pipe Specification, and Inspection

Both lines are registered pipelines under SI 13 because they carry a high hazard fluid, but they do not require statutory registration. The 98% sulphuric acid is registered line WC5007 and the oleum line is WC5010.

Both lines are 3-inch nominal bore welded lines, and are lagged and electrically trace heated to prevent freezing in winter. The 98% sulphuric acid line was originally fabricated from mild steel but there was an incident in 1992 when a pin hole leak was discovered downstream of a butt weld. The maintenance file for the line contains details of the incident and a report on the subsequent investigation, which was carried out. ICI found that a similar pattern of corrosion was taking place at all similar welds. The incident report contains a number of recommendations including replacing the line with stainless steel, publicising the incident, and inspection of all butt welds on similar duties involving sulphuric acid. The line was reconstructed using stainless steel in 1993 and this is recorded in a subsequent inspection report. There have been no similar incidents on the line after this replacement.

Records showing the scheme of inspection of the lines (Forms INS/21) and the subsequent inspection reports (Forms INS/22) were examined in the Engineering Registry. The last visual inspection of the 98% sulphuric acid line was in April 1996 but it took until December 1996 before the report was signed off. Comments in the inspection reports were mostly about the need for minor repairs to the lagging on the pipe line. The next thorough examination of this line was scheduled for June 1997 but the report was not yet available in the Engineering Registry.

3.4.3 Auditor's Inspection of the Line

The entire 800 metres of the two lines was walked in order to discover whether there were any obvious defects or inappropriate fittings which could lead to sudden failures. Copies of the line diagram showing the transfer lines were used during this inspection. These drawings date from 1993 and were last updated in September 1996.

The pipe bridge supporting the lines is used for a number of other lines and identification of the sulphuric acid lines is not always obvious. Attempts have been made to attach identification labels to the lines but most of them have become illegible with age.

The inspection revealed the presence of two, low section drain off points which although valved and blanked, did not follow good piping standards since the poor arrangements at the discharge end could lead to spillages to the ground during line draining. Although these drain points are used very rarely their purpose should be questioned and their design re-examined.

At the Quarry Site end of the transfer lines the oleum line is raised on an overhead pipe bridge across the site roadway before entry to the storage tank CT1105. This is inconsistent with the general design in the area in which all other transfer lines are routed through a new purpose designed pipe trench under the roadway. Although of little consequence, as the roadway is rarely used, it is an unnecessary overhead obstruction given that there is adequate room for the line in the pipe trench.

Other than these relatively minor points the transfer lines were found to be in good condition, adequately supported, and suitably maintained. Nothing was found which gave any concerns about the potential for accidental releases from these transfer lines.

3.4.4 Control of the Material Transfer, Operating Instructions, and Operator Awareness

The Sulphuric Acid Plant and its control room were visited in order to interview the Shift Controller and one of the shift operators. There are normally two operators for the plant, one inside the control room and one carrying out duties on the plant, both reporting to the Shift Controller. In addition the Quarry Site operator can be called on during the day to confirm the settings of the transfer lines to the bulk tanks. However, as was found for the Hydrochloric Acid Plant, the main duties of this operator are the filling of road tankers from the bulk tanks.

The control room was generally tidy with adequate instrumentation for the transfer operation and recording of tank levels.

The transfer of acid to the Quarry Site tanks is a continuous operation at a constant rate. Material can be off loaded from the bulk tanks for use on the plant or for filling road tankers. Filling of the bulk tank may occur at the same time and so there is no way to reconcile receiving tank levels with imports. Physical balancing of the tank levels at the Quarry Site is an important part of the process operation. There are three storage tanks for oleum (each with different capacities) giving a total capacity of 4,650 tonnes, but the system is operated to a maximum of 2,500 tonnes. This gives an excess capacity of 2,000 tonnes, which allows the contents of any tank to be transferred to another if emergency repairs to the tank are necessary. The 98% sulphuric acid system is operated similarly, with a maximum storage capacity of 6,600 tonnes in two identical tanks, but a normal working capacity of 2,500 - 3,500 tonnes. Levels within the storage tanks are recorded four times every day. These records were inspected and found to be complete and up to date.

The Plant operating instructions are held for reference in the control room. These are sufficiently detailed but are old and in the process of being updated to a more useable format. There is a requirement in the instructions to check the transfer line for leaks on a monthly routine, but no records are kept to show that this inspection has been carried out. Leaks of oleum would probably be easily detected due to the fuming nature of the material, but leaks of 98% sulphuric acid would be much more difficult to detect. The engineering design of the pipeline and scheduled engineering inspections must be relied on to guaranty the integrity of the system.

There is a set of Emergency Procedures for the actions to be taken for dealing with spillages of oleum and chlorosulphonic acid, and included changes introduced during a review in January 1996. The operator interviewed was fully aware of the correct notification procedures and actions to take on discovering a leak along the transfer line.

A copy of a recently designed training manual for the plant was examined. This is an excellent example of a step wise approach to training new plant operators and covers all aspects of operation including environmental protection.

3.5 The Transfer of Heavy Fuel Oil (HFO) from the Bulk Storage Tanks at Picow Farm to the Day Storage Tanks Located at the Castner-Kellner Power Station.

3.5.1 Oil Transfer Operations

HFO is stored in three bulk storage tanks alongside the main railway line at Picow Farm, a distance of about 2000 metres from the Castner-Kellner Power Station. The HFO is unloaded from rail tankers at a dedicated

unloading siding adjacent to the bulk tanks. There is also a facility for unloading HFO road tankers at the far side of the railway. Each of the bulk tanks has a capacity of 35,000 tonnes of HFO. In normal use, HFO is pumped into one of the two smaller day tanks located next to the power station, from which it is fed at a controlled rate into the boilers.

The power station, part of which dates back to 1917, is due to be closed down in about three years time. HFO has been in use for almost thirty years and the present HFO transfer line is less than 30 years old. Natural gas is the preferred choice of fuel for environmental and economic reasons, with HFO used only as a standby fuel during occasional interruptions of the gas supply. There have been no deliveries of HFO since the last delivery by rail in 1994. It is not envisaged that there will be any further deliveries and the railway sidings and off-loading facilities have fallen into disrepair. The remaining stocks in the bulk tanks should provide sufficient reserves for the next three years.

The heated transfer line from the bulk tanks to the power station runs on a low level pipe support bridge alongside the railway line, through a residential area, for most of its distance before it re-enters the ICI site. It then runs on an overhead pipe bridge across the site before reaching the day storage tanks. Only one of the two day tanks is now used.

3.5.2 Engineering Details, Pipe Specification, and Inspection

In 1995 the HFO transfer line was designated as a registered pipeline, coming under the ICI registration requirements because it carries a high hazard fluid. There are no statutory registration requirements.

All details of the line itself, including the design codes, temperature and pressure ratings, and fabrication details are contained in the pipeline specification sheets. These also contain the detailed specifications of any approved fittings that may be used on the line.

Inspection of the line against the specification is carried out by Eutech Engineering, formerly ICI Engineering Department, and is independent of the production site. At present the line is on a two monthly inspection frequency because a defect was discovered on one of the anchor points for the pipe supports along the railway line. Normally inspections would be carried out at 14-month intervals, and it is believed that this could be extended to 26 months. The last inspection was started in April 1997, but has not been completed in order to allow work to proceed on the repair of the defective pipe support. The detailed design showing the proposed method of repair was examined.

The system of organising inspections of the pipeline uses the MERLIN computerised system for scheduling the work into the forward work

programme of the works engineering section.

There is single ownership of the pipe support bridge on which the transfer line runs and this is the responsibility of the Power Station Engineering Manager. The pipe bridge is inspected at the same time as the pipeline.

3.5.3 Auditor's Inspection of the Line

It was not possible to walk the entire length of the line because much of it was inaccessible. The inspection was therefore limited to the beginning and end of the line, and various vantage points. From this limited inspection there was nothing evident which could lead to a sudden major failure of the line.

3.5.4 Control of the Material Transfer, Operating Instructions, and Operator Awareness

The Power Station control room was visited to interview the duty Shift Manager and an operator familiar with the HFO transfer operation.

Despite the age of the Power Station, the control room was clean and tidy. The control panels have been updated over the years and contain a reasonable level of modern instrumentation, but there is no level indication of the bulk HFO tanks at Picow Farm. There is a pipeline oil pressure alarm on an annunciator panel, which would give warning of a major failure of the line. Any operations such as starting the transfer pump to transfer HFO from the bulk tanks at Picow Farm requires an operator to be present at the tanks. Although a modern plant would have level indication at both ends of the transfer, the requirement of the presence of an operator at the tank farm prior to the start of transfer provides some safeguards against spillages.

Written procedures, which cover the operation of the plant, are set out in Local Standing Orders (LSOs). Some examples of these LSOs were examined. LSO 2.23 is the Oil Spillage and Emergency Procedures. LSO 2.30 is the procedure for inspecting and auditing of equipment. The LSOs are audited on a regular basis, and LSO 2.23 was last audited on 23

December 1995. LSO 2.4, which covers Alarms and Trips, was written in 1978 but it is currently being re-written.

A revised training manual which covers the operation of the HFO transfer was produced in 1996. It is based on the previous very comprehensive training manual written in 1972 which included details of all plant items, controls, and operating principles. It remains available for reference but it had been reproduced by photocopying so many times that much of it, particularly diagrams, had become illegible.

3.6 The Transfer of Chlorine from the Chlorine Plant to the Chloromethanes (CM2)Plant and the Per/Tri Plant.

3.6.1 Chlorine Transfer Operations

The two chlorine transfers selected for this audit were chosen as representing the duty of the chlorine network at the Runcorn Site. The chlorine network dates back to 1959, but there were additions and changes in 1967 and in the early eighties. Chlorine storage tanks date from 1955 onwards.

Chlorine is produced from the electrolysis of brine, and after leaving the cell rooms the chlorine is treated and dried before it is compressed and transferred on site as gaseous chlorine, or liquefied and transferred as a cryogenic liquefied gas to other parts of the site. Gaseous chlorine is supplied to the Per/Tri Plant and liquefied chlorine is supplied to the Per/Tri Plant and CM2 Plant.

3.6.2 Engineering Details, Pipe Specification, and Inspection

The transfer lines for both gaseous and liquefied chlorine are registered pipelines under SI 13. The ICI pipe specification for dry liquefied chlorine dates back to 1979, but the specifications are being revised to incorporate recent changes in international standards. There is nothing in these changes to suggest that the current pipeline is not suitable for the required duty. But where new pipelines are being installed the revised specifications require impact testing of the steel instead of the current standards which requires stress relieving of the pipe wall to achieve the same purpose.

The liquefied chlorine line which runs from the Chlorine Plant to the CM2 Plant is a 4-inch nominal bore mild steel, welded line, installed in 1985. It is fully insulated along its length.

The Chlorine Plant operators carry out routine visual inspections of the transfer lines on a weekly basis and these inspections are recorded. Annual inspections are carried out by Eutech Engineering and they also carry out a thorough examination every three years including radiography of the line at selected points. The last inspection of the line to CM2 Plant was carried out on 23 January 1997. Records of this inspection were examined and there were no concerns recorded in the inspection. There was a comment that the line has had a good history to date.

The system of control of modifications was discussed. Records were examined and found to comply with the site instructions observed during the audit of other transfer systems.

3.6.3 Auditor's Inspection of the Line

The entire length of the line was walked from the liquefied chlorine stock tanks at the Chlorine Plant to the cut off point with the CM2 Plant (a distance of approximately 1000 metres). Overall, the line was found to be in good condition with no sign of deterioration, or repairs and modifications having been carried out. There were only two minor points raised during this audit:

(i) Where the line crosses a roadway on an overhead pipe bridge in the construction area for the Corvic Extension Project, there are no warning signs to indicate the dangers of the chlorine line, and there is the risk of damage from construction traffic.

(ii) The final section of the line follows a contorted route passing under two culverts which are no longer necessary and makes inspection difficult. When convenient a new section could be installed following a more direct route and avoiding subterranean sections.

An inspection of the gaseous chlorine line from the Chlorine Plant to the Per/Tri Plant, a distance of about 800 metres also revealed no areas of serious concern, although two patches of surface rust were discovered one of which could have been caused by the contents of neighbouring pipelines dripping on to the chlorine line. The Maintenance Engineer noted these for attention.

Other than the relatively minor points noted in this report, the part of the Chlorine Network examined during this audit was found to be in good condition, and well maintained. Nothing was found which gave any serious concerns about the imminent potential risk of accidental unauthorised releases from these transfer systems.

3.6.4 Control of the Material Transfer, Operating Instructions, and Operator Awareness

The small control room for the chlorine transfers was visited and operators were interviewed. The control room and level of instrumentation was adequate for the transfer operations, although consideration should be given to upgrading the instrumentation and computerised data logging of appropriate records.

Operating instructions for the "Liquid Chlorine Distribution From F Tanks" were available in the control room and were examined. They were first issued in 1989 and contain a recorded list of amendments, the last being in July 97. These instructions are well written and contain sufficient level of detail for the operation of the transfer systems. A set of

emergency procedures for the area was also examined. They were dated November 1996 and were last amended in March this year. As would be expected for the handling of such a hazardous material, the operators were well trained in emergency procedures for dealing with leaks.

A copy of the IPC authorisation for the Chlorine Plant was not available to the operators in this control room, although their operating instructions contain an interpretation of the relevant sections in a format more appropriate to the operators. The operator's understanding of their requirements under IPC was considered to be satisfactory.

3.7 Conclusions

3.7.1 The requirements set out in the ICI Runcorn Site Instruction SI 13 ("The Registration, Examination and Maintenance of Piping Systems") were followed for all of the transfer systems examined in this audit. In following these instructions the management have ensured that appropriate design and construction practices are used in fabricating pipelines across the site, and that inspection and maintenance is carried out to a high standard at the recommended frequency.

3.7.2 The inter-plant transfer lines examined were found to comply with good engineering standards, and there were no obvious shortcomings which could lead to a sudden failure likely to result in contamination of the environment.

3.7.3 On older plants the process operating instructions, including those for inter-plant transfers of materials, have not been revised for many years and only recently has a start been made to update them. There were no appropriate instructions for the hydrochloric acid transfer.

3.7.4 Standards of controls and instrumentation on these older plants were variable, and were just adequate. They could all benefit from investment in more up to date instrumentation, with more thought given to the layout of controls and instruments associated with the inter-plant piped transfer operations.

3.7.5 There is a strong emphasis on environmental protection on all the plants visited. Process operators had adequate training and knowledge of their plants to be aware of the potential for causing harm to the environment and the actions to take in the event of a major spillage, although the procedures for summoning help at such times need re-enforcing.

3.8 General Recommendations

3.8.1 A system should be introduced for the formal review of all written operating procedures and instructions at an appropriate frequency. Written

operating instructions for the transfer of hydrochloric acid from the Hydrochloric Acid Plant to the Quarry Site Bulk Storage Tank should be provided as soon as possible.

3.8.2 Consideration should be given to upgrading the control panels and instrumentation used for some of the older plants which transfer hazardous materials over long distances.

3.8.3 A condition of an Authorised IPC Process is that it ".....shall be managed and operated by sufficient persons who are suitably qualified, experienced, trained and supervised in respect of the duties to be undertaken in connection with the carrying on of the process". ICI should review its compliance with this condition with respect to plants where there is only one shift operator.

3.8.4 Additional training should be provided so that process operators are clear about how to summon help in the event of a major spillage on their plants.

3.8.5 Comments and items pointed out for attention in the main sections of this report should be noted and acted upon.

4.0 PLANT OVERHAULS (SI 47)

4.1 Objective

Plant overhauls necessitate shut-down, decommissioning, maintenance work, recommissioning and start-up. Many of these are non-routine activities which introduce the potential for environmental releases. Risks also derive from the large numbers of operators (often contractors) working in unfamiliar environments. Site Instruction 47 is designed to minimise the risks associated with overhauls by establishing a system for the definition and proper execution of work. The audit aimed to assess how well it does that.

4.2 Discussion

SI 47 was described as being the most complex of all the Site Instructions and requires a large effort to implement. It also interfaces with a number of other SIs (e.g. SI 3 - Permit to Work, SI 5 - Modifications, SI 31 - Decontamination). The Per/Tri Plant is particularly complex and because it retains a number of live connections during overhauls, this necessitates a very comprehensive and structured approach.

The Per/Tri Plant is shut-down every year for replacement of reactor catalyst but the last major overhaul was in 1995. Decommissioning for the overhaul started on 12 May and at the time of audit (3 & 4 July) units were being brought back on line with a view to start-up on 12 July. The major jobs on this overhaul were the replacement of D Reactor and replacement of the top section of a distillation column. The overhaul has involved in excess of 350 people on 24 hour working and will cost several million pounds. Over 1200 Permits to Work have been issued and this has required up to 12 issuing officers.

Selected parts of SI 47 were scrutinised and observations were made on some of the key steps.

4.3 General

The title of the SI differs between the actual document ('Safe Systems of Work for Overhauls'), and the Index ('Safe Systems of Work during Overhauls and Re-commissioning of Plants'). However, it was established that they refer to the same document.

SI 47 was issued on 1 November 1989 and there have been no revisions in the intervening seven and a half years.

SI 47 has been applied to previous overhauls on Per/Tri and, whilst there were overhaul completion reports, the Plant Manager was not aware of any suggestions that had been made for improvements to SI 47. If these existed, then they would

be held by SHE department who would collate feedback for incorporation into the next revision.

An 'update file' is held centrally by SHE department for each SI to collect feedback and developments in best practice. This file is used to prepare SI revisions. Comments found on the update file suggested that SI 47 was "too long and detailed" and was "difficult to understand/adhere to". It was also identified as being "based on previous organisational structures" and that "ideas about overhauls have moved on".

SI 47 has obviously been written from a Safety and Health perspective and its main objective is stated as 'to set down principles for safe working'. Page 26 even describes SI 46 as a 'Safety Instruction' when it is entitled a 'Site Instruction'. The objective fails to mention environmental protection and there is only passing reference in the text. It is true that the provision of safe working conditions will often deliver environmental protection, but the omission of a specific environment reference is seen as important. SI 47 is to be revised in 1997/98 and it was noted that the 'SHE Standards and Guidance' now includes environmental aspects of shut-downs.

Management undertakes Level 1 audits against SI 47 but these are aimed at checking compliance with its requirements and not questioning its applicability. Level 2 audits have been carried out by SHE department staff to establish if SIs are fulfilling their intended purposes. There has been no Level 2 audit of SI 47 during the Per/Tri overhaul but SHE department staff undertook an audit of VC3 on 20 June 1997. This found the local auditing to be adequate and that Safe Systems of Work were in place and were well understood. The only adverse comment was on the need for a display of plant status (this was addressed on Per/Tri).

There is no tier of instructions below SI 47 but there is much documentation to fulfil its requirements. SI 47 is very complicated and describes the functions of many personnel throughout a number of activities. Although this is well explained, SI 47 would benefit from a schematic diagram to simplify description of the interactions.

4.4 Planning

Six months prior to commencement of the overhaul, a detailed list was drawn up showing all the project work to be undertaken plus any repairs arising from the plant "defects list". Additional work may be added to this scope of work as a result of findings during the overhaul. Method statements cover all 1500 jobs. Of these, 16 jobs were identified as being new or posing particular site risks and underwent a 'Job Safety Analysis'. The Job Safety Analyses were observed to address environmental issues (e.g. decontamination of the Caustic stock tank (T603) identified the need for outfall protection). Project teams were assigned for any major or novel jobs.

The extensive use of contractors for overhaul work could be a concern if they are inadequately briefed. It was therefore pleasing to see the significant effort and expenditure (£100k) that had gone into demonstrating the need for adherence to site objectives. Twenty of the 25 overhaul supervisors were supplied by the contractors AMEC and they attended a one-week induction course. The 350 AMEC day operators attended a three-day induction course. There is statistical evidence (accident rates) and improved operator attitude that demonstrates the benefits of this investment.

4.5 Management Organisation

SI 47 requires the creation of a management organisation that integrates the activities of personnel and achieves the main aims of an overhaul (ie. SHE performance, cost and duration). The overhaul was carried out using the Per/Tri's Plant's own maintenance operators and a 350 strong workforce from AMEC. This management organisation has been effectively conveyed through the use of purpose made charts, which have photos of post holders in addition to their name and title. This has aided the integration of a large team from diverse origins.

The Per/Tri Plant has been divided into 69 systems to create more manageable workloads. For each system there is a line diagram showing the system boundaries, a list of component kit and the necessary isolations. Each system will have an owner who has ultimate responsibility. System owners have to ensure compliance with the required quality standards; monitor the implementation of Permits to Work; and carry out audits ("Job Freezes").

4.6 Learning From Previous Overhauls

SI 47 requires a report to be prepared on completion of the overhaul. The 1995 overhaul report identified 'Critical Success Factors' which were aimed at improving the next (i.e.1997) overhaul. These factors have been addressed in the following manners :

Safety : Contractor briefings have been a major contribution in reducing classified injuries from six in 1995 to zero in 1997 (as at 3/7/97).

Preparation : Robust preparation was identified as a pre-requisite for successful overhauls and this resulted in £1 million being spent on planning in the nine months before the overhaul started.

Resources : Efficiency of the overhaul was compromised in 1995 by inadequate manning levels and this was addressed in 1997.

Business Forecasting : In 1995 the Per/Tri stocks were exhausted during the overhaul and this pressurised the overhaul team to get the plant back on line as soon as possible. This may lead to poor quality work and so the 1997 overhaul

commenced with product stock levels that would allow unfettered attention to the necessary work.

4.7 Conclusions

4.7.1 SI 47 has been rigorously applied on the Per/Tri Plant through a comprehensive system of planning and controls.

4.7.2 SI 47 focuses very strongly on the 'safe' execution of overhauls but makes little reference to environmental protection. The Per/Tri Plant management has identified this shortcoming and have made appropriate amendments to accommodate environmental issues. The SI is complicated and lengthy.

4.7.3 The learning from a similar overhaul in 1995 has been well incorporated into the preparation and execution of the 1997 overhaul.

4.8. Recommendations

4.8.1 When SI 47 is revised in 1997/98 it should make more reference to environmental issues. Consideration should also be given to making it less complicated and could well benefit from the inclusion of a schematic diagram to explain the interplay of personnel and documentation.

5.0 ALARM, TRIP AND INTERLOCK SYSTEMS (SI 81)

5.1 Objectives

Site Instruction 81 defines how alarms, trips and interlocks should be categorised, designed, implemented, tested and maintained. Many protective systems are designed to prevent environmental releases and so their condition is a very important factor in plant environmental performance. The audit aimed to identify the extent of SI 81 implementation on three very different plants.

5.2 Findings

The actual SI is entitled; 'Alarm /Trip/Interlock Systems', but this differs from the longer version given in the SI index ('Registration, Inspection and Maintenance of Alarms, Trips and Interlock Systems'). However, these titles referred to the same document.

Auditing was against Issue 2 of SI 81, which is dated 30 November 1994. SHE department staff indicated that the original SI was written with a bias towards electrical instrumentation and failed to recognise the role of mechanical protective systems (e.g. tanker loading barriers). This necessitated a prompt re-issue.

The fundamental requirement of SI 81 is that protective systems are categorised. The top tier of systems is termed 'SHE Critical' because the systems provide the ultimate protection against major events. The next tier of 'SHE Related Systems' may affect safety, health or the environment, but are designed to minimise the likelihood or consequences of a major event (rather than providing ultimate protection). 'Process Operability Systems' do not affect SHE, but provide control of the process. The categorisation is based on the significance of hazards, the type and likelihood of failure, and the potential consequences.

Protective systems are ranked according to the type of hazard and the required grade of instrument reliability. Systems are then designed and maintained to pre-determined standards.

New protective systems cannot be commissioned until the requirements of SI 81 have been applied. However, there is no set timescale for the implementation of SI 81 on existing protective systems.

The SI requires a written programme for system testing. The test dates are usually recorded on the MERLIN computer system. Operation beyond a due date is viewed seriously and requires a modification under SI 5. The presumption is that the complete system will be tested under operating conditions, unless this creates a hazard or renders the process inoperable. Any system failures are investigated and reported to the Plant Manager.

SI 81 implementation was considered for two plants under the Fluorochemicals authorisation (Klea 134a and Fluothane) and the VDC4 Plant (covered by the Chlorinated Ethylenes authorisation).

5.2.1 Klea Plant

The Klea 134a Plant is one of the newest on the site. Although it was designed before the introduction of SI 81, major process modifications (e.g. inhalation grade product) have necessitated the full adoption of SI 81. The Klea Plant alarms/trips/interlock systems have been almost fully categorised in accordance with SI 81 and there remain only a small number of systems where categorisation is outstanding.

The Klea 134a Plant has 58 hardwired shutdown systems. Of these, six have been registered as 'SHE Critical', 31 have been registered as 'SHE Related', and 15 are for 'Process Operability'. The six remaining systems are of lower priority and have outstanding questions which will determine their status. In addition to the hardwired systems there are several hundred protection systems which fulfil operational functions and are not covered by SI 81 (i.e. they are "ungraded").

The Klea 134a Plant has a Shutdown `System Listing' which indicates the loops making up each protective system, the loop test method and the frequency of testing.

The intentional defeat/override of protective systems is a high-risk operation and SI 81 requires written procedures which stipulate the circumstances for defeat and re-establishment. The Klea 134a Plant management is currently writing standard operating procedures to cover this requirement.

The MERLIN list of programmed instrument testing was viewed. The programme was found to be up to date and there were no extensions to test dates. In general, the plant finds it difficult to test systems under operating conditions and it is usual to make isolations. Written procedures exist for test methods and there is a list of defects which arise from testing.

The failure of a protective system in service has to be investigated and reported. System Z152 failed on 13/03/97 due to a leaking valve, but the incident was demonstrated to have been investigated and resolved.

The Klea 134a Plant control room staff knew which systems had been declared 'SHE Critical' and were able to go through the response to initiation of a chosen SHE system (Z152 in this case). The control room staff were satisfied with the protective systems, and the occasional false initiation at shut down was easy to rectify. The initiation of 'SHE Critical' systems is very infrequent and it took some time to find the last one (low

HF pressure in April 1996) as there is no chronological record of initiations.

5.2.2 Fluothane Plant

The Fluothane Plant has about 150 alarms/trips/interlocks, which can be broken down into 14 systems. The categorisation process only started in November 1996 and 110 of the alarms have been covered to date. This late start reflects the absence of any major modifications to the plant since the SIs issue in 1994. Categorisation is expected to be completed by the end of 1997, after which there will be an exercise to determine whether the instruments are fit for their intended purpose.

There is already a programme of instrument testing in place, but this is based on historical knowledge and does not provide the same rigours as SI 81. The current testing programme is scheduled on MERLIN and is covered by test methods.

5.2.3 VDC4 Plant

The VDC4 Plant management has found it very difficult to find the resources needed to implement SI 81. Although the extra work is a one-off, it requires very intensive and time-consuming studies. A programme was sanctioned in Q4 1996 (i.e. two years after issue) and is due to be completed in Q4 1997. A shortage of staff has meant that a retired Operations Manager has been brought back to undertake the work. He was involved in the plant design and commissioning and so has the local knowledge which is considered essential for the proper implementation of SI 81. Of the 700 plant alarms, 330 have been categorised to date and the breakdown has been 20 'SHE Critical'; 79 'SHE Related'; and 224 'Process Operability'.

Despite the lack of formal implementation there has been a subjective assessment of the VDC4 Plant protective systems and 38 of them have nominally been assigned as 'SHE Critical'. The systems are tested on a three monthly basis in accordance with a programme set on MERLIN. This frequency will be reconsidered when all the systems have been categorised.

Records were viewed that confirmed that the three month testing frequency had been complied with. An instrument fault was selected (03SD040 in May 97) and it was demonstrated that the four identified faults had been rectified.

In the control room there is no chronological record of shutdowns, although each system initiation is recorded.

Operators log any overrides of a shutdown system and a blue flashing light activates on the alarm panel. However, there was found to be poor control of access to the override cabinets because keys were missing or locks did not work. There was some discussion as to whether the override procedure was too elaborate and was therefore ignored. The system for ensuring that override keys are in place was also found to be on almost total override.

Audits have been carried out against SI 81 (even though it is not fully implemented) and the following observations were made.

AUDIT DATE	AUDITOR	COMMENTS	SCORE
31 May 1995	AD	Identified need to implement SI 81. Action : APD/MP/IW by Q3 1995 - outstanding	Very Poor
28 Oct 1996	AD	No tests for alarms other than 900 Unit. Need to rationalise routines. Poor feedback from Seiger detectors. Action on PE (by Q2 1997) - completed	Poor
9 April 1997	RD	Bypass (override) book very good although no written procedure. Poor control of bypass keys. Action on IW (by 09/07/97) - still outstanding on 08/07/97.	Poor

The following comments are made :

It was disappointing to see that three audits had been carried out over the last two years giving scores of Poor or Very Poor. The plant management recognised that this was due to a lack of resources, but a solution was slow in being implemented.

No audits have been carried out by the Plant Manager, but this is purely a result of the random nature of the programme for SI auditing.

When the May 1995 audit was completed it was unrealistic to expect that SI 81 would be implemented by Q3 1995.

Audit actions are occasionally allocated to the wrong person.

Actions do not always make it from the audit sheet to the list of outstanding actions.

Actions identified by RD's audit are recorded on a different system and do not appear on the master list of outstanding actions.

5.3 Conclusions

5.3.1 SI 81 does not set a completion date for full implementation.

5.3.2 There is variable implementation of SI 81. Implementation was good on the Klea 134a Plant, but poor on Fluothane and VDC4.

5.3.3 The level of implementation appears to reflect plant age, the extent of major plant modifications and the large resource implications of the SI.

5.3.4 Even on plants where the SI had not been fully implemented, it was encouraging to see that interim measures had been enacted to categorise, test and audit protective systems. Although not to the same level of detail as SI 81, the interim measures appeared to be achieving similar objectives.

5.3.5 When 'SHE Critical' systems initiate there is no requirement for this fact to be recorded. Analysis of records could be aided by the chronological recording of these initiations.

5.3.6 On the VDC4 Plant there was poor control of access to the override cabinets, despite the identification of this problem on a previous ICI compliance audit. One system for monitoring override keys was itself on almost constant override and this is bad practice.

5.3.7 The last three ICI compliance audits of SI 81 on VDC4 gave consecutive markings of "Poor", "Poor" and "Very Poor", but no actions had been taken to remedy this situation.

5.3.8 SI 81 compliance audits on VDC4 showed that there has been mis-allocation of remedial actions, the setting of un-realistic completion dates for actions, and the "loss" of actions between the audit report and the list of actions. Measures should be put in place to address these points.

5.4 Recommendations

5.4.1 The full adoption of SI 81 is an important factor in the environmental performance of plants and resources should be provided to ensure its prompt implementation on any outstanding plants.

5.4.2 Systems should be implemented to highlight and remedy any successive poor scores during audits of SI 81.

6.0 REGISTRATION. INSPECTION AND MAINTENANCE OF ATMOSPHERIC PRESSURE STORAGE TANKS (SI 19)

6.1 Introduction

Site Instruction 19 requires all atmospheric pressure storage tanks to be assessed for registration. Atmospheric pressure storage tanks should be registered if they are either situated outside the site boundary, contain a flammable liquid with a flash point below 55°C, or contain a fluid whose properties are such that a leak could potentially cause pollution of the environment or harm to human health.

Tank registration provides a formal scheme of inspection and maintenance to ensure integrity. Pressure vessels are registered under Site Instruction 16. The same range of documentation for inspection and maintenance is common to both types of vessels.

The Statutory Records Department maintains registered equipment files for all registered tanks, which document all associated design, inspection and maintenance information. The design, inspection and maintenance history for non-registered tanks is held locally on the plant in the SHE dossier.

SI 19 was issued 30 June 1996. The discussion below examines its application by the Chloromethanes Section and on the Sulphuric Acid Plant, part of the Klea Section.

6.2 Objectives

- To establish whether the procedures for inspection and maintenance of atmospheric pressure storage tanks are consistent with the requirement "to maintain in good operating condition all plant, equipment and technical means used in carrying on the Authorised process" (Ref. IPC Authorisation Condition 1.2).
- To establish that the design, inspection and maintenance of these tanks are consistent with the IPC authorisation requirement in that the process is "carried out by sufficient persons who are suitable qualified, experienced, trained and supervised".
- To establish whether the procedures for tank design, registration, inspection and maintenance are rigorously applied and the actions comprehensively documented.

6.3 Findings

6.3.1 Implementation

The Chloromethanes Section was committed to fully implementing Site

Instruction 19 by mid-1996. The usual approach to full implementation of Site Instructions, as discussed above, is by setting targets through annual site or section SHE Improvement plans. Targets for fully implementing engineering orientated Site Instructions such as SI 19 would normally be set by each section depending on priorities, resources and expenditure.

The minutes of a Klea Section Engineers meeting of 8 October 1996 were examined. A number of objectives were set for 1997, which included full implementation of SI 19 across the section.

6.3.2 Assessment

Atmospheric storage tanks are assessed for registration, using an INS/25 form, by a team appointed by the Responsible Engineer, normally the Section Engineering Manager. The assessment team calls upon appropriate personnel from Inspection, Materials, Vessel design and Safety to ensure the availability of adequate expertise and experience. The results of the assessment are summarised on the assessment form, approved by the Responsible Engineer and kept with the Registered Equipment Files in the Statutory Records section. The details documented on the assessment form include the duty, description of the tank, material of construction, "codal" assignment (i.e. decision tree route in the assessment criteria), the likely mechanism and location of deterioration, and the decision whether to register.

All tanks on the CM1 Plant have been fully assessed for registration using the appropriate assessment form and signed off by the Responsible Engineer. The Hydrochloric Acid Plant, which is part of the Chloromethanes Section, has some tanks still requiring assessment.

All atmospheric storage tanks on CM2 appear to have been previously registered under a scheme for registering pressure vessels. The Section Engineering Manager endorsed this view. On a point of clarity, this does not imply that these tanks were registered as pressure vessels under Site Instruction 16. The use of Group Engineering Standards (GESs) and Engineering Department Procedures (EDPs) generally predate the introduction of Site Instructions. Prior to the Pressure Systems Regulations 1989, the statutory requirement for registration of pressure vessels was limited to essentially air and steam receivers. ICI deemed it good operating practise to extend the scheme of registration to other vessels, including atmospheric pressure storage tanks, particularly in the light of using hazardous materials on site.

The Registered Equipment files for atmospheric storage tanks on CM2 do not have an INS/25 assessment record as they are superfluous to tanks registered under the pressure vessel scheme. However, the documentation for inspection and maintenance is common to both types of vessels.

The implementation of SI 19 is being progressed on the Sulphuric Acid Plant at present. In a memorandum of 3 February 1997 to the Klea Section Engineers, nine atmospheric pressure storage tanks were identified as having been assessed for registration although a large number of atmospheric storage tanks had previously been registered under the procedure for pressure vessels.

6.3.3. Registration

Registered tanks under SI 19 are required to be issued with a unique PV (Pressure Vessel) number by the Statutory Records section, which must be clearly marked on the tank along with the plant item reference.

The Responsible Engineers nominee, usually a Plant Engineering Manager, is responsible for ensuring that the tanks identified for registration have a Registered Equipment file created by the Statutory Records section.

CM1 Plant tanks have all been marked up with their registered PV references but the Hydrochloric Acid Plant tanks and the sample of tanks examined on CM2 still require marking. All tanks examined did however appear to be referenced with their Plant Item reference number.

The Statutory Records section set up inspection routines for each registered tank on the inspection and maintenance computer database (MERLIN) only when a completed scheme of inspection and the initial inspection report has been submitted.

Registered Equipment files for registered atmospheric storage tanks include:

(i) a design drawing and design specification (PV1 form)
(ii) an assessment form (INS/25)
(iii) a scheme of inspection (INS/1)
(iv) all detailed inspection reports (INS/3)
(v) any modification/repair reports (INS/5)
(vi) a Design Verification Certificate (DVC) - required for a modified or replaced vessel
(vii) any reviews of the examination period (INS/8), and
(viii) all inspection chits (INS/15) supplied by the inspector as interim reports, to indicate 'fit for purpose'.

6.3.4 Inspection

The scheme of inspection is agreed between the Responsible Engineer's nominee and a 'third party' Inspection Engineer. The engineer is normally from the Eutech Engineering group. The scheme of inspection is documented on an INS/1 form and requires approval from the Responsible Engineer and the Senior Inspection Engineer. The scheme includes the

initial and maximum inspection intervals appropriate to the relevant inspection grade X, Y and Z, which are referenced in Group Engineering Guidance (GEG) 4.1. The grade is chosen after consideration of the duty, and potential causes and consequences of tank failure. For the registration of atmospheric pressure vessels the maximum interval for inspections is 74 months for grades Y and Z, and 144 months for grade X.

At present, a scheme of inspection is in place for all registered atmospheric storage tanks on CM2 Plant but not for all tanks on the CM1 or Hydrochloric Acid Plants. The INS/25 assessment form for CM1 registered tanks was completed on the 20 December 1995 but there is still no formal scheme of inspection for these tanks over 18 months later. On examination of a Registered Equipment file for a hydrochloric acid tank (PV7814) on CM1 Plant, two records of discretionary inspections at four year intervals were evident, the most recent being in August 1994. It was not determined if the inspection routine for this tank had been entered onto MERLIN, although it was clear that inspection and maintenance routines for some non-registered tanks are logged onto MERLIN.

An example of an approved scheme of inspection form for a chloroform tank on CM2 (PV5957) was examined. This detailed the preparation works for the inspection and the scope of the inspection; visual internal and external examination with hammer tests; ultra sonic thickness checks every 72 months; and visual external checks every 24 months. The form was signed off by the Eutech inspector and Responsible Engineer's nominee and approved by the Senior Eutech Inspection Engineer and Responsible Engineer.

The scheme and frequency of inspection is information entered onto MERLIN, which will notify due and overdue inspections on a monthly basis. A computer listing is circulated to the Responsible Engineer and his nominee. The Responsible Engineer's nominee is responsible for submitting a report to the Responsible Engineer accounting for all overdue inspections.

An example of a 'marked up' listing with overdue inspections dated 13 February 1997 was examined. There were no reported 'overdues' for CM1 and those for CM2 appeared to have reasonable justification (e.g. 'project to by-pass vessel, awaiting INS/8 form' - change in the inspection interval). In addition, MERLIN may notify vessels as overdue when the inspection has in fact been completed. This is because there may be a delay between the inspection and Statutory Records section receiving the approved inspection form to update the computer database.

All routine inspections of registered tanks (also known as "codal" inspections) are recorded on an INS/3 form and signed by the inspector and Responsible Engineer's nominee. The Responsible Engineer countersigns the report when -

(i) the tank is assigned inspection grade Z,
(ii) there has been a change in the recommended inspection frequency, or
(iii) where significant modification or repair has taken place.

Where it is deemed necessary to change the inspection frequency between the scheduled inspections, an INS/8 forms must be completed and approved by the Senior Inspection Engineer and the Responsible Engineer.

An example of a change to the inspection interval was noted for a stock tank containing 100% sulphuric acid. The Inspection Engineer recommended that the maximum interval should be extended from 48 to 74 months. The justification was based on the tank being fabricated from stainless steel and that 100% sulphuric acid was less corrosive towards steel than the 96 or 98% acids, which were held in mild steel storage tanks. The Senior Inspection Engineer and the Responsible Engineer had both signed the form as required.

The examples of INS/3 forms examined for registered atmospheric pressure tanks on the Chloromethanes and Sulphuric Acid Plants were considerably detailed, comprehensive and signed off by the appropriate personnel. It was also apparent that the documentation for all scheduled inspections was complete and contained in the respective Registered Equipment files.

There were no evidence on the Chloromethanes Section or Sulphuric Acid Plant of any formal deferrals, although it was clear that a procedure was in place for any such event, again requiring approval by the Senior Inspection Engineer and the Responsible Engineer before the inspection due date. An example was quoted where 77% sulphuric acid was sold at a very low market value to enable the storage tank to be emptied and internally examined within the agreed inspection interval.

6.3.5 Maintenance

A Plant Maintenance Planner is responsible for organising routine plant maintenance into 'events' up to 12 months in advance for annual strategic maintenance plans and up to 18 months for plant or section overhauls. The Central Maintenance Group allocates event numbers, which the planner uses to assign a number of routines to. A Works Order, generated by MERLIN, is raised for each routine. This may include for a tank examination, the procurement of scaffolding etc. For each event number the Work Orders would be grouped into event lists. Work event meetings are held routinely between the Maintenance Planner, Plant Engineer and the Maintenance Co-ordinator to define the general routines and requirements for scheduling into events. The Planner would then enter the event list on MERLIN. The benefits of entering the event lists onto MERLIN are that whole events can be costed out, the range of associated tasks are easily identified, the history

of the individual events can be monitored and it facilitates in generating reports.

All repairs and modifications, including change of tank duty to Registered tanks, are required to be documented on an INS/5 form, and are usually carried out by the local plant maintenance operators. Modifications and replacement tanks are subject to design verification by an Authorised Engineer and require a Design Verification Certificate (DVC). An Authorised Engineer in this context is a specialist vessel design engineer responsible for ensuring that the design of a vessel is satisfactory for the conditions specified on the design drawing. A Project Manager is appointed where the design of a new vessel is required. Vessel design specialists from ICI Engineering Technology, including Vessel Engineers and Materials Engineers are used to produce a design specification. Independent consultant inspectors are also used at vessel manufacturing premises. All newly installed vessels require an approved scheme of inspection and a commissioning inspection before they can be put into service.

Where repairs or modifications have taken place, the INS/5 form must be signed off and approved by the relevant nominees to indicate that the maintenance is complete and the tank can continue in service. It is only then that the INS/3, the inspection report, can be signed and approved. Procedures for modifications and temporary repairs are considered in Site Instructions 5 and 27 respectively.

There was an example noted where an INS/3 form referred to a replacement dip pipe (internal branch) having been installed in a 100% sulphuric acid storage tank. However, there was no record of the required maintenance report form INS/5 on the Registered file.

6.3.6 Failure in Service

The Responsible Engineer is required to ensure that where a registered tank has either failed in service or its suitability for service is severely compromised, the review procedure is followed. An inspection must be completed to ensure that the tank can continue in service, consideration is given to reviewing the scheme of inspection and in the event of failure, a thorough investigation is carried out into the cause. An investigation report is required to be submitted to the Responsible Engineer (normally the lead person) and the Senior Inspection Engineer and a copy placed on the Registered Equipment file held by Statutory Records.

There were no documented incidents of recent tank failures for the Chloromethanes Section.

6.3.7 De-registration

There was no evidence to suggest that any registered atmospheric tanks on Chloromethanes or the Sulphuric Acid Plants had been de-registered and remained in service, which would require approval by the Responsible Engineer and the Senior Inspection Engineer. The likelihood being that once a tank is registered it would remain under that system of inspection and maintenance.

6.3.8 Internal Operational Audits

The SHE officer for each section produces an annual audit plan, approved by the Plant or Section Manager, for all relevant Site Instructions. The audit plan includes those Site Instructions that have yet to be fully implemented on a particular plant or section. Thus providing an indication of progress towards full implementation. Audit reports are held by the SHE officer, who circulates the results of the more critical SI audits to the relevant Plant/Section Managers.

The Chloromethanes section is currently carrying out operational audits against SI 19 on a biennial basis. The most recent audit of 30 April 1997 scored one on a scale of one to five, ranging from very poor to excellent. The audit identified

(i) the requirement for a scheme of inspection to be implemented for registered tanks on the CM1 and Hydrochloric Acid Plants

(ii) to paint all registered tanks with their PV reference number, and

(iii) to set up inspection routines on MERLIN for all CM1 Plant and Hydrochloric Acid Plant registered tanks.

There have been no operational audits carried out on the Sulphuric Acid Plant against SI 19 to date. The agreed audit frequency against SI 19 was stated as once every five years.

6.4 Conclusions

6.4.1 The site has comprehensive, robust and quality procedures for the inspection and maintenance of atmospheric pressure storage tanks.

6.4.2 The relevant personnel responsible for design, inspection and maintenance are generally specialists suitably qualified, experienced, and trained in their particular areas of duty.

6.4.3 Aspects of the procedures which are 'SHE Critical' (e.g. the scheme of inspection) require additional approval from more senior management

within the relevant discipline.

6.4.4 The actions taken from application of the procedures have been comprehensively documented where those procedures have been fully implemented.

6.4.5 Operations staff are familiar and understand the Site Instruction, which is readily available on plant.

6.4.6 There is a well defined operational audit system in place to determine compliance with the Site Instruction. However, there is no firm commitment to a compliance date whereby the Site Instruction must be fully implemented across each section. This has potential to compromise environmental performance on the site.

6.5 Recommendations

6.5.1 Consideration should be given to setting firm compliance dates for fully implementing SI 19 across each section of the site.

7.0 REGISTRATION. INSPECTION AND MAINTENANCE OF BUNDS (SI 37)

7.1 Introduction

Site Instruction 37 specifies the procedures for the registration, inspection and maintenance of earthworks and bunds to ensure fitness for purpose. The relevant area of interest for the audit was the aspects of SI 37 relating to bunds. The Site Instruction incorporates two Engineering Department Procedures (EDPs) relevant to bunds, namely Registration of Bunds and Requirements for the Examination of Registered Bunds.

A register of all bunds is required to be maintained which contains information relating to design, duty, inspection and maintenance. All bunds must be assessed against the registration criteria, based on the potential, mode and consequence of failure.

New bunds which meet the criteria are subject to a design verification procedure and have an approved scheme of inspection before commissioning. The provision of bunds in certain circumstances are statutory requirements (e.g. The Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972 and The Fire Certificates (Special Premises) Regulations 1976). In addition, the provision of bunds is also recommended in Health and Safety Executive guidance for the storage of flammable liquids with a flash point below 55°C.

7.2 Objectives

- To establish whether the procedures for inspection and maintenance of bunds are consistent with the requirement to maintain in good operating condition all plant, equipment and technical means used in carrying on an Authorised process.

- To establish that the design, inspection and maintenance of bunds are carried out by sufficient persons who are suitable qualified, experienced, trained and supervised.

- To establish whether the procedures for design, registration, inspection and maintenance are rigorously applied and actions comprehensively documented.

7.3 Findings

7.3.1 Implementation

SI 37 was issued on 14 November 1996 but has not been implemented on any of the sections on the site. A pilot study has been progressing since January 1997 on the VDC4 Plant, to trial SI 37 implementation . The study appears to be at an early stage of progression, focussing on identifying

which tanks require registration and reviewing the content/layout of the related documentation.

Targets for fully implementing SI 37 on the Chloromethanes and Klea sections have been set through SHE Improvement plans for 1997, although the Klea Section Engineer referred to SI 42 (registration, inspection and maintenance of drainage structures), as having a higher priority for implementation in 1997.

7.3.2 Registration

The Site Civil Engineer is responsible for ensuring that all bunds on site are assessed for registration. Bunds are required to be registered if there is a statutory requirement, a HSE recommendation or where failure of containment would have significant potential to cause harm to human health or pollution of the environment. These will generally include any bunds that provide containment to a registered storage tank or vessel. Potential hazards identified by loss of containment include ground water contamination, discharges into the surface water drainage system, spread of fire and releases of hazardous vapours.

Each Section Manager is required to appoint a nominee to ensure that an inventory of all bunds in their area of responsibility are identified on a section layout drawing and uniquely referenced. Documentation supporting registration is to be held in Asset files by the Statutory Records Section.

An INS/80 form is used to document the assessment process for each bund and an INS/79 is used to summarise this information. The INS/80 form comprises 7 steps for consideration against the requirement to register. A bund which provides containment for Category 'A' substances must be registered. Category A substances include List 1 substances cited in the Groundwater and Dangerous Substances directives and Schedule 2 of the COSHH Regulations 1994. The assessment and registration form INS/80 requires the approval of the Site Civil Engineer.

It was apparent that the extent of bunding on both the Chloromethanes Plant and the Sulphuric Acid Plant was essentially limited to bunds required by statute or those recommended by HSE guidance. A sample of atmospheric storage tanks observed on the CM2 Plant, which included methylene chloride and chloroform, were not bunded and relied on the drainage system for secondary containment. A spill from this area drains to a catch pit and passes through a separator, where any aqueous phase is diverted to the EIP system and the organic phase is recovered for reworking.

7.3.3 Inspection

Routine visual examinations of bunds would generally be carried out in the

course of a housekeeping audit. Defects for consideration would include cracks or holes, subsidence and impaired drainage. Thorough examinations require a scheme of inspection (INS/77) and a nominated inspector, both approved by the Site Civil Engineer. The inspection interval should not exceed 36 months and the inspection should include a visual inspection and any other examinations deemed relevant. This may include a water test for containment and ability of the bund to withstand the full hydrostatic head, particularly at the first thorough inspection and at further examinations if the integrity of the bund is in question.

Following approval of the scheme of inspection and the first thorough examination, the Statutory Records section would set up inspection routines on MERLIN. Overdue inspections would be notified by MERLIN and reported to the Site Civil Engineer. Inspection reports for all registered bunds should be held by the Statutory Records section, whilst reports for non-registered bunds should be held on the appropriate plant in the SHE dossier (SHED).

There are few bunds on the Klea and CM2 Sections but those inspections that have been carried out appear to be limited and have been on a discretionary basis.

7.3.4 Maintenance

Plant Production Managers are responsible for ensuring that their bunds are 'fit for purpose' and must ensure that any defects and associated repairs are incorporated into maintenance routines on MERLIN. All modifications are required to be carried out in accordance with Site Instruction 5 (Site Controlled Modifications) and are subject to design verification by an appropriate engineer or organisation appointed by the Site Civil Engineer.

7.4 Conclusions

7.4.1 The site has comprehensive, robust and quality procedures for the inspection and maintenance of bunds used for secondary containment.

7.4.2 Site Instruction 37, has not been implemented on any section of the site to date. A pilot study on the VDC4 Plant started in January 1997 in order to trial the implementation of SI 37. It appears that there must be some difficulties in timely implementation of SI 37.

7.4.3 The personnel responsible for design, inspection and maintenance are suitably qualified, experienced, and trained in their particular areas of duty.

7.4.5 There is no firm commitment to a compliance date for full implementation of SI 37 on each section. This has potential to compromise environmental performance.

7.5 Recommendations

7.5.1 Consideration should be given to setting firm compliance dates for fully implementing SI 37 across the site.

7.5.2 Priority should be given to completing the pilot study currently in progress to enable full implementation of the Site Instruction.

7.5.3 Wider consideration should be given to secondary containment at source (i.e. within a bund rather than depending on drainage to catchpits or treatment facilities). However, it is accepted that a properly constructed risk assessment should be carried out before automatically considering bunding as the best retrospective option.

8.0 TANK FILLING OPERATIONS AND DEALING WITH SPILLAGES

8.1 Objective

Tank filling operations are recognised as having the potential for spillage, particularly from overfilling. It is important that procedures and equipment are in place to minimise the risk to the environment. Two plant areas on the Chloromethanes Plant (CMs) and the KOH/Caustic Plant were chosen for audit since both have a large number of storage tanks.

Site Shift Managers play a key co-ordinating role in the response to any environmental incidents, and so their activities were also examined.

8.2 Findings

8.2.1 Instrumentation

Site Instruction 81 refers to Alarms, Trips and Interlock Systems. Its relevance to tank filling operations with respect to the appropriate alarm system was investigated. Alarms are typically at two locations e.g. in the control room and local to the tanks. There is not always secondary containment on tanks and heavy reliability is placed on alarms to prevent overfilling and spillage. There was a comprehensive registry system on computer showing listings for all plant related alarms. The register contained test intervals, an indicator for current status, and advanced warning for scheduling, and any overdue inspections. Plants employ a number of operators as schedulers, for short and long term planning. During the audit, one alarm system was found to be operating just past its due date for testing, however this was backed by a site modification as required by the site instruction. A review of frequency had recently been carried out, and there was a system in place to pick up on trends as major defects are circulated to all managers via the modification forms. Current status is always available, and it is the responsibility of the relevant electrician /engineer to sign off the checks, paper copies of all inspections are kept.

8.2.2 Operator Training

SI 81 states that there must be appropriate training and validation for any staff involved in the operation, maintenance, testing and inspection of alarms etc. To this end each plant had a training log for each member of the team, although there was not a consistent approach for how this log was kept. The CMs Plant had a computer system which made it very easy to determine at what time any team member last received any training and when this would be due for renewal. It was clear that extensive training is made available to all plant employees and in particular it was noted that this included emergency exercises. For each training course, there was a clear record that all training had been validated by the responsible person.

8.2.3 Emergency Procedures for Environmental Incidents

Reference was made to SI 48 whose purpose it is to ensure that essential emergency plans and arrangements are in place, in order to minimise adverse effects from the sites activities. This includes effects on site personnel, the local population and the environment. To this end it is the responsibility of each plant to ensure appropriate local training and the shift management team to co-ordinate site wide procedures. It is the Shift Manager's responsibility to make the initial contact with the Agency during an incident.

The KOH/Caustic Plant had good clear emergency procedures, specially written with reference to environmental incidents, instructions were given for individuals by job title. The CMs Plant environmental emergency procedures were unavailable for inspection as they were being re-written. The plant is currently involving all its personnel in a range of emergency exercises including environmental incidents, as the need for this experience and training had been identified. It was thought that these exercises would provide useful information when writing the new procedures.

The Shift Management Team are very good at ensuring their own team receive regular training exercises and have an exercise a month programmed throughout the year, including some with the County Emergency services. These exercises also act as formal training sessions, particularly for new Shift Managers, and are kept as a record in their training manual. The plants involved are usually made aware of these exercises in advance, as they are primarily designed to test the Shift Managers, site procedures, and how they link in with local procedures.

The Shift Management Team has recently carried out an audit of individual plants' emergency procedures and environmental response. This clearly identified a need for the site to make improvements and the Shift Managers have offered their services to all plants to update and practice local procedures. Each plant will be re-audited at the end of the year.

Individual staff on the plants were questioned as to whether they had been involved in environmental exercises. All had been, except for one plant operator at the Picow Farm site.

Spillage procedure documentation was found in offices and control rooms associated with the plant. The whereabouts of this information was confirmed by individual plant personnel.

8.2.4 Local Emergency Risk Assessments

SI 49 requires all manufacturing plants to produce SHE assurance reports. These are very important documents which ensure that plants operate in a

safe and environmentally acceptable way. They incorporate several key principles including hazard studies and risk analysis. The report should also contain a review of recent incidents and a summary of emergency exercises completed.

For both plants the current SHE assurance reports were in draft, and they were made available for inspection. The KOH/Caustic Plant also made available the previous report from 1990, the latest draft report reviewed the action plan from 1990, together with new issues. The CMs Plant did not make available their previous document as by their own admission the document paid very little attention to environmental issues. This has definitely been corrected for the current report. It is worth noting an extract from the CMs Plant report which states 'the site has come under increasing environmental pressure from the public and the Agency, as a result environmental actions will have an increased priority for completion.' It is also worth highlighting that the CMs Plant report specifically looked at the protection of ground water.

Of the two reports examined they were significantly different in the way they had been put together, and to the extent of the reports. SI 49 was issued in April 1997 and is designed to ensure consistency for all reports.

8.2.5 Containment of Spillages

Of the two plants under investigation each have a considerable number of tanks for the storage of raw and intermediate materials and finished product. In general there are very few tanks with secondary containment in the form of a bund, filling operations are closely monitored and alarmed. If however these were to fail, there are a number of routes the overflow could take. Some overflow to process drains and pits, some to bunded areas, although in many cases the storage tanks are so large, construction of a bund has not been possible. For many any overflow would pass directly to storm drains, with no further means of containment other than the drains themselves. There does not appear to be any consistency in why some tanks have bunds and others do not, other than where it is a requirement for health and safety reasons.

As was found for the storage tanks, there is not a consistent arrangement for tanker loading areas, for example Picow Farm loading area is contained and any spillage would be directed to a sealed pit, the contents of this pit are tankered off site for disposal. However at the Quarry site, drainage from the tanker loading area is directed over some distance via site drains to an effluent pit, where any spillage would then mix with process effluent and storm waters.

Except for high hazard materials it was not found to be general policy to

keep some tanks empty for emergency situations but rather to rely on movement to off-site storage.

For spillages on a plant, each plant should be equipped to take action, at least in the first instance. To this end the storage/availability of local spillage containment equipment was investigated on the two plants. Both the CMs Plant and the KOH/Caustic Plant had local spillage containment equipment. It was stored in a dedicated area, and housekeeping inspections were used to ensure these were maintained. Local stores were inspected and found to be well stocked and organised. The exception to this was the Picow Farm road site, were no local spillage containment equipment was held. This area would benefit greatly from the added protection of this equipment as it is remote from the main site, and so access to equipment from the sites main emergency store could take some time.

Individuals on plant were asked what they would do in the event of a spill in their plant area. Responses were mixed, from checking to see which manhole it would be appropriate to seal, with reference to drawings in the shift supervisors office, to knowing exactly by number (manholes are referred to by a number and this number can be found on plant drainage diagrams) which manhole to seal to contain a spillage in a particular area.

As well as local emergency equipment on particular plants, the site has an Emergency Store which comes under the ownership of the Site Shift Management Team. Equipment in this store is extensive and is for use by the Site Emergency Response Team, who respond to any incident with trailers ready loaded with equipment specific to the different needs of the various plants across the site. Equipment includes booms, adsorbents, pumps (to deal with acid/alkali or solvent spills), hoses, temporary tanks, drain seals. There is also a trailer ready equipped to deal with off-site emergency incidents. All this equipment is on a regular maintenance programme. There is limited access to the store, with one shift manager taking the lead, site security have access to the store. There was evidence from the inspection of the equipment logs that some checks were not up to date.

Examination of the details of an incident on VDC4 (information supplied on an Environment Incident Report) clearly indicated availability of local spillage containment equipment averted what could have been a significant environmental incident.

8.2.6 Environmental Incident Reports

Some Environmental Incident Reports were examined, with respect to SI 51. (Reporting, investigation and documentation of accidents, occupational diseases and environmental incidents). The purpose of the instruction is to

define responsibilities for reporting and investigation during environmental incidents.

The audit trail for any incident on the site can be followed through either Incident Report (IR) form or in the case of environmental incidents an Environmental Incident Report (EIR) form. Following a report to the Site Emergency Response Team of an environmental incident an EIR will be generated. For the purpose of the audit the last six months reports were made available for inspection. Some were very poorly completed, the category of incident was missing, with no signature of the shift manager completing the form, and in some instances the second page was missing altogether. A new computer system was introduced in March this year, which should aid the process, although currently it seems to be compounding the problems. A recent internal audit also came to the same conclusions about the poor completion of forms.

Ten individual reports were selected at random from those likely to have had some sort of recommendation following the incident. The originals, which are kept in the SHE administration offices, were then checked for compliance with target dates. Of the ten reports only one had been satisfactorily completed with recommendations carried out before the target date. One was still being investigated. The remaining eight still had some actions recorded which had not been completed by the required date. Responsibility for the completion of the report lies with the plant/outfall manager, as 'authors', the original reports are kept within the SHE administration section who log timescales and report to managers when actions are out of date. This administration section is currently setting up a database which will highlight out of date reports, the system should make it easier to identify shortfalls.

All environmental incidents are reported via the 'Thursday Meetings' this information is cascaded to all personnel. This is an excellent communication system for reporting incidents and highlighting the problems to the rest of the site. However there doesn't appear to be a system of reporting back once recommendations have been completed or solutions found. In particular it would prove very useful to the Site Shift Managers to have feedback, particularly where they have made a recommendation.

All environmental incidents must be reported and where necessary reported to the Agency. Recent instructions have been given, slightly amending existing internal reporting, to give clarification to internal categorisation of environmental occurrences. This has not yet been incorporated into appendix 7 of SI 51.

There was evidence that the site does learn from previous incidents and the Site Shift Management Team is very proactive in this area. Any deficiencies

are noted and where possible incorporated in the monthly training exercises.

8.2.7 Hand Over of Work Between Successive Shifts

SI 38 refers to the hand over of work between successive teams or individuals. This SI defines the requirements and responsibilities for individuals responsible for the same plant, equipment, task or area so that safety health and environmental matters are communicated. For the audit it was important to determine that systems are in place for good communication particularly when a changeover occurs during an incident.

For each of the teams investigated good clear logs were evident. Individual work areas all have their own logs and these are brought together by the appropriate Team Leader/Shift Supervisor for a report across the plant for that particular shift. Back copies of these reports are kept, and were made available for inspection. Each plant clearly identified any environmental incidents and these were given equal importance with health and safety at the start of the report.

The Shift Managers have a new computerised system for the completion of shift logs. These are clear and concise. A summary of the log is available on the main notice board within the shift managers office, and the log is also made available via the ICI e-mail system. Safety and environment is the first topic on the log.

8.3 Conclusions

8.3.1 Instrumentation was found to be adequate for the tank filling operations examined with a comprehensive system for auditing the alarm systems.

8.3.2 There was generally good evidence of staff training with appropriate records kept. The recording system used on the CMs Plant was particularly good.

8.3.3 Although good quality emergency response procedures were available for inspection on the KOH\Caustic Plant, this was not the case on the CMs Plant where they were being rewritten.

8.3.4 The Site Shift Management Team provides an excellent service to the local plant area staff for training needs in dealing with emergencies. They have shown initiative in recently auditing all of the local emergency procedures, and highlighting some deficiencies.

8.3.5 Production of updated SHE assurance reports was found to be in hand on the two plants audited. The final reports will be very important documents in that they pull together many aspects of the SHE policy and the progress on implementation.

8.3.6 There are very few tanks with dedicated bunds for secondary containment whereby spillages would be completely retained.

8.3.7 Overflows from tanks without bunds pose a serious environmental risk, and this is minimised by having procedures and equipment in place.

8.3.8 There is a good system in place for the rapid notification of incidents. However the follow up and feedback from the incidents was found to be lacking in some respects.

8.3.9 There were clear reports in place covering the hand over from successive Shift Managers.

8.4 Recommendations

8.4.1 The training record system on the CMs Plant should be considered for other plants.

8.4.2 The CM's Plant management should produce a written environmental emergencies procedure quickly, to bring it in line with other plants.

8.4.3 The Site Shift Management Team should continue with their auditing role to make sure that ICI can be confident that they have local staff in place who are properly equipped and fully trained in dealing with emergencies.

8.4.5 The implementation of SI 49 and production of the SHE assurance reports should be progressed quickly.

8.4.6 ICI should continue to review its policy on secondary containment with a view to minimising the impact of spillages and where possible enabling any material which has been spilt to be re-used rather than disposed of.

8.4.7 Logs relating to the inspection of equipment in the emergency stores should be kept up to date.

8.4.8 Improvements should be made to the method of tracking EIRs from original ownership through to the completion of all required actions and eventual feedback of the outcome to those who could learn from the actions.

9.0 MAINTENANCE SYSTEMS

9.1 Objective

With regard to relevant conditions set in IPC Authorisations AL 7456 (Production of Chloromethanes) and AL 7421 (Production of Perchlorethylene, Trichloroethylene, and Vinylidene Chloride), evaluate the adequacy of the maintenance system in the following areas:

- Structure of the Maintenance Function
- Policy for Management of Maintenance
- Procedures
- Communication
- Resources
- Planning and Execution of Maintenance
- Purchasing and Stores Control
- Measurement of Maintenance Performance

9.2 Findings

9.2.1 Structure of the Maintenance System

For each plant on the site prior to 1996 the Engineering discipline reported via a line from the craftsmen grade, through various levels up to the Area Engineer. The Operating Plant Manager and the Area Engineer then reported to the Section Manager. The Area Engineer also had a dotted line responsibility to specific Site Engineers who in turn reported to a N.W. Engineering Manager. These plant maintenance teams were responsible for specifying and maintaining standards, carrying out reactive maintenance and condition monitoring and some planned short term maintenance. For long term maintenance events, the Planning and Overhauls group would carry out the planning and maintenance activities, the maintenance being performed by Company personnel and when necessary contract personnel.

During early 1996 the plants covered by these two authorisations and many other plants on the site changed to a structure where a Development Manager, Maintenance Manager and Operations Manager report to a Manufacturing Manager. The Maintenance Superintendent and the craftsmen report to the Operations Manager, and carry out reactive maintenance, short term maintenance and condition monitoring. The personnel reporting to the Maintenance Manager are responsible for the long term planned maintenance and support for day maintenance under operations. A new overhauls group was formed to cover shutdown overhauls.

The Area Engineer along with the Manufacturing Manager reports to the Section Manager. Working for the Area Engineer are E & I Engineers, a Contracts Manager and a Reliability and Improvement Manager. The Area

Engineers, one for solvents and one for CMs, are still the Responsible Engineers for the purpose of Site Instructions and Engineering Department Procedures. The Area Engineer sets engineering standards via a dotted line responsibility to the maintenance manager (who may be the Responsible Engineer nominee, but this is not always the case on the site). The changes referred to above were as a result of a Coopers and Lybrand Consultant Report, which was not viewed. It was reported that the consultant's report had recommended that a Responsible Engineer did not have to have an engineering background, which apparently has been challenged by some personnel carrying out the Resident Engineer role.

To compound these changes the Per/Tri Plant has undergone another change in its structure bringing together the roles of Technology Manager and Engineering Manager reporting to the Manufacturing Manager. The role of the Technology Manager being to carry out long term plant improvements and consideration for increase in production capacity. The Engineering Manager is responsible for replacement of large plant items (Special Revenue Monies - SRM). Reporting to the Engineering Manager are dedicated Electrical & Instrumentation Engineers, Development Engineers, Technical Assistants and a Task Manager (which was an ex Maintenance Manager role). The Area Engineer role continues and a dotted reporting structure line exists between him and the Engineering Manager. In this case there is also a reporting line because of the Responsible Engineer role (a term given in Engineering Department Procedures).

The change to the Per/Tri structure was reported as having been carried out to improve the focus on engineering since it was considered that it had been diluted under the Consultant's recommended structure.

9.2.2 Policy for Management of Maintenance

All the personnel interviewed during the audit had a good understanding of why maintenance is important in controlling environmental risks.

ICI has a detailed document called Guidelines for the Development of a Maintenance Strategy on Merseyside Operations. This guidance is utilised to generate maintenance strategies for the plants. The guidance includes consideration of the Company SHE policy, site SHE targets and improvement plans, Group Engineering Procedures, Site Instructions, Engineering Procedures, Site maintenance organisation and plans, the site strategy on improved working practices, information technology, manpower and contract services, legislation requirements and resource limitations.

The document covers production requirements, asset life, maintenance execution, availability requirements, cost consideration and systems. The maintenance execution section details which personnel would be utilised for the various categories of maintenance. The categories of maintenance being broken down into defect work, safety defects, project work, task/overhaul work and day team work. The document includes targets and references to

the appropriate local procedures. The appendix of the document gives detailed maintenance policy on pumps, pipe work, valves, structures, heat exchangers and pressurised systems. In many of these areas emphasis has been placed upon:

(i) reporting/recording and investigation of failures, examining the information to identify any common themes so that pro-active measures can be taken to reduce failures;

(ii) condition monitoring, the carrying out of material thickness checks, the use of corrosion probes, vibration analysis etc to identify problems before a leak/failure results;

(iii) consideration as to the registering of equipment under the various Site Instructions, which is based upon SHE criteria.

It is evident that IPC authorisations, site environmental policies and procedures affect the way that the maintenance system is operated. Each week, SHE meetings are held in each section to disseminate information on problems that have, or could have caused, environmental consequences.

The Company operates a policy of Improved Working Practices whereby operational staff are trained to carry out basic maintenance work. There is a formalised training scheme and records of competence are held on a plant by plant basis. The common competence obtained is basic pipe fitting, however these personnel would never be used on pressurised or critical pipe work systems and there would obviously be no welding element to the work.

All maintenance craftsmen are required to have served a recognised apprenticeship. The local manager is responsible for identifying and agreeing any additional training requirements to match the demands of the technology on the plant. This is of a great importance in the region of Control and Instrumentation where technology is advancing rapidly.

Professional Engineers follow a professional development scheme, and there is a coaching programme covering a full range of technical aspects. An Engineering Professional Effectiveness log is retained for five to six years for the various positions the person would hold.

Where there is a shortfall in resource, predominantly relating to craftsmen, the Company operate a five key contractor strategy, the details of which would have been held with the Contracts Manager. This was not viewed. The current system has been in operation since 1994. For each contract that is in force there is input from maintenance personnel to measure the performance on quality, safety, health and environmental aspects. Every six weeks the progress is reviewed with a Management Board. The integrated maintenance contractor supplies a report at stipulated intervals throughout the year. The report contains a SHE section containing objectives. ICI personnel carry out SHE audits of contractors under the appropriate SI.

The Sections on the site co-ordinate their planned maintenance activities to level out the demands on maintenance personnel. In this same way ICI also endeavour to contain the peak demands on contract staff in order to ensure that wherever possible the contractors utilised are already conversant with the Company procedures, guidelines and practices.

9.2.3 Procedures

The highest of the engineering procedures are the Group Engineering Procedures (GEPs) and are influenced by the Group SHE Policies Standards and Guidelines. The influence of UK legal requirements regarding standards for construction and maintenance of process equipment, are considered in order to produce Engineering Department Procedures (UK Based). Below these are the Specialist Engineering Department Procedures for works, design etc and in addition to those are guides and specifications. Engineering British Standard requirements or accepted equivalents are embraced within these documents. The Standards Section based at The Heath controls all the documents. Controlled copies of Site Instructions are held in the appropriate work areas.

The role of the previously referred to Responsible Engineer, and who is authorised to appoint him, is included in the Group Engineering Procedures and Guides.

For the mechanical engineering discipline the role of Site Engineer no longer exists, although for Electrical and Instrumentation this role still exists. The controlled copy of Site Instructions examined contained a controlled copy of a "Table of Equivalence" for the various changed titles that are contained within the Site Instruction.

Site controlled modifications are covered by SI 5. This is a detailed instruction that covers the change (permanent or temporary) to existing plant, office premises, and maintenance or process practices. The document contains an 'M' form for completion prior to a modification proceeding. A sample number of forms were checked to establish if the forms had been fully completed and that the various sanction stages had been carried out by authorised personnel. They were found to be satisfactory.

9.2.4 Communication

In order to ensure that shared learning occurs regarding engineering matters, there are a number of regular meetings. The meetings ensure the transfer of information within each of the engineering disciplines, across the engineering disciplines, and to the Business Engineering Manager. At each of the meetings minutes are taken, actions agreed and the minutes are circulated as required. The engineering meetings held are:-

Area Engineers	-	every month
Responsible Engineers & Business Engineering Manager	-	every six weeks.
Responsible Engineers nominees (Plant Engineers) - all mechanical	-	every month
Engineers - Electrical and Instruments	-	every month
Section Engineering meeting	-	every six weeks

In addition to these meetings there are the previously referenced weekly SHE meetings for the section. Matters from these meetings could be carried up into the structure of the meetings referenced above.

Defects that occur on the plant are logged in the MERLIN computer system for action. If the defect has an implication for SHE then it is marked as a SHE defect. On the Per/Tri Plant SHE defects are reviewed in the morning meetings by the day maintenance team (part of Operations). In addition every week there is also a Maintenance Review Meeting which is attended by Shift Supervisor, Maintenance Superintendent, Maintenance Co-ordinator, and a member of the Per/Tri Management Team. The requirements of the meeting are covered by a local maintenance procedure. Targets for completion of SHE defects are detailed in Standing Instructions.

The Per/Tri Plant holds a monthly SHE meeting with a SHE representative from each shift, SHE representative from maintenance, Engineering Manager, Operations Manager and Manufacturing Manager. The meeting is to review the effectiveness of the system in dealing with SHE defects, and also deals with significant projects and looks for comments on the maintenance practices / procedures to be adopted.

9.2.5 Resources

For the plants under these two authorisations the number of craftsmen employed by the Company was reported as being constant since the early 1990s or an increase of one or two when the manning for the Environmental Improvement Project is taken into consideration.

In relation to the professional engineering grades the level was considered to have increased to accommodate the Reliability Engineering role and it is planned to make a permanent position for an Electrical and Instrumentation Engineer, a post that has been on a six months trial.

The Area Engineer for Solvents Section produced graphs for Runcorn Site that showed the total number of professional engineers in the years 1989 to 1996. The overall trend is an increase to the 1996 level. The 1996 level was an approximate increase of 5% on the previous year. The grades covered are from the development grade through to an established Area Engineer. In 1996 over half the engineering grades were above the development grade.

The Area Engineer also produced graphs showing the age profile of engineers at Runcorn Site in the year 1996. Approximately 35% were in the age range of 25 to 30, the next highest was the 50+ range, followed by the 30 to 35 year olds. The figures tend to suggest a reasonable balance of "youth" and "experience".

Where the data was available a brief examination was made of financial resources. The data was available for the VDC, EDC, CMs and Per/Tri plants. The following trends were apparent. Figures 2 and 3 show the trends for the maintenance component of the costs.

VDC

- Reliable data exists for 1993 to1996 and shows fairly consistent operating costs.
- Increased maintenance costs of approximately 40% in the year 1994 on 1993, a reduction in maintenance costs in 1995 of approximately 12%, and then a further increase in 1996 back to approximately 1994 levels.
- There was a marked increase in Special Revenue Monies (asset replacement) in 1994 over the previous 1993 period and the costs in 1995 were more or less the same, with a marked reduction showing in 1996.

EDC

- Fairly consistent operating costs from 1993 to1996
- Fairly consistent maintenance costs from 1993 to 1995 with a marked increase in maintenance spend in 1996.
- Special Revenues Monies (Asset replacement) - increase from 95 over 94, and the costs between 95 and 96 appear to be stable.

CMs

- Fairly consistent operating costs from 1991 to 1996, the highest being in 1994.
- There was an approximate 40% decrease in maintenance costs in 1993 when compared with 1991. In 1994 and 1995 maintenance costs steadily increased to approximately 10% above 1991 costs. During 1996 there was only a marginal decrease in maintenance costs compared to 1995.
- Special Revenues Monies (asset replacement) costs decreased approximately 80% in the period 1991 to 1993. In 1994 the costs were marginally increased, but in the period 1995 there was almost a five fold increase in costs when compared with 1991. In 1996 the costs only declined marginally on the 1995 levels.

Per/Tri

- Fairly consistent operating costs from 1991 to 1994, an increase in operating costs in 1995 and a larger increase in 1996.
- Maintenance costs increased in 1992 over 1991 in the period 1992 to 1994 the costs were fairly consistent, in 1995 the costs increased approximately 20% and in - 1996 the costs increased further by approximately 25%.

- Special Revenue Monies (asset replacement) costs in 1992 were approximately 120% that of 1991. In 1993 the costs fell to 45% less than 1991 levels and the cost in 1994 returned to 1991 levels. In 1995 the costs increased approximately 180% and in 1996 the costs were slightly less than the 1995 level.

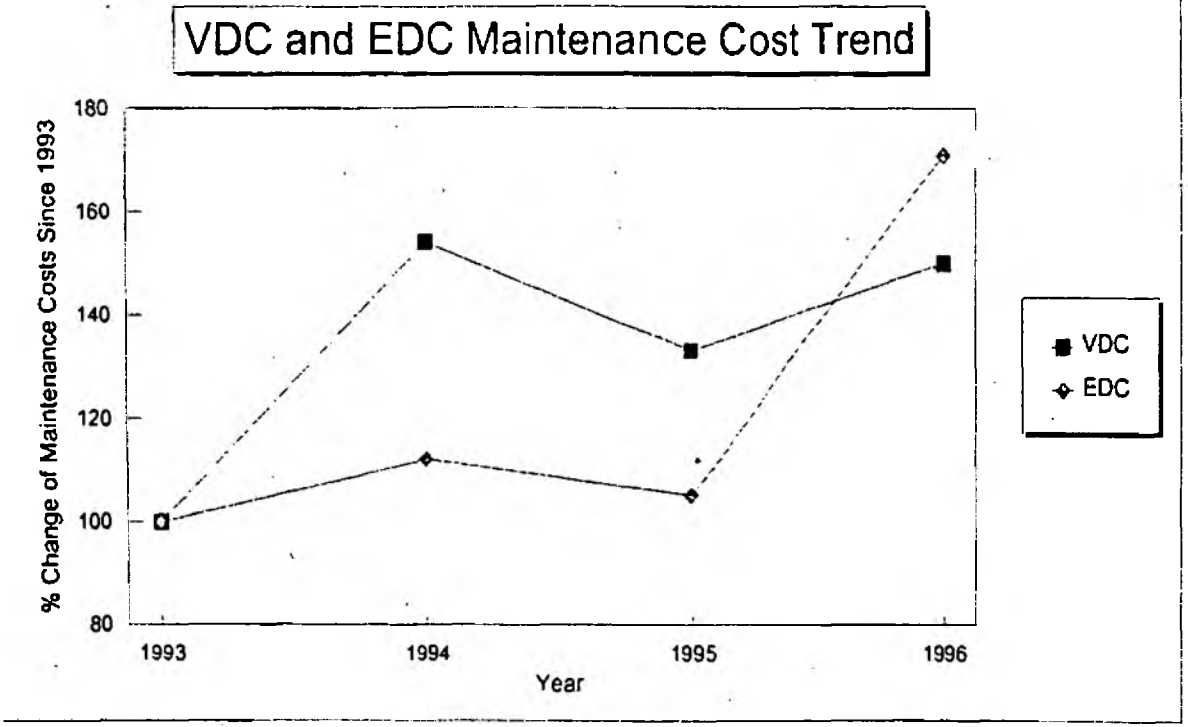
VDC and EDC Maintenance Cost Trend
% Change of Maintenance Costs Since 1993
180
160
140
120
100
80
1993
1994
1995
1996
Year
VDC
EDC

Figure 2

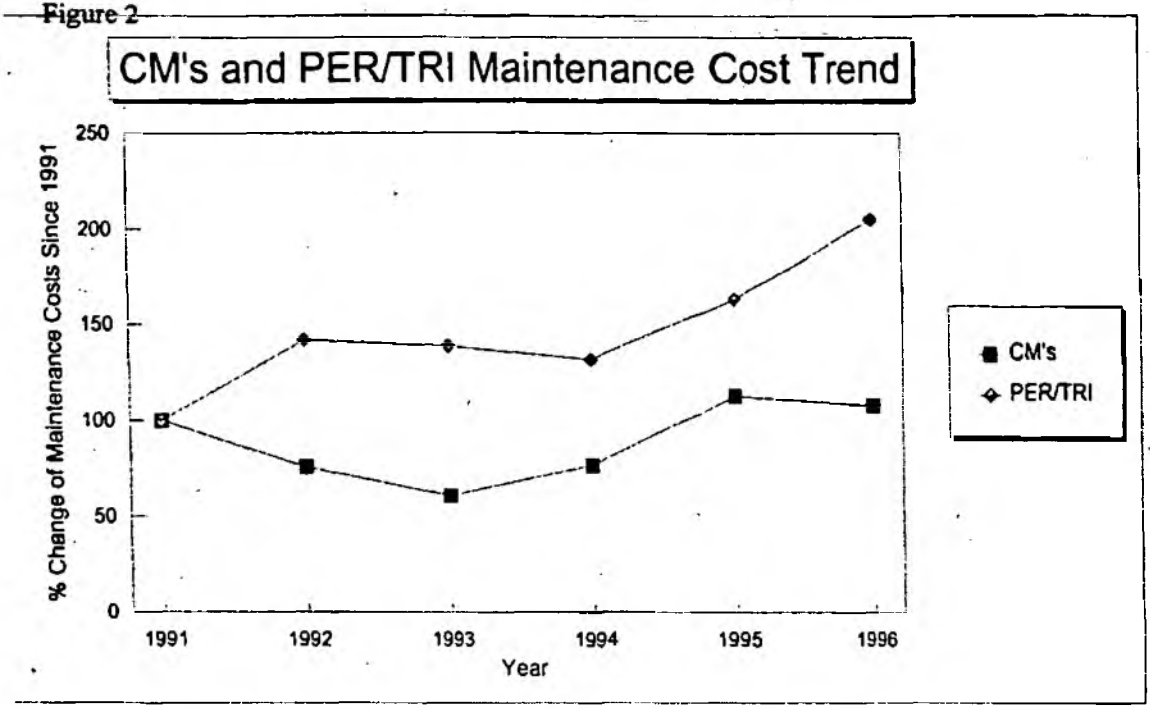

Figure 3

9.2.6 Planning and Execution of Maintenance

Some plant equipment is considered to have implications in relation to Safety, Health and Environment. For mechanical plant there is a system of registration under various Site Instructions. The registration is based upon either statutory requirements and/or the potential for a leak or an emission to cause serious harm to the environment.

As previously discussed in Section 5, electrical trips, alarms and interlocks are also given consideration as to the effect on Safety, Health and Environment. From the General Engineering Guidance on Critical Instrumented Protective Systems, there are two types of hazard; Types 'A' and 'B". In Site Instruction 81, the Type 'A' hazard has been split into 'SHE Critical' (i.e. risk to safety, health and environment and the last line of defence), and 'SHE Related' a risk to safety, health and environment and the system is a warning prior to the last line of defence. The decision on 'SHE Critical'/'SHE Related' is by a group of people (e.g. Plant Manager for the Area, Electrical and Instrument Engineer). A process of review is carried out to ensure correct categorisation. In order to ensure consistency Electrical and Instrument Engineers attend a training course in relation to categorisation.

The frequency of maintenance is determined either by statutory requirements or experience that has been gained from operational data. For alarms/trips/interlocks, on new projects, the Site Engineering Department carry out a formal study as part of the hazard study to assess the required frequency.

On the CMs Plant a brief examination was made on the retention of maintenance records on 'SHE Critical' and 'SHE Related' alarms, trips and interlocks. The records were found to be detailed and of a good standard.

An examination of the central system for retaining records for registered pressure vessels and atmospheric vessels was examined. The records system was found to be of a good standard, with records readily retrievable.

The scheduling of maintenance for these registered items of plant, along with other plant and equipment, is carried out through the MERLIN computer system. There are controls on the MERLIN system regarding who has the facility to change instructions and those who have read only access.

Under Site Instruction 27 (Temporary Repairs) a temporary repair can be carried out provided it meets the requirements in the procedure. An examination of the procedure and the way it was being used in practice on the Per/Tri Plant revealed the following:

(i) The term "Authorised Engineer" was considered by site personnel to be the Works Engineer or the Responsible Engineer's nominee. However, this was not clearly defined.

(ii) Section 6.2 states that the initiator of a temporary repair report shall assess whether the proposed repair is a temporary repair or a modification. This assessment is made by the Authorised Engineer, the section is meant to prompt the initiator to consider the path before proceeding.

(iii) Section 5.4 states that for each temporary repair, there shall be a procedure specified in writing by the Authorised Engineer before the repair work has started. Appendix 1, which shows the key steps flow chart, denotes the requirement for the Authorised Engineer to authorise the temporary repair prior to the repair proceeding. However, there is an additional reference that the specification and authorisation could precede the immediate need for a temporary repair, but only on equipment/systems defined by the Authorised Engineer. The need for sanction prior to proceeding with a repair is vague in some areas and the text does not support the flow diagram.

(iv) A temporary repair log sheet was being maintained, however in a number of cases there was no defect number allocated. The defect number is the formal route of generating a Work Order on the MERLIN system to give a full and proper repair at a later date. In addition the log had not been initialled/signed for authorisation of the repair to proceed, although the repairs had been completed. Also in a large number of cases the log carried the initials of the Authorised Engineer but they had not been entered by him.

(v) A repair specification in the log had not been signed as complete by the Maintenance Superintendent, although the work was known to have been completed. The repair specification form carries a box for completion of repair, which is to be signed by the Maintenance Superintendent, this is not covered in the procedure. The repair specification form does not require the Authorised Engineer's signature, although section 5.4 of the procedure requires a specification to be made in writing by the Authorised Engineer.

(vi) A large number of completed records had been removed from the log for retention elsewhere. The Authorised Engineer was not aware that they had been removed. The log did not record their removal or where they had gone to.

On the CMs Plant the role of the Maintenance Co-ordinator and the Area Maintenance Planner was examined. The defect book held on the MERLIN system is utilised by the craftsmen to carry out standard type repairs to items and clear any SHE defects first. There are obviously repairs that fall outside this category which require short term planning. An example of this was reviewed and the standard of the sketches/drawings, reference material and knowledge of the plant were all of a high standard.

The system being utilised for long term planning was also examined. The work order details, job specifications and systems for tagging of equipment

for overhauls were all found to be of a high standard. The reference material (e.g. line specifications and diagrams, and heat treatment requirements) were all readily retrievable and well maintained. It appears that the CM1 Plant, which is the older of the two plants, has a poorer document support system. This is not uncommon for old plant and therefore more reliance is placed upon engineering input and plant knowledge. A large library of job specifications are retained, which are utilised to supplement overhaul requirements.

9.2.7 Purchasing and Stores Control

A consideration of any maintenance system is that the material or equipment utilised for refurbishment or replacement of plant is to the correct grade specification, type etc for the job to be carried out.

In order to get some form of assessment of the integrity of the equipment ordered and whether it was to the required specification, a brief examination of the Runcorn Site stores was carried out.

The stores hold an accreditation to BSEN ISO9002: 1994. They are audited by British Standards twice a year and carry out their own internal audit on each of the procedures once a year.

A purchase order for an important piece of equipment was examined. The piece of equipment was to be refurbished and then received as stock. Information with the purchase order clearly defined the refurbishment specification, the requirements upon receipt and the documentation to accompany the equipment. The equipment was located in the outside stores area but had not been marked "For storage" although the paperwork denoted it had cleared goods received and receipt inspection.

An examination was made of the "Quarantine Areas" for non-conforming items in the Heavy Store and the Light Bay Goods Inwards. The areas required improvements to the marking of the boundaries, and items that were considered to be non-conforming which were situated adjacent to the quarantine area had not been clearly marked as non-conforming items. The procedure gave clear instructions on how to operate correctly.

9.2.8 Measurement of Maintenance Performance

ICI showed that they had collated data on the number of Work Orders raised in the period May to December 1996. The category that the work Orders fell into were split into predictive maintenance, preventative maintenance, proactive maintenance and reactive maintenance. This information had been collated for each of the Runcorn plants.

Predictive maintenance is the assessment of the condition of the asset, predicting a date/period when maintenance will have to be carried out. Preventative maintenance is where services are carried out at regular interva7ls. Proactive maintenance is work such as vibration analysis of

bearings or laser alignment of couplings etc. Reactive maintenance is effectively maintenance in response to breakdowns. Predictive, preventative and pro-active can all be grouped as being a strategic approach to enable maintenance to be carried out at the most appropriate interval, against reactive maintenance which is maintenance driven by a failure.

This information has environmental importance since the failure of a piece of equipment could well result in the uncontrolled release of substances from the process into the environment. Even if the failure of the equipment does not result in a release, the additional shutdown and start-ups could result in short term higher emissions from the authorised process vents.

Data for CM 1, CM 2, Per/Tri and VDC show that the proportion of reactive maintenance is about 50%. ICI consider that this can be reduced.

ICI expressed caution that the categorisation of Work Orders is not always straightforward, and discrepancies do occur.

In order to reduce the reactive component to maintenance the Company reported the following site wide initiative.

- PLIPS is a pump records system which has existed since 1991/92. Historic records of cost and failures are retained and the information is utilised to derive improvement. The feedback is fed through Responsible Engineers and their nominees.

- A site condition monitoring team undertakes vibrational surveys of bearings etc.

- Laser alignment of motors and equipment is undertaken, where possible, to improve the integrity of the installation work.

The above tools are being used by ICI to reduce their reactive maintenance. In addition it was established that on the Per/Tri, EDC and CMs Plants, measurements of the actual downtime (except for lack of plant demand) have been taken and improved targets have been set for next year. Improving the downtime will result in continuous operation thereby reducing the levels of emissions, reducing the frequency of decontaminations with their associated risks, and reducing the risks of emission associated with unsteady operational circumstances.

The Per/Tri and EDC plants have a reliability team consisting of a Mechanical Engineer, Process Engineer, Shift Operator, Maintenance Co-ordinator and an Electrical/Instrument Technician. Breakdowns are investigated to establish the cause of failure.

The Area Engineer for solvents revealed a new line of thinking that is being considered for maintenance activities. The idea is called "Equipment Specific Policy" which effectively gives consideration to a piece of equipment from the design specification (the cradle) to the asset replacement

(the grave). This is in the early stages of development, but has the potential to reduce reactive maintenance.

9.3 Conclusions

9.3.1 A large number of changes to any system brings with it the potential for reduction in performance. The thrust of the changes appears to be related to the Engineering line. The recent change to the Per/Tri Plant has obviously come about due to some inadequacies or scope for improvement that the Company itself has identified.

9.3.2 The guidance document for the development of a maintenance strategy on Merseyside Operations was of good quality. The maintenance strategy document for the Per/Tri Plant was detailed. However there appeared to be a lack of reference to consideration or precaution to be taken regarding releases or potential for releases from the process to the environment upon preparing equipment for maintenance but this deficiency was identified by the plant mangement.

9.3.3 The Works Engineering Department Procedure was briefly examined and the standard of the documentation appeared to be high. It had obviously been refined and developed over many years and is part of a controlled document system ensuring consistency and compliance with up to date standards. The Site Instructions are retained in a folder titled "Safety Instructions". This is a legacy of a past system.

9.3.4 The communication system is well structured and were found to be of good detail with actions appointed as appropriate. It is evident that the maintenance system gives careful consideration to SHE matters. However, the Standing Instruction that related to performance targets for clearing SHE defects was under the Solvents Section Safety Guidelines and the heading under item 12 of the minutes from the monthly Per/Tri SHE meeting said "Safety Defects" when it also related to environmental matters.

9.3.5 Manning levels for professional engineering grades across the site have increased over the past seven years. What proportion of this increase has been enjoyed or is required by the plants covered by these authorisations, it is difficult to say. However on interviewing the Area Engineer for the Solvents Section, he stated that he did not feel there was a problem with the current manning levels, and if there was he would be making a case to increase staff as required.

With regard to finances there was no obvious reduction in maintenance costs for EDC, Per/Tri and VDC. However on the Chloromethanes plants there was a decline in maintenance costs in the period 1991 to 1993 which was then gradually returned to 1991 type levels in 1995. It is not possible to conclude whether the historic level of maintenance costs has been adequate or whether the current levels are adequate..

9.3.6 In relation to mechanical equipment there does not appear to be a clear definition of what is 'SHE Critical' plant, only the acknowledgement that if it is registered it is 'SHE Critical'.

On the Per/Tri Plant, Site Instruction 27 (Temporary repairs) was found to be lacking in clarity in places and was not being fully followed in relation to authorisation of repairs, specification of repairs and retention of records.

The short term and long term planning role on the CMs Plant appeared to be working adequately.

9.3.7 From the sample examined the purchase order details were acceptable and the method of checking the purchase order against the goods received was being carried out in an acceptable manner. The procedure for marking goods that had cleared "goods received" and were for storage had not been fully followed. Some items which were known to be non-conforming items from "goods receipt inspection" had not been clearly marked or segregated as required by the Stores procedures.

9.3.8 ICI are actively taking steps to improve diagnosis of potential mechanical failures and carry out an increased proportion of preventative maintenance. This will result in environmental benefits.

9.4 Recommendations

9.4.1 Plant maintenance strategies should include consideration or precautions to be taken regarding releases or potential for releases from the process to the environment upon preparing equipment for maintenance. Where this detail is already covered in Site Instruction or local instruction, a reference to the instruction should be included in the document.

9.4.2 The title of "Safety Instruction" should be removed from folders containing Site Instructions and should be replaced with the appropriate title to improve clarity.

9.4.3 More care should be taken in Local Instruction and Standing Instructions to ensure that the title of documents and headings in minutes incorporate the word "environment" where it is applicable.

9.4.4 ICI should continue to collate data and ensure that resources meet the demands upon them. This is of particular importance as the standards expected throughout industry are always increasing.

9.4.5 Ensure that mechanical plant has a clear definition of 'SHE Critical' equipment.

9.4.6 There is need for a review of SI 27 and the manner in which it is applied on the Per/Tri Plant.

9.4.7 Procedures for marking of goods that have cleared goods receipt inspection and procedures for dealing with non-conforming products need to be complied with.

9.4.8 It appears that categorisation of maintenance work needs to be improved in order to enable informed decisions to be made on the data collated. The current approaches to reduce reactive maintenance should be continued and monitored carefully to ensure that progress is being achieved. Clear staged targets should be set to ensure that where slippage occurs, additional action is taken to return to the programme requirements.

10.0 HOUSEKEEPING

10.1 Objectives

The standards of housekeeping and cleanliness can give some indication of the staff commitment to safety and the environment. A clean and tidy plant indicates that spillages and wastes have been dealt with properly and that people are working as a team with pride in looking after their plant. Site Instruction 47 identifies the need for the containment and removal of unwanted equipment and materials and requires that there should be thorough and systematic inspections with records of the findings and corrective actions taken. It requires additional inspections at such times as plant overhauls. Overhauls necessarily use a great deal of equipment and materials, and generate large quantities of waste. As the Per/Tri was undergoing a major overhaul the opportunity was taken to check how well ICI have implemented their audit guidelines and to observe a housekeeping audit being undertaken by a Plant Manager.

10.2 Findings

On the Sulphuric Acid Plant general observations were that there was no accumulation of wastes or scrap materials. Access routes and alarms were free of obstructions and all areas inspected were kept clean and tidy.

On the CMs Plant, housekeeping audits are carried out on a weekly basis, and scores are generated against various categories (e.g. waste/scrap, safety equipment, documented safety routines, signs and appearance). The audit team comprises of the Plant Engineer, Plant Manager, Shift Team Leader, Plant Cleaner and the Lagging/Scaffolding Supervisor. The audit results were satisfactory and it was evident that the Chloromethanes house-keeping audit scheme was more detailed than the requirements of the associated SI.

On the Per/Tri Plant, housekeeping audits are carried out every month by the Shift Supervisors. During this year's overhaul there were daily housekeeping tours. There are packages of housekeeping checklists for each of the nine units into which the plant is split. The particular package for the effluent treatment unit (600 Unit) includes ten checklists for discrete sub-units.

During the Environment Agency Audit on 4 July 1997 our auditor accompanied the Plant Manager on a housekeeping audit of the Per/Tri 600 Unit. It took two hours to audit four of the ten sub-units. The overall audit score was "poor" by virtue of such items as: redundant equipment, burst bag of sodium carbonate, broken pump drip tray sited above drain; and empty barrels on the canal bank. It was considered that many of the housekeeping observations related to items that had been at fault for some time and had not been identified on previous audits in April and May 1997. It is probable that previous auditors had observed a similar situation but had not recognised them as requiring remediation. This points to a difference in expectations between managers and operators. Photographs have been taken in the past and displayed in offices to illustrate examples of bad housekeeping but they should really be shown to the operators who effect good housekeeping.

10.3 Conclusions

10.3.1 General comments about housekeeping in most areas was good.

10.3.2 A thorough audit of the 600 Unit gave a poor rating, and previous audits had not picked up on some of the problems. This illustrates that management can have different expectations and perceptions to operators.

10.4 Recommendations

10.4.1 Address the deficiencies identified in the housekeeping audit and consider this for the whole of the Per/Tri Plant.

10.4.2 There needs to be more training of operators to ensure that they understand the full requirements of housekeeping required by the management.

10.4.3 It is recommended that the time spent on the audit is recorded on the audit sheet to give some indication of the level of scrutiny.

11.0 ENVIRONMENTAL AWARENESS SURVEY

11.1 Objective

ICI Runcorn Site has been the subject of some business divestment in recent years with the sale of the PVC8 and VC3 plants. There is continuing speculation that further divestments might follow and this has lead to uncertainties about the site's future. This in turn has caused adverse publicity and speculation in the media. For example, a recent editorial in the ENDS Report (Ref 2) commented that:

"The immediate causes of the incidents at ICI's works include a long standing failure to upgrade the ageing site infrastructure at Runcorn, along with de-manning and lack of investment in preventative maintenance and alarms".

The Agency considered that all this publicity could have some effect on the attitude and morale of staff and that an environmental awareness survey might give some useful pointers.

11.2 Findings

The Agency has not used such surveys before and this survey was seen as a trial. The survey involved a series of questions designed to give an overall indicator of ICI's employee attitude to environmental issues, followed by a series of questions to test the individual's involvement and awareness of environmental matters.

The questions were of a probing nature and each was formulated to provide answers to specific concerns. We were looking for honest answers and so the questions were asked away from line managers (where possible) and assurances were given that comments would remain anonymous.

The environmental awareness survey was carried out by each auditor for about one hour on 7 July 1997. The surveys were addressed at a range of managerial, supervisory and operational staff in both production and maintenance. A total of 29 surveys were completed and the composition of the staff is shown in Table 1.

Table 1 also shows the first set of 11 questions that were posed. The scores indicate the number of respondees to each statement.

Table 1

Environmental Awareness Survey

Tick appropriate box

Department	Manager	Supervisor	Operator/day staff
Production	6	3	8
Maintenance	6	2	4

Completed by: .....

	Please tick the appropriate box to show the level of agreement with each of the following statements	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1.	You are kept informed of the causes of environmental incidents on other plants.				10	19
2.	Suggestions to improve environmental releases are seldom acted upon.	12	15			2
3.	The plant suffers from lack of maintenance.	4	15	7	2	
4.	Productivity is usually seen as more important than the environmental consequences.	18	10		1	
5.	Action is seldom taken against people who do not follow site instructions.	5	15	5	2	1
6.	My line manager often talks to me about environmental issues.	1			14	14
7.	There has been a move towards reactive maintenance at the expense of preventative maintenance.	8	12	3	6	
8.	My line manager's lack of knowledge about plant operations compromises our environmental performance	17	11			1
9.	Management only bother to look at environmental improvements after there has been an incident.	9	15	3	1	
10.	Sufficient manning is available to prevent environmental incidents.		2		25	2
11.	Environmental incidents have occurred because of lack of maintenance.	1	14	3	10	

The 29 interviewees were then asked a set of ten further questions. These questions were more subjective and sought to elicit deeper understanding of environmental issues. The questions and their aims are listed below together with a summary of the answers that were given.

Q12. What do you think the biggest environmental shortcoming is for the site and your work area?

Aim: This question was aimed at getting an opinion on the major difficulties which ICI faces in achieving compliance with IPC authorisation limits.

Answers: The main area of comment (45%) indicated that aqueous effluent is viewed as the biggest problem. These comments made reference to the historical layout of the site, its effluent drainage and treatment systems and requirement to achieve lower consent limits.

Other specific comments were made about site instructions, the new incinerator, equipment, housekeeping, pace of change of legislation etc.

Q13. What are you doing to improve environmental performance?

Aim: Here we were looking for a commitment to make improvements

Answers: All those questioned responded positively, often giving several areas in which improvements were being made. The actions covered the following areas:-

Training - there were many good comments about giving and receiving training on SHE matters.

Communication - again many positive responses particularly about passing on information and learning from incidents and raising general staff awareness on environmental issues.

Improvements to plant - These included specific projects related to improving the environmental control (e.g. new alarms). More general improvements included considering carrying out further risk assessment with particular attention to environmental impacts, and the implementation of SIs.

Maintenance - There were several comments on this relating to improvements in maintenance scheduling and maintenance of SHE critical plant.

Production - There were two very positive statements, presumably from plant managers, that they would shut the plant down if there were any environmental problems.

Q14. What training have you had on IPC?

Aim: This was to reinforce our view that a great deal of IPC training had been given to employees

Answers: Nearly everybody had received some training. Most had been on the 'CHECK' package, an internally produced course presented by the local management. Some had been on a five day 'SHE' course and others had received specific training from line managers. Some had been directly involved with producing IPC applications.

Q15 What environmental objectives have you been set to achieve this year?

Aim: We had been informed that some individuals had environmental objectives set in their annual work plan. This question was to establish the type of targets set.

Answers: Response to this varied considerably. At the operator level there was nothing specific. At the supervisor level three out of the five had a particular objective. Of the twelve managers, eleven had objectives set, only a few specific, most referred to general plant SHE objectives, Challenge 2000, and compliance with the Site Instructions.

Q16. What substances are used in your work area which have an EQS?

Aim: A range of substances made or used on site have an Environmental Quality Standard (EQS). This is a maximum concentration that is allowed in controlled waters. The Agency is required to take and analyse monthly samples from the River Weaver downstream of ICI. There is a requirement to report failures to the D.E.T.R.

Answers: Responses indicated that very few people knew what an EQS was.

Q17 What waste minimisation targets have you for your work area?

Aim: Although there is an ICI site wide interest in reducing waste this was to establish whether local waste reduction initiatives were in place.

Answers: Only a few examples. Most had none set or referred to the general requirements of Challenge 2000.

Q18. Where is the IPC Application and Authorisation kept?

Answers: Three operatives and one supervisor did not know where they were kept, but everyone else knew.

Q19. Have you read them?

Answers: Eleven people had not read an IPC Authorisation, but these were mainly operators who would not be expected to have done so.

Q20. Are you aware of ICI's corporate environmental objectives over the next few years?

Aim: This was to establish the extent of the knowledge of ICI's SHE targets.

Answers: 25 out of the 29 referred to Challenge 2000 (Ref 3).

Q21. Have you read anything about ICI's new method to evaluate the potential environmental impacts of wastes and emissions?

Aim: To see how far the new concept of weighting individual compounds by their environmental effects had cascaded down to employees.

Answers: This referred to ICI's methodology known as the 'Environmental Burden Concept' (Ref 4). Nine managers, two operators and one supervisor had read about it.

11.3 Conclusion

This survey was carried out as a trial to establish if questionnaires may be useful tools for identifying any problem areas. The survey did elicit some worthwhile responses and it would be a useful approach for future audits. However, more care needs to be taken in the wording of questions in order to minimise confusion.

The first series of answers (Q.1 to Q.11) indicated a high degree of agreement with the way the site was being managed. As expected, the only significant hint of disagreement was in the maintenance area. This was expected because most incidents will have equipment failure somewhere in their root causes.

The second series of questions was designed to probe the depth of individual's knowledge on environmental issues and their commitment to making improvements. Answers indicated a generally good awareness and commitment. They indicated that aqueous discharges were a particular problem, however, there was poor knowledge of the requirements to meet EQSs in the River Weaver. The ICI environmental burden concept is relatively new and it is not surprising that knowledge was limited to some management.

We did not find any evidence to suggest or deny the assertions in the recent ENDS Report about upgrading, de-manning and investment. However it must be remembered that our sample was small and our questions may not have been sufficiently targeted.

11.4 Recommendations

The Agency should consider developing questionnaires as diagnostic tools to identify areas of potential weaknesses in company's environmental performance, particularly on large sites.

ICI should progress its concepts of environmental burden to site operators with particular reference to the materials used on site.

12.0 CONCLUSIONS

The audit findings did not indicate there were any common causes behind the recent spate of incidents, although many of the shortcomings identified by the audit surrounded older plants. These plants were constructed over 25 years ago when expectations of environmental performance were much lower. There has been considerable expenditure on these plants which has improved their performance but compliance with IPC standards represents a considerable challenge. The following paragraphs sumarise the conclusions from the main body of the report.

12.1 SHE Issues

ICI take their environmental responsibilities seriously as part of their three cornered Safety, Health and Environment policy and provide comprehensive guidance for the Runcorn Site. The SHE management function delivers this policy at site level and has issued 96 Site Instructions (SIs) during the past eight years. A programme of revision is in hand to improve and update them. Ultimate responsibility for their implementation rests with the separate business managements. Although it is accepted to some extent that the training needs limit the rate of implementation, the Agency is concerned that the current level of implementation of some recently issued procedures is poor. Considerable effort is put into auditing the site's compliance with the SIs.

12.2 Inter-plant Piped Transfer Systems

Those systems examined were found to comply with good engineering standards and complied with the relevant Site Instruction. On the older plants audited, operating instructions had not been revised for many years and there was no appropriate instructions for hydrochloric acid transfer. Standards of controls and instruments on these older plants were just adequate.

12.3 Plant Overhauls

The relevant Site Instruction had been rigorously applied to the 1997 overhaul of the Per/Tri Plant. Learning from the previous major overhaul in 1995 had been fully taken into account for the preparation and execution of the overhaul. The SI itself focuses strongly on safety without sufficient emphasis on the environment. The plant management identified this shortcoming and made appropriate amendments to their plan to take into account environmental issues.

12.4 Alarms, Trips and Interlock Systems

The level of implementation of the relevant Site Instruction was variable, being good on a newer plant but poor on one of the older plants. The implementation of this SI has a considerable resource implication particularly on the older plants. On the older plants internal compliance audits were recorded as poor or very poor. Some deficiencies were found in the remedial actions recommended for improving the level of compliance on this plant.

12.5 Regulation. Inspection and Maintenance of Atmospheric Pressure Storage Tanks.

The relevant Site Instruction is a high quality procedure for this work and the site has the qualified, experienced staff to implement the instruction. The SI was issued in June 1995 but has only been partly implemented, no firm dates have been set for full compliance.

12.6 Registration. Inspection and Maintenance of Bunds

Site Instruction 37 is a comprehensive quality procedure which addresses this important aspect of containment. Although the SI was agreed in November 1996 it has not yet been implemented to any extent on any section of the site. The main action has been the progression of a pilot study on one plant area. It appears that there must be some difficulties in the timely implementation of this SI.

12.7 Tank Filling Operations and Dealing with Spillages

There is very little dedicated bunding of tanks in the plant areas audited. ICI relies heavily on operators and alarm systems (to prevent overfilling) and emergency procedures (for dealing with incidents should they arise). Instrumentation and training was found to be satisfactory.

SHE assurance reports will eventually form the backbone to SHE policy and compliance for each plant. They will contain sections on the risks associated with plant operations and lessons learned from incidents.

ICI has a comprehensive internal incident reporting scheme which is generally quite good.

12.8 Maintenance Systems

The management interface between production and engineering functions can be achieved in different ways and is often changed in order to fit in with the overall business efficiency requirements. This has happened recently on this site. As a consequence it has been necessary to draw up a "Table of Equivalence" to identify the various changes in staff titles and responsibilities to be used in conjunction with certain SIs.

Guidance for the development of maintenance strategy was good and well applied, but there was a lack of reference to environmental implications.

There was considered to be an adequate level of professional engineers employed with some indication of a small growth in numbers.

On the plants examined most showed that the level of expenditure on maintenance had been sustained over the past few years, although one plant showed a reduced spend from 1991 to 1993.

Planned maintenance is considered to be the most efficient in terms of costs and environmental implications. The site has a relatively high proportion of reactive maintenance but ICI has identified this problem and is striving to reduce this.

12.9 Housekeeping

The comments made by the Audit Team were that housekeeping was generally quite good. The exception was on one plant area when an actual housekeeping audit was witnessed.

12.10 Environmental Awareness Survey

This was very much a trial and considered as another dimension to a site audit. It showed that there was a very high level of environmental awareness and that most people were involved in making improvements to some extent.

13.0 RECOMMENDATIONS

There is now a full complement of Site Instructions. The older ones require revision as soon as possible particularly those which do not make full reference to environmental considerations or where the areas of responsibility have changed as a result of management structure changes.

Although having a good quality set of instructions goes a long way to meeting the Environmental Agency's requirements and ICI's own standards, it is the rigour with which they are applied that makes the big difference to performance. Poor internal compliance audit results should be acted upon promptly and firmly.

Of particular concern is the delay in the full implementation of some Site Instructions. It is not unreasonable to expect that some time interval should be allowed, but target implementation dates should be clearly set as an objective. Delays should only be sanctioned in exceptional circumstances after full consideration of the risks involved.

There are many comments and recommendations made within the report and the Agency will expect ICI to consider them and agree on appropriate action. Particular recommendations are made in sections 2.6, 3.8, 4.8, 5.4, 6.5, 7.5, 8.4, 9.4, 10.4 and 11.4.

The Agency expects ICI to remedy any deficiencies identified by this Audit and will follow up actions arising from this audit in its routine regulatory IPC inspection work.

References:

1. Report on the trial Large Scale Audit of ICI Chemicals & Polymers at Runcorn in October/November 1995. HMIP, March 1996

2. ENDS Report 268, Editorial p.2, May 1997

3. Challenge 2000 - Safety, Health and Environment. ICI, 1995

4. Environmental Burden: The ICI Approach. ICI, 1997.

Acronyms/Abbreviations

BATNEEC	Best Available Techniques Not Entailing Excessive Cost
BPEO	Best Practicable Environmental Option
C&P	Chemicals & Polymers
CM	Chloromethane
COSHH	Control of Substances Hazardous to Health
CSRL	Carbon Steel Rubber Lined
DETR	Department of Environment Transport and Regions
DVC	Design Verification Certificate
EDC	Ethylene Dichloride (1,2 Dichloroethane)
EDP	Engineering Department Procedures
EIP	Environment Improvement Project
EIR	Environment Incident Report
EPA90	Environmental Protection Act 1990
EQS	Environmental Quality Standards
GEG	General Engineering Guidance
GEP	Group Engineering Procedures
HFO	Heavy Fuel Oil
HMIP	Her Majesty's Inspectorate of Pollution
HSE	Health & Safety Executive
IPC	Integrated Pollution Control
IR	Incident Report
KOH	Potassium Hydroxide
LSO	Local Standing Orders
NRA	National Rivers Authority
SHE	Safety, Health & Environment
SHED	Safety, Health & Environment Dossier
SI	Site Instructions
SRM	Special Revenue Monies
VC	Vinyl Chloride
VDC	Vinylidene Dichloride
WRA	Waste Regulation Authorities

APPENDIX 1 : IPC AUTHORISATIONS

A. ICI ON THE RUNCORN SITE

Generic Name of Authorisation & Reference	Products	Production Capacity	Main Uses
Chlorine AL7294 / AX1573	Chlorine Hydrogen Sodium hydroxide Sodium hypochlorite Potassium hydroxide	767,000 tpa 21,000 tpa 130,000 tpa 90,000 tpa	Site processes 80%, water chlorination Site power station Soap, paper Bleach, sewage treatment Agrochemicals, detergents
Chloromethanes AL7456.	Methyl chloride Methylene chloride Chloroform Carbon tetrachloride	50,000 tpa 120,000 tpa 50,000 tpa	Solvent Paint Remover, solvent Solvent, insecticides Toll distillation
Chlorinated ethylenes AL7421	Perchloroethylene Trichloroethylene Vinylidene chloride	} 125,000 tpa 20,000 tpa	Metal degreasing, dry cleaning Metal degreasing, site (A133a) Resin coatings
Fluorochemicals AL7243	HFC 134a HCFC 22 Fluothane	5,000 tpa 30,000 tpa 500 tpa	Refrigeration, inhalers Transitional refrigerant, PTFE Anaesthetic
Cereclor AL7413	Cereclor	60,000 tpa	Oils, plasticisers
Hydrogen Fluoride AL7448	HF	33,000 tpa	Site (Fluorochemicals)
CTF AL7332 / AU5700 / AW9757	Chloro trifluoro methyl pyridine	1,000 tpa	Herbicide intermediate
Sulphuric acid AL7278 / AV5519	Sulphuric acid Sulphur trioxide	250,000 tpa	Battery acid, fertilisers Site (CSA/SO_3)
Sulphur dioxide AN1718	Sulphur dioxide	32,000 tpa	Bleaching, sugar beet industry
Chlorosulphonic Acid AN1726/AV5411	Chlorosulphonic acid	17,000 tpa	Detergents, pharmaceuticals
Hydrogen chloride AL7430	Hydrogen chloride	75,000 tpa	Site (CMs/CSA), acid cleaning
Combustion AA3123 / AI1701 / AU5742	Steam Electricity	225 te/hr 56 MW	Site Site
Vent gas incineration AI5162			Destruction of chlorinated hydrocarbons

B. OTHER COMPANIES ON THE RUNCORN SITE

Company & Reference	Products	Production Capacity	Main Uses
European Vinyls Corporation AK6039 / AP8730 / AT6298	PVC	120,000 tpa	Piping, window frames
European Vinyls Corporation AK6039 / AO7045 / AP8993	Vinyl chloride Ethylene dichloride	200,000 tpa 180,000 tpa	Site (PVC) Site (VC, VDC, Tri), antiknock
Rocksavage Power Company AT6476 / AX1212	Electricity	750 MW	Site (350 MW)
Mercury Recovery Services AV6027	Recovered Mercury	200 te (one off)	Re-use in mercury cells
Scottish Hydro Electric (Under design)	Steam	225 te/hr	Planned for ICI site

ICI CHEMICALS & POLYMERS LTD
RUNCORN SITE HEADQUARTERS

Appendix 2

RUNCORN AND NORTHWICH SITES
INSTRUCTIONS - NUMERICAL INDEX

CURRENT CONTENTS LIST

NUMBER	TITLE	Issue Number	Date Of Issue/ Latest Revision
1	Health and Safety Policy	1	31 July 1991
2	Auditing	1	30 June 1995
3	Permit to Work Procedures	1	4 February 1991
4	Isolation of Electrical Power Equipment for Permit to Work	1	1 November 1989
5	Site Controlled Modifications	2	1 September 1995
6	Programmable Electronic System	1	15 July 1994
7	Entry Into Confined Spaces	1	1 October 1991
8	Use of Contractors	1	29 December 1995
9	Burning and Welding. Control of Ignition Sources on Plants	1	4 February 1991
10	Isolation of Plant and Equipment from Hazardous Fluids	1	1 March 1993
11	Interplant Pipeline Isolation Procedures (IPIC)	1	4 February 1991
12	Risk Assessment	1	3 October 1995
13	Hazardous Pipelines - Assessment, Registration and Inspection	2	17 October 1991
14	Safe System of Work for Undertaking Maintenance on Process Plant Equipment	1	1 March 1993
15	Registration, Inspection and Use of Abrasive Wheels	1	31 October 1994
16	Registration, Examination and Maintenance of Pressure Vessels	1	15 March 1994

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Update : April 1997

NUMBER	TITLE	Issue Number	Date Of Issue/ Latest Revision
17	Registration, Inspection and Maintenance of Fixed Pressure Relief Streams	1	15 March 1994
18	Excavations - Protection Against Electrical Risk	2	1 August 1995
19	Registration, Inspection and Maintenance of Atmospheric Pressure Storage Tanks	1	30 June 1995
20	Control of Lifting Equipment	1	13 May 1994
21	Control of Asbestos Containing Materials	1	30 September 1994
22	Control and Use of Ionising Radiation	1	27 October 1993
23	Registration, Examination and Maintenance of Registered Machine Systems	1	30 September 1994
24	Use of Flexibles and Hoses on hazardous duties	1	13 May 1994
25	Prevention of Damage to Hearing from noise at Work	1	8 April 1992
26	The Control of Substances Hazardous to Health	1	31 July 1991
27	Temporary Repairs	1	15 July 1994
28	Personal Protection Equipment Including Eye Protection	2	30 September 1994
29	Loading and Offloading of Goods	1	14 November 1996
30	Operation of Fork Lift Trucks	2	29 December 1995
31	Decontamination of Process Equipment and Packages Prior to Repair or Disposal	1	30 September 1994
32	Tanker Loading and Offloading	1	3 October 1995
33	Site Roads	1	14 November 1996
34	Use of Portable High Pressure Water Jetting Equipment	1	13 May 1994
35	The Use of Cartridge Operated Tools	1	13 May 1994

NUMBER	TITLE	Issue Number	Date Of Issue/ Latest Revision
36	Work on Roofs	1	30 November 1994
37	Registration, Inspection and maintenance of Earthworks and Bunds	1	14 November 1996
38	Handover of Work Between Successive Teams or Individuals	1	1 August 1995
39	Loading and Unloading of Tank Ships	1	14 November 1996
40	Control of Personnel on Site	1	1 April 1997
42	The Registration, Inspection, Operation and Maintenance of Drainage Structures	1	14 November 1996
43	Waste Disposal on Land	2	13 May 1994
44	Authorised Emission/Discharges to the Environment	1	1 August 1995
45	Land Protection	1	1 August 96
46	Waste Reduction and Conservation of Resources	1	1 August 96
47	Safe Systems of Work During Overhauls and Recommissioning of Plant	1	1 November 1989
48	Emergency Procedures (including Spillage Containment)	1	31 October 1994
49	SHE Assurance	1	1 April 1997
50	Use of Overhead Cranes and Powered Hoists	1	1 April 1997
51	Reporting, Investigation and Documentation of Accidents, Occupational Diseases and Environmental Incident	1	30 September 1994
52	SHE Improvement Plans	1	16 January 1995
53	Preparation, Issue and Maintenance of Merseyside Operations Safety Instructions	2	27 October 1993
54	Inspection of Plant Structures and Pipebridges	1	1 January 1990
55	Guarding of Machinery	1	17 March 1995

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NUMBER	TITLE	Issue Number	Date Of Issue/ Latest Revision
56	Operation of Unfenced Machinery	1	17 March 1995
57	Management of Redundant Plant and its Demolition	1	16 May 1995
58	Communication Processes	1	September 1990
59	Welding, Cutting and Grinding on Systems Under Pressure	2	14 November 1996
60	Provision of Plant Information, SHED, Engineering Line Diagrams	2	27 October 1993
61	Operating and Maintenance Instructions	1	14 November 1996
62	SHE Control and Hazard Studies on all Site Projects	1	1 August 1996
63	Prevention of the Unauthorised Introduction of Ignition Sources into Electrically Classified Areas	1	31 July 1991
64	Housekeeping and cleaning	1	16 January 1995
65	Application of Major Hazards Legislation	1	17 March 1995
67	Provision of Hazard Data and Introduction of New Substances onto MOps Site	1	30 September 1994
68	Prevention of Noise Nuisance External to Sites	1	30 November 1994
69	Work on or Adjacent to Live Electrical Conductors	1	15 July 1994
70	Health Assessments	1	30 November 1994
72	Public Affairs	1	16 May 1995
73	SHE Information of Purchased Goods	1	15 July 1996
74	Substance Abuse	1	29 December 1995
75	Stress	1	29 December 1995
76	Smoking	1	29 December 1995
77	Travelling on Company Business	1	July 1993

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NUMBER	TITLE	Issue Number	Date Of Issue/ Latest Revision
78	Visual Display Equipment Assessment, Awareness and Recording of Information Relating to the Use of Equipment in the Workplace	1	30 November 1994
79	Fire Management	1	29 December 1995
80	Registration, Inspection and Maintenance of Electrical Equipment	1	15 July 1994
81	Registration, Inspection and Maintenance of Alarms, Trips & Interlock Systems	2	30 November 1994
82	External Chemical Emergency Service (ECES)	1	30 June 1995
83	Site Development Plans	1	14 November 1996
84	Corporate Memory and Management Structure	1	15 July 1996
85	Hazardous Area Classifications	1	15 July 1994
86	Gas Detectors	1	29 December 1995
87	Use of Industrial Explosives	1	1 August 1996
88	Lone and Isolated Workers	1	31 October 1994
89	Operation and Movement of Cranes, Heavy and Abnormal Vehicles.	1	22 April 1996
91	Idle Plant	1	29 December 1995
92	Portable Air Driven Equipment	1	14 November 1996
93	Safety, Health and Environmental Support Resources and Facilities	1	22 April 1996
95	Temporary Access	1	29 December 1995
96	Manual Handling	1	31 October 1994
97	Use of Mobile Work Platforms	1	16 May 1995
98	Control of Legionellosis	1	13 May 1994
99	Laboratory Operations	1	16 May 1995

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91	Idle Plant	1	29 December 1995
92	Portable Air Driven Equipment	1	14 November 1996
93	Safety, Health and Environmental Support Resources and Facilities	1	22 April 1996
95	Temporary Access	1	29 December 1995
96	Manual Handling	1	31 October 1994
97	Use of Mobile Work Platforms	1	16 May 1995
98	Control of Legionellosis	1	13 May 1994
99	Laboratory Operations	1	16 May 1995

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Updated 1 April 1997

NORTH WEST REGION ADDRESSES

REGIONAL OFFICE
Environment Agency
PO Box 12
Richard Fairclough House
Knutsford Road
Warrington WA4 1HG
Tel: 01925 653 999
Fax: 01925 415 961

NORTH AREA
Environment Agency
Chertsey Hill
London Road
Carlisle CA1 2QX
Tel: 01228 25151
Fax: 01228 49734

CENTRAL AREA
Environment Agency
Lutra House
Dodd Way
Walton Summit
Bamber Bridge
Preston PR5 8BX
Tel: 01772 339 882
Fax: 01772 627 730

SOUTH AREA
Environment Agency
Mirwell
Carrington Lane
Sale M33 5NL
Tel: 0161 973 2237
Fax: 0161 973 4601

For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY
GENERAL ENQUIRY LINE
0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY
EMERGENCY HOTLINE
0800 80 70 60

ENVIRONMENT AGENCY

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