Environmental Auditing
-an appraisal of existing guidance and current practice with a view to developing a standardised audit protocol

by

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DEDICATION

To Karen –

this is as much your achievement as it is mine.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to those whose unwavering support and assistance in completing this thesis will never be forgotten.

In particular I would like to thank Mr. Noel Connaughton who kept me on the straight and narrow in times of confusion. Thank you for supporting my good ideas and bringing me back to reality when I presented the bad ones.

Many thanks are necessary to the companies and individuals who afforded time to contribute by means of the questionnaire, forwarding information or for just taking that call.

Overall, to my parents, Jack and Eleanor, your faith in me will always get me there in the end.

ABSTRACT

Environmental auditing in modern day Irish organisational management is a concept which is growing in significance with the continual development of new environmental legislation and industrial standards.

With the increasing complexity of issues that need to be addressed under the environmental banner, guidance is required for both the auditor and the auditee on the management, organisation and content of the environmental audit.

With no registration scheme to ensure quality of the environmental audits currently being conducted in Ireland there is a requirement for the development of a practical working tool to assist in the development of a standard approach to conducting the environmental audit.

This thesis examines existing publications on the approaches to environmental auditing, examines how environmental auditing is conducted in the field and presents a conceptualised working protocol to assist in ensuring that as environmental audits are conducted, they are done so in a comprehensive, traceable and orderly fashion.

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SECTION 1

INTRODUCTION

1.1 BACKGROUND

Audits have historically been associated with the financial sphere of investigation and reportability. Conventionally the term refers to a *"systematic examination of the accounts and financial performance of a business"*(McKenna & Co., 1993).

The catalyst for the commencement of formalised environmental auditing is generally attributed to the impetus provided by the passing of the United States (US) National Environmental Protection Agency Act (NEPA) in 1969.

Gradually since then, the introduction of environmental legislation, commitments, action programmes and policies have developed at an exponential rate on a global basis.

In Ireland, primarily as a result of its membership in the European Community, an extensive web of legislation and standards has been adopted. The scope of this legislation and these standards is extremely wide due to the all-encompassing nature of the term environment (e.g. Waste Management Act 1996, EMAS, Integrated Pollution Control, etc.)

To validate compliance of industry or regulatory authorities with such environmental guidance and legislation, the practice of environmental auditing has resulted in the proliferation of companies in the environmental consultancy industry in the Irish market since the early 1990s.

The number of guises in which an environmental audit is currently being marketed and conducted is so extensive, that to define the boundaries and standardise the environmental audit mechanism to an acceptable level, is a challenge to even the most well versed practitioner.

Standardising an environmental auditing mechanism should be seen as a priority action item. The reason for this is two-fold, in that, firstly, unless the industry standardises the quality and content of an environmental audit, the quality may deteriorate as incompetent practitioners enter the field, and secondly, if consumers or auditees lose faith in the quality of the environmental audit to which they are subjected, the concept of environmental auditing and its benefits may become compromised.

1.2 TARGETS AND OBJECTIVES

The target of this thesis is to develop a standardised guidance protocol for conducting an environmental audit.

To achieve this target it is postulated that there are five individual milestones to be achieved. These milestones are described hereunder;

- Define an Environmental Audit
- Identifying best practice standards for conducting an environmental audit;
- Identifying tools available for the environmental auditing process;
- Assessment of current practice in the field of environmental audits; and
- Preparing a draft protocol standardising the approach to conducting an environmental audit.

1.3 PROPOSED METHODOLOGY

It is proposed that the mechanism by which these objectives will be achieved is as follows;

- Literature Review;
- Questionnaire; and
- Development of a standard environmental audit protocol.

1.3.1 Literature Review

In conducting the literature review, the following hard information databases were utilised for my research;

- University College Dublin
  (libraries at Belfield, Richview, Earlsfort Terrace and Blackrock);
- Trinity College Dublin;
- Institute of Technology, Sligo;
- Personal collection.

Acknowledging the extensive source of information that is the internet, both the general internet and the internal University College Dublin 'Telnet' were utilised. These soft information databases were investigated using search engines focussed on words or phrases such as 'environmental management', 'environmental audit', 'EMAS', 'ISO', etc.

1.3.2 Questionnaire

To determine the extent and nature by which environmental auditing is implemented in 'the field' by Irish companies, it was decided that the most appropriate mechanism by which to obtain this information would be by circulating a questionnaire to a targeted group of companies.

1.3.3 Development of a Standard Environmental Audit Protocol

The drafting of a standard environmental audit protocol was deemed to be the best method of developing a practical working tool. It was speculated that this tool would be designed based on information obtained during the literature review, questionnaire responses and the author's experience in the field of environmental consultancy.

SECTION 2

CONCEPT OF ENVIRONMENTAL AUDITING

2.1 DEVELOPMENT OF ENVIRONMENTAL AUDITING

As was identified at the beginning of the introduction, the term 'audits' has historically been associated with the financial sphere of investigation and reportability.

The specific activity of environmental auditing can be traced to the United States where voluntary audits commenced in the 1970s. This commencement of voluntary auditing is speculated as being linked to the development and subsequent passing of the United States (US) National Environmental Protection Agency Act (NEPA) of 1969. This Act required that all federal agencies consider the environmental impacts of any strategies adopted or decisions taken. While the passing of the Act resulted in the development of the field of environmental impact assessment (EIA), similarly, environmental disclosure requirements of the Securities and Exchange Commission (SEC) provided the impetus for the development of the field of environmental auditing. These original audits consisted of environmental performance reviews or compliance audits aimed at reducing the risks to investors to legal liability as a result of company actions (Shannon Quality Training, 1995).

At this point it would be prudent to distinguish between the fields of environmental impact assessment and environmental auditing;

Environmental Impact Assessment is a tool for predicting environmental impact(s), whereas an environmental audit is a multidisciplinary process of assessing the environmental performance of a company (including process, storage, environmental management and operating procedures) to identify environmental impacts and liabilities (European Commission, July 2000).

Simply put, EIA is a predictive exercise assessing the potential environmental impacts of an action while environmental auditing is the activity through which the verification of the environmental implications of the activity are determined.

While it is acknowledged that environmentally threatening incidents occurred prior to the 1980s, it was when the liabilities of major disasters of that decade such as at Bhopal, Prince William Sound and Schweizeralle began to have serious impact on the financial accounts of the responsible companies (Union Carbide, Sandoz and Exxon respectively) that the requirement for maintaining a 'clean sheet' concerning environmental management became a necessary prerequisite among senior managers (Schaltegger, Muller, and Hindrichse, 1996).

Following these well-documented incidents, two internationally recognised guidelines were published which also emphasised the requirement for environmental auditing;

(i) *The Valdez Principles*[Note 1] *(10)-*

"organisations will carry out annual self-evaluation, they will make the results public and they will have an independent audit of the results carried out".

(ii) *The International Chamber of Commerce* (ICC) *"Business Charter for Sustainable Development (15)*

"openness to impacts and concerns"(16), "Ensure compliance through measuring performance, auditing and providing information periodically to the stakeholders".

(Shannon Quality Training, 1995)

Note 1 The Valdez Principles were published in 1989 by the Coalition for Environmentally Responsible Economies (CERES), a non-profit membership organisation comprised of leading social investment professionals, environmental groups, religious organisations, public pension trustees and public interest groups (Lamprecht, 1997).

The European Union has used (and continues to do so) action programmes for the environment as a policy framework from which specific directives and regulations have been developed. The previous or fifth programme published in 1992 advocated a new approach to European environmental and industrial policy interactions, based on the concept of sustainable development. The fifth programme proposed a series of measures to achieve this, including environmental auditing.

In 1992, the Environmental Protection Agency Act was passed by the Irish Government paving the way forward for the creation of the national Environmental Protection Agency. This Act also provided a vehicle for the licensing of specified categories of activities with an holistic environmental licence known as an Integrated Pollution Control Licence.

In June 1993, the European Council adopted a proposal from the European Commission allowing voluntary participation by companies in the industrial sector in an EU 'Eco-management and Audit Scheme' (*Regulation No. 1836/93*) commonly referred to as EMAS.

In early 1994 the National Standards Authority of Ireland (NSAI) published an Irish environmental management system standard, known as *IS310: 1994 Environmental Management Systems-Guiding Principles and Requirements*. In October 1996 the European Standards Organisation (CEN) recognised the work completed by the technical sub-committee (TC207) of the International Organization for Standardization (ISO) in developing an international standard for environmental management systems (ISO 14001, published in September 1996). Arising from this recognition, CEN directed Ireland to withdraw its IS310 international standard, (Grimes, 1999).

In 1996, the Waste Management Act was passed by the Irish Government providing for a Waste Licensing mechanism for specified waste activities to be introduced by the Environmental Protection Agency.

In March 2001, a review of the original European Council EMAS regulation was published (*Regulation [EC] No. 761/2001 allowing participation by organisations in a Community eco-management and audit scheme [EMAS])* known as EMAS II.

As can be seen from the above, the regulatory and voluntary environmental controls under which companies are being placed, or placing themselves under in Ireland in the year 2002 are becoming more diverse and numerous. The environmental auditing mechanism has developed in tandem to the extent that defining its boundaries and standardising its implementation to an acceptable level is a challenge to even the most well versed in the field.

2.2 DEFINING AN ENVIRONMENTAL AUDIT

Just as the scope of the term 'environment' is wide, so is the definition for 'environmental audit'. However, as the field of environmental auditing has matured so has the definition, and it is considered that the definition as drafted in the EC Regulation No. 761/2001 of the European Council and Parliament (commonly referred to as EMAS II) is the most accurate;

"Environmental audit shall mean a management tool comprising a systematic, documented periodic and objective evaluation of the performance of the organisation, management system and processes designed to protect the environment with the aim of;

(i) facilitating management control of practices which may have an impact on the environment;

(ii) assessing compliance with the environmental policy. Including environmental objectives and targets of the organisation.

(Official Journal of the European Communities L114, 2001)

In effect the definition when broken down to its key constituents states that an environmental audit is a mechanism by which the environmental impact of a

company's activities can be determined, the ultimate aim of the exercise being the assistance to management of controlling these impacts and subsequently safeguarding the environment.

2.3 TYPES OF ENVIRONMENTAL AUDIT

Considering that auditing the environmental impact of companies' activities may at this stage be perceived to be opening 'Pandora's Box', it should be considered that as the field of auditing has blossomed, so has the development of the generic types of audit.

2.3.1 Phase 1 or Contaminated Land Audit

The purpose of a Phase I or Contaminated Land Audit is to identify liabilities arising from contamination of (soil and/or) groundwater on a site or within a building. Phase I audits could typically be conducted in the event of suspect storage integrity of hazardous material or in the currently topical event of the suspicion of illegal landfilling.

Phase I audits are the initial step in what can ultimately result in a three phase audit. The second step in this three phase audit process is a Phase II survey or intrusive qualitative/quantative investigation if deemed necessary following the findings of the Phase I survey. The final phase encompasses delineating necessary remedial action identified as a result of the conclusions drawn on the Phase I audit and confirmed by the Phase II audit. (McKenna & Co., 1993).

2.3.2 Property Transfer/Takeover or Due Diligence Audit

Environmental due diligence is the exercise conducted by a purchaser, underwriter, or lender in a wide range of commercial transactions, including public offering of shares, re-financing, asset purchase, share purchase or merger (McKenna & Co., 1993).
The purpose of the audit is to identify any liabilities or residuals associated with the subject of the commercial transaction which may influence the value of the subject of the audit (e.g. property or company).

2.3.3 Compliance Audit

Compliance audits focus on the operation of an activity and/or management of an organisation to determine, for example, compliance with pertinent environmental legislation (e.g. Waste Management Act, 1996, Environmental Protection Agency Act, 1992) or even compliance with a parent company's environmental policy.

2.3.4 Environmental Management System Audit

An environmental management system as defined as;

'that overall part of the management system which includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing , implementing, achieving, reviewing and maintaining the environmental policy'

(ISO, 1996)

Due to the increased focus on environmental best-practice in industry, a number of management standards have been drafted. The British Standards Institute (BSI) published the first environmental management standard in 1992, namely BS7750.

In September 1996, the International Organization for Standardization (ISO) on the recommendations of the technical committee (TC 207) set up by its Strategic Advisory Group on the Environment (SAGE), published two environmental management system standards, ISO 14001 and ISO 14004.

In June 1993, the European Council adopted a proposal from the European Community allowing voluntary participation by companies in selected industrial sectors in an EU Eco-management and Audit Scheme commonly referred to as EMAS (Official Journal of the European Communities, 1993). This regulation was revised in 2001 (Regulation [EC] No. 761 of 2001).

These management systems are available to facilitate the demonstration of companies' commitment to effectively managing the environmental aspects of the companies' operations.

An environmental management system audit is conducted to check the conformance of the system with a standard (ISO 14001 or EMAS) in the case of a 'formal' environmental management system. In the case of an 'informal' environmental management system, the purpose of the audit is to check the effectiveness of the environmental management system in implementing the company environmental policy.

2.3.5 Corporate Environmental Audit

A corporate environmental audit can be considered as an internal examination conducted by a company with reference to its own environmental operations as a means of assessing its environmental compliance and performance. Its aim is to assess whether the company is complying with environmental regulations, its own environmental standards and environmental management systems where these are in operation (McKenna & Co., 1993).

To this extent a corporate environmental audit can be considered as being the amalgamation of compliance and environmental management systems audits.

2.3.6 Associate Audit

Associate audits are conventionally audits conducted to assess the environmental management of associate companies. The term associate generally refers to suppliers, distributors (or agents) or licensees. The 'association' with the company is either by their provision of company inputs (e.g. raw materials, goods or services) or by dealing with the company's outputs (e.g. products or wastes).

One of the main driving forces behind the development of associate audits is the *Business Charter for Sustainable Development (*ICC, 1989*).* This charter states that contractors and suppliers acting on behalf of a company subscribing to the Charter should be actively encouraged and, where appropriate, required to improve their

practices so as to make them consistent with those of the company itself. (McKenna & Co., 1993).

2.3.7 Issue/Product Audit

Issue audits are conducted to assess the environmental impact of products as well as the production processes from which they are generated. Issue audits are commonly referred to as 'Life-Cycle Analysis' audits. The principle of 'Life-Cycle Analysis' is that all environmental aspects associated with the generation of a product from its raw material though to its final disposal are addressed. This principle is core to the completion of the issue audit.

2.3.8 Other Environmental Audits

The eight type of audit I wish to classify at this point is best addressed under the working title of *Other Environmental Audits.* It is the author's belief that environmental audits should be regarded as management tools. When the principles of environmental auditing are comprehended and the environmental auditor becomes proficient in auditing, then audits can be developed for a limitless range of environmental subjects. These subjects can vary from the micro-environment application such as waste oil management in a garage to the macro-environment issues such as carbon credit trading on a global scale and the wide variety of topics in between.

2.4 BENEFITS OF ENVIRONMENTAL AUDITING

There are numerous benefits to environmental auditing. The primary benefits are the attainment of the specified objective(s) of the audit conducted (e.g. life-cycle information, liability delineation). However, there are a number of secondary benefits which the company may enjoy including;

2.4.1 Compliance with Environmental Legislation

One of the immediate benefits of environmental auditing is that management can determine their compliance status with all pertinent environmental legislation related to the activities conducted within the company. Due to the wide scope of environmental legislation, not only are companies frequently not in compliance, but frequently are not aware of the existence of certain environmental legislative implements.

2.4.2 Improved Management Awareness of Environmental Issues

In conducting an environmental audit, management awareness can be increased regarding the possible negative environmental implications of certain 'standard operating procedures' as well as potential liabilities arising there from.

2.4.3 Cost Minimisation though Improved Environmental Performance

Environmental audits can identify cost recovery and saving opportunities through minimisation of wastes, recycling, energy saving, reduction in use of raw materials, sale of by-products, etc. (European Commission, 2000).

2.4.4 Competitive Advantage

Through the implementation of improved in-house manufacturing and management practices identified by means of an environmental audit, benefits can be reaped through the associated competitive advantage. This competitive advantage can arise directly through tangible cost savings of improved manufacturing process and minimisation of waste generation or intangible benefits such as 'green marketing'.

2.4.5 Compliance with Company Policy

As is the case in many large-scale multinationals, corporate environmental policies may have been drafted in the absence of personnel from daughter companies. Environmental auditing can determine the compliance of daughter companies' management and activities with the parent company's policies.

2.4.6 Reduced Insurance Premiums

Through externally validated environmental audits, a company that has identified its existing and potential environmental liabilities and established corrective actions to address same, can expect to enjoy a reduction in the premium it pays for insurance cover. However, it must be acknowledged that due to the historical liabilities accrued from environmental 'catastrophes' some form of environmental liabilities risk assessment is a generally accepted prerequisite to receiving environmental impairment cover.

2.4.7 Comparative Analysis and Benchmarking

Internal environmental auditing can provide a benchmark as to the performance of individual facilities when compared to sister companies within the same organisation. External auditing can be used to provide invaluable information as to 'best environmental practice' from either compliance or good management practice perspectives.

2.4.8 Stakeholder Confidence in Company Environmental Performance

The stakeholder of a company is any individual or group who has an interest in the company because they can affect or be affected by the companies activities, these include for example, management, employees, tax agencies, shareholders, environmental pressure groups, suppliers, customers or geographical neighbours, etc. (Schaltegger *et al.,* 1996*)*. Through the completion of an environmental audit, the stakeholders can be assured that the company has identified its strengths and weaknesses regarding the management of its environmental aspects and compliance with pertinent legislation. Audits and their subsequent publication can be used to increase public awareness about a company's environmental performance. They may also encourage public involvement in the environmental management of a company.

2.4.9 Provision of Data for Regulatory Authorities and Regional or National State of the Environment Reports

A company can foster better communications and relations with regulatory authorities by the provision of information on company environmental performance. This information may then assist in the generation of official environmental reports.

2.4.10 Review of Environmental Progress

Frequent repetition of environmental audits can provide company management with an ever-developing picture as to the progress of the company's environmental performance. This will also provide assistance in assessing the strengths of the environmental controls in a company over extended periods of time.

2.4.11 Attracting Future Employees

Maintaining a good environmental record can be considered as a tool to enhance recruitment success for high calibre personnel.

SECTION 3

ENVIRONMENTAL AUDITING STANDARDS

3.1 INTRODUCTION

In the previous section, a definition for an environmental audit, the types of environmental audit and the benefits of environmental auditing have been delineated. The scope of the environmental audit as described in the previous section is far-reaching, therefore to maintain consistency, one might ask questions such as '*how is the quality of an environmental audit maintained?*', '*is there any defined guidance for the content of an audit* ?' and '*what is required of an 'environmental auditor'*?'.

To provide some form of agreed standard format for the environmental audit and the environmental auditor a number of voluntary management standards have been drafted on a European and international basis, including ISO 14010, 11 and 12, ISO 19011, EMAS, Responsible Care©.

3.2 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

The International Organization for Standardization has published a series of standards for environmental auditing.

These standards have included;

- ISO 14010-Guidelines for Environmental Auditing-General Principles (ISO, 1996);
- ISO 14011-Guidelines for Environmental Auditing-Audit Procedures-Auditing of Environmental Management Systems (ISO, 1996)
- ISO 14012-Guidelines for Environmental Auditing-Qualification Criteria for Environmental Auditors (ISO, 1996).

Following the lessons learned from feedback concerning the practical application of these standards, the International Organisation for Standardisation (ISO) published a draft standard *ISO/DIS 19011-Guidelines for quality and/or environmental management systems auditing* on the 31st May 2001.

The preparation and development of this standard is being conducted by a joint working group (JWG) set up by two subcommittees of the ISO technical committees *ISO/TC 176, Quality management and quality assurance* and *ISO/TC 207, Environmental management.*

The JWG Secretary, Dick Hortensius, detailed the benefits as;

1. a uniform approach to auditing environmental and quality management systems, facilitating ultimate combination of both as required;

2. saving money, due to the fact that one audit team being able to audit both systems, as well as limiting the disturbance of the audit subject(s) to a single audit;

3. providing certification/registration bodies with a uniform approach to the auditing mechanism;

4. providing a framework that enables organisations to set their own competence requirements and related auditor evaluation processes; and

5. the combination of the descriptions of the management of audit programmes and the conduct of individual audits in a single guideline.

(www.iso.ch)

The purpose of this standard is envisaged to consolidate the experience to date through the publication and implementation of the six existing quality (ISO 9000 series- 10011-1, 10011-2 and- 10011-3) and environmental (ISO 14000 series- 14010, 14011 and 14012) management systems auditing standards.

Through the implementation of the new standard, it is anticipated that it will assist in the integration of quality and environmental management systems and thereby save money and minimise interruptions to the audit subjects.

The draft standard was distributed to ISO's members for a five-month ballot closing on the 31st October 2001. It is anticipated that following approval, the draft standard will be republished regarding comments received from ISO's members for a further ballot. It is forecast that the standard will be issued as a complete standard later this year (2002).

According to ISO (www.iso.ch)

"ISO 19011 provides guidance on the conduct of internal or external quality and/or environmental management system audits, as well as on the management of audit programmes. Intended users of this International Standard include auditors, organizations implementing quality and/or environmental management systems, and organisations involved in auditor certification or training, certification or registration of management systems and accreditation or standardization in the area of conformity assessment".

3.2.1 The Clauses of the Draft ISO 19011 Standard

The standard is divided into a set of seven clauses;

CLAUSES 1,2 and 3

These clauses outline the scope, normative references and terms and definitions respectively.

The scope of the standard is to all organisations that require internal and external auditing of quality and/or environmental management systems.

The phrase audit is defined as a "*systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled*".

The standard divides audits into first, second and third party audits. This division is based on the following;

First Party Audit- internal audits conducted by or on behalf of the organisation for its management review and other internal purposes and can form the basis for an organisation's self declaration of conformity.

Second Party Audits- are audits conducted by parties with an interest in the organisation (e.g. customers or other persons on their behalf).

Third Party Audits- are audits conducted by external, independent audit organisations (e.g. certifiers of conformity to ISO 9001 and 14001).

Second and third party audits are considered as being external audits.

CLAUSE 4

This clause details the principles of auditing. The purpose of defining these principles is to provide assurance that if followed, all auditors working independently from one another, will under similar circumstances return the same conclusions.

These principles are divided into those applicable to the auditor and the audit process. Those relevant to the auditor include;

Ethical Conduct- trust, integrity, confidentiality and discretion are key attributes of the auditor.

Fair Presentation- audit findings, conclusions and reports should be formulated responsibly from the audit activities. Any obstacles encountered should also be detailed.

Due Professional Care- the auditors should be sure to address the audit in a competent fashion.

Principles related to the audit process itself include;

Independence- this principle is included to ensure that the auditor is not influenced by any third party or bias such that the audit findings will be based on evidence only.

Evidence- all evidence should be verifiable.

CLAUSE 5

This clause outlines the steps to be taken in planning, implemented and managing an effective audit programme.

The requirement for this clause of the standard is based on the fact that in accordance with the complexity of the organisation being audited, there may an identified need to run a number of audits focussing on separate facets of the organisation's activities. These constituent audits may vary in complexity, length or perceived importance to maintain compliance with the standard being audited against.

The preparation of the audit programme should address;

- Objectives and extent of audit programme (i);
- Responsibility, resources, and procedures (ii);
- Implementation of the audit programme (iii);
- Monitoring, reviewing and improving the audit programme (iv); and
- Ensuring appropriate records are being maintained (v)

A schematic indicating the development of the audit programme is detailed below.

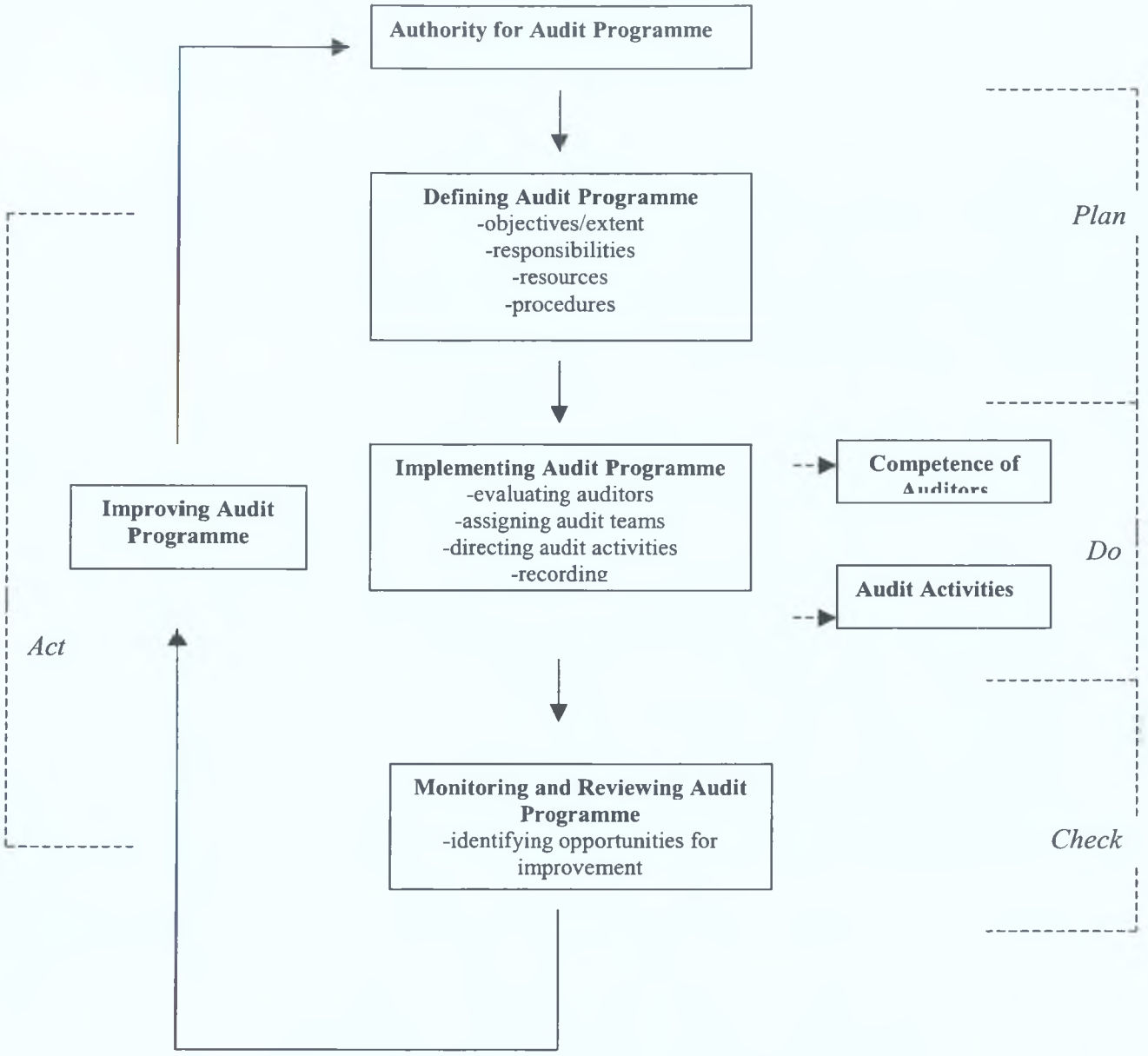


Figure 3.1 ***Illustration of the application of the Audit Plan-Do-Check-Act cycle to the management of an audit programme, (ISO, 2001).***

(i) Establishing Objectives and Extent of Audit Programme

The standard acknowledges the fact that the objective of the audit programme may not necessarily be limited to compliance with the management system standard but may also address issues such as commercial requirements, management priorities, regulatory

requirements and customer requirements. Thus the objectives should be clearly delineated at a preliminary phase.

Establishing the extent of the audit programme can be dictated by issues such as certification, the size of the company, results of previous audits and concerns of interested parties. These influences are far and wide reaching and not limited to those factors mentioned but are site specific and should be regarded as such.

(ii) Responsibilities, Resources and Procedures

It is critical that responsibility is assigned for the individual facets of the audit programme. The responsible parties should be competent and have a general understanding of the audit principles. The function(s) of the person(s) assigned responsibility for the audit programme should embrace the policies of implementing an effective environmental audit programme, e.g. definitions, monitoring, reviewing and improving the audit programme as well as assigning the requisite resources (human, financial, etc.).

Appropriate care should be taken in identifying the resources required for implementing the audit programme. The resources are not just limited to financial resources but include identifying appropriate audit techniques, identifying methods of continual improvement for the auditors utilised, allocating the necessary time to complete the audit programme and the necessary consumables.

Once the background of the audit programme has been formulated, the responsibilities have been identified and the resources attained, the procedures for initiating the audit programme should be delineated. These should clearly identify the protocol for formulating plans and schedules, ensuring the competence of the audit team members, selecting appropriate audit teams, conducting the audit and the associated follow-ups, maintaining necessary programme records, monitoring and improving the audit programme.

(iii) Audit Programme Implementation

As part of the implementation of the audit programme it should be ensured that;

- ❖ The programme is effectively communication to relevant parties;
- ❖ Audits and related activities are coordinated and scheduled;
- ❖ Auditors are regularly evaluated and improvement mechanisms are implemented;
- ❖ Effective progress with the audit schedule is maintained;
- ❖ Appropriate records are maintained;
- ❖ Effective review and distribution of audit reports is effected; and
- ❖ Audit follow-ups are conducted as required.

(iv) Audit Programme Records

The records that should be maintained to track effective implementation of the audit programme include;

- ❖ Audit records (including plans, reports and reviews);
- ❖ Non-conformity reports (including corrective and preventive action reports);
- ❖ Audit programme reviews; and
- ❖ Personnel reports (including individual and team evaluations, training).

(v) Audit Programme Monitoring and Reviewing

As part of the effective implementation of an audit programme, the programme itself should be continually monitored as it is implemented, as well as being reviewed at frequent intervals.

The continual monitoring aspects should include the use of 'performance indicators' such as;

- ❖ Effective implementation of the plan by the auditors;
- ❖ Conformity with associated programmes and schedules;

- ❖ Feedback from clients, auditees and auditors; and
- ❖ Time taken to implement identified corrective actions.

The programme review should also address wider scope issues such as;

- ❖ Results and trends from monitoring;
- ❖ Conformity with detailed auditing procedures;
- ❖ Addressing newly identified needs as identified from comments of auditors, auditees, or new developing auditing practices; and
- ❖ Audit consistency.

Based on the results of the review, effective corrective and preventive action plans can be assigned with a view to improving the suitability, competence, effectiveness or otherwise of the audit programme.

CLAUSE 6

This clause sets out the specific guidance for conducting the audit (*see Figure 3.2-Overview of Audit Activities below*).

(i) Initiating the Audit

The first step to take in initiating the audit is to appoint the team leader. Following this appointment, the objectives of the audit should be clearly defined. The input of the client is essential as this stage to ensure a satisfactory outcome on completion of the audit in terms of objectives, scope or criteria.

Once the objective and scope of the audit have been agreed, the feasibility of completing an effective audit regarding issues such as availability of information, cooperation of the auditee and availability of resources should be ascertained. The auditee (or client) should be advised as to the outcome of this feasibility assessment and in the event of shortcomings being identified, these shortcomings should be resolved to the satisfaction of the audit team leader and the auditee.

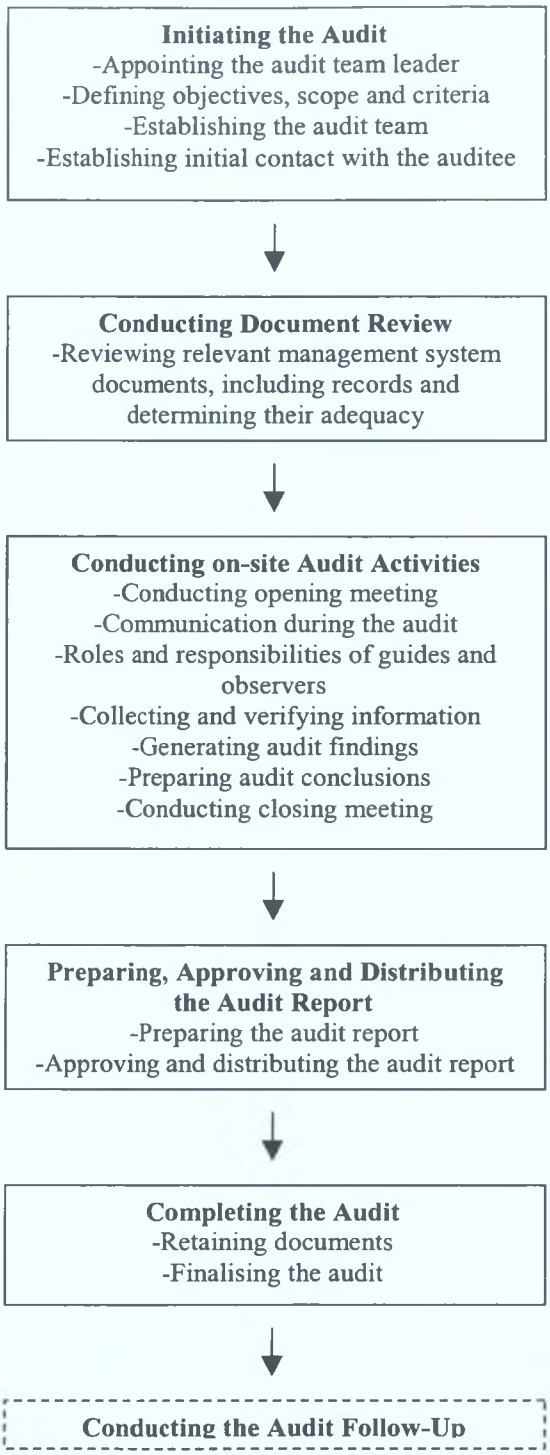


Figure 3.2 ***Overview of Audit Activities, ISO, 2001.***

The next phase of initiation is the selection of the audit team. In selecting the audit team, consideration should be given to the following factors;

- Audit objectives, scope and time frame;
- Required competence of the audit team;
- Accreditation/certification requirements;
- Required independence of the audit team from the audit subject matter;
- Ability of audit team to work effectively together; and
- Language, culture or other social influences.

Prior to commencing the audit, it is recommended that the initial contact be made between the audit team and the auditee prior to commencement of the audit. This is seen as an important aspect of the pre-audit activity to;

- Establish communication channels;
- Agree audit composition and scheduling;
- Advise the auditee of requirements for site guides and staff interviews as well as affording the auditee to nominate any accompanying persons required on behalf of the auditee;
- Provide the auditee with the details of relevant documents and records that will be required for inspection; and
- Advise the audit team of any site safety rules.

As a precursor to conducting any on-site activities the requested auditee's documentation should be reviewed to determine conformity with the audit criteria. Any gaps in the information requested should be identified and agreed with the auditee prior to progressing with the audit.

The audit plan should then be drafted regarding the following issues;

- Objectives
- Criteria and reference documents
- Scope
- Date(s) and location(s) for on-site activities;
- Time programme;
- Roles and responsibilities of attendees;

- Allocated resources; and
- Confidentiality.

The detail of the audit plan should be agreed by all parties involved in the audit.

Once the audit plan has been agreed, the audit team should be assigned their responsibilities for the individual components of the audit. Once the responsibilities of the audit team have been assigned to the individual members of the audit team, the necessary reference material should be collated as required in conjunction with the drafting of checklists and audit sampling plans, forms and records.

(ii) Conducting on-site Activities

On the day of the commencement of the audit, an opening meeting should be conducted between the audit team and the auditee's management or those responsible for the functions or processes being audited. It is envisaged that on the occurrence of this meeting, the audit plan is reviewed including a summary of how the audit will be undertaken. It is important that the auditee be provided with the opportunity of asking questions as required.

Depending on the complexity of the audit and number of audit team members, the communication arrangements of the audit will be chosen. If deemed necessary, the audit team should liaise regularly to monitor progress, exchange information and observations as well as reassigning works between auditors as required. The standard also states that in the event of evidence being collected of the existence of an immediate or significant risk (e.g. leakage of hazardous waste to a receiving watercourse), this should be reported to the auditee (and client as appropriate) immediately such that the appropriate action can be taken. Any general concern extra to the audit scope should be articulated to the auditee (and client as appropriate) in a responsible time frame and manner.

If during the occurrence of the audit, the audit team identify that the scope or terms of the audit cannot be achieved, the auditee (and client as appropriate) should be advised

immediately. It is the responsibility of the audit team leader to determine with the auditee (and client as appropriate) whether the issues identified can be resolved, whether they can be modified to the satisfaction of all parties or whether the audit needs to be abandoned.

Audit evidence should be evaluated against the audit criteria and determined as being conforming or non-conforming. The determination of evidence collated from the audit as being conforming or non-conforming should only be decided upon following addressing all reference material decided upon in the audit plan and the input of all the audit team members.

Conformities or non-conformities should be classified, referencing the locations, activities, functions, processes or requirements being audited against. Supporting evidence should also be recorded. Non-conformities should be reviewed, agreed and graded in consultation with the auditee. Any unresolved differences of opinion should be noted. Recommendations arising from the non-conformances identified should be prepared.

Prior to completion of the audit activities on-site, a closing meeting should be conducted. The purpose of this meeting is to present the audit findings to the auditee and to seek agreement on same by the auditee. Agreement on audit findings should be obtained at this stage as deemed possible. Any difficulties or situations that may have impacted negatively on the reliance of the audit findings should be presented to the auditee at this stage. Also, in the event of no agreement on the existence of any non-conformities, this should be recorded.

(iii) Preparing, Approving and Distributing the Audit Report

The standard emphasises that the audit report contents and preparation is the responsibility of the audit team leader. The audit report should be clear, concise, accurate and complete. For completeness of the report, the standard recommends that the following information should be included in the report;

- Audit objectives;
- Audit scope;
- Client;
- Audit team members;
- Dates and locations of on-site audit activities;
- Audit criteria;
- Audit findings; and
- Conclusions.

The audit report should also detail any issues arising from the completion of the audit such as difficulties completing the audit, unresolved issues, areas not covered as well as whether the audit objectives were attained or not. Following agreement on these and/or other related issues, an agreed follow-up plan should be drafted.

It is stated specifically in the standard that it should be noted that the audit report is the property of the client. Confidentiality should be respected and appropriately safeguarded by the audit team and all those on the audit report circulation list.

(iv) Completing the Audit

Documents related to the audit should be managed as agreed with the client. These documents should be retained locally or by the audit team or destroyed in accordance with the procedures as outlined in the audit programme or with reference to regulatory or contractual agreements.

The audit plan is considered complete when all scheduled activities have been conducted and the approved audit report has been circulated.

CLAUSE 7

This section of the standard provides guidance concerning the key skills, training, education and experience required to become an auditor.

(i) General Auditor Skills

Auditors should be aware of the following and be able to practice the key skills;

- Principles, procedures and techniques;
- Effective planning and organisation;
- Time management;
- Ability to focus and prioritise;
- Effective collation of information through effective interviewing, listening, observing and document review;
- Validation of information;
- Determine the suitability of the information to support audit findings and conclusions;
- Understand implications (both positive and negative) of the application of various techniques;
- Maintain good field (audit) records;
- Drafting and presentation of clear and concise audit reports;
- Confidentiality; and
- Communication.

In conjunction with these skills and in the event of auditing an environmental management system, the auditor should have knowledge and skill in;

- Practical application of management system structures;
- Holistic operations of management systems;
- Management system standards or other such base criteria;
- Priority of constituent documentation;
- Reference materials; and
- Information systems for document control.

On a site specific basis, the auditor should understand;

- Organisation size, structure, functions and relationship;

- ❖ General business processes and related terminology; and
- ❖ Cultural and social customs of auditee.

The auditor should also be aware of the appropriate laws, regulations, safety requirements, contractual agreements and environment of the organisation being audited.

Additional skills required for audit team leaders include;

- ❖ Effective audit planning and resource management skills;
- ❖ Presenting the audit team to the auditee;
- ❖ Managing and directing audit team members;
- ❖ Maximising audit productivity;
- ❖ Conflict resolution; and
- ❖ Report writing skills.

Concerning the environmental knowledge base, auditors should be familiar with;

- ❖ Environmental management methods and techniques [e.g. terminology, principles and tools (i.e. impact assessment, life cycle assessment, etc.)];
- ❖ Environmental science (including anthropogenic impacts, interactions, protection and monitoring/measurement techniques); and
- ❖ Technical environmental aspects of auditees' activities.

On a personal level, auditors should be ethical, open-minded, diplomatic, observant, perceptive, versatile, tenacious, decisive and self-reliant.

(ii) Auditor Education and Work Experience

The training, education and experience required for an auditor is wholly dependent of the subject of the audit. Therefore these requirements, in the case of an audit team member involved in internal audits being conducted on a well documented site control issue (e.g.) waste management, vary significantly to those required for an audit team

leader from an environmental consultancy conducting an external audit on an extremely technical or broad range of issues. The skills required of the auditor should be determined by the audit team leader in assigning the responsibility for conducting individual audits or sections thereof.

(iii) Maintenance and Improvement of Auditor Competence

The standard recommends that once auditor competence has been attained, training should not cease. This training need not take on only the mantle of formal education but may manifest itself via e.g. work experience, training, attendance at seminars, etc.

Continual professional development should be tailored in accordance with the needs of the individual, the organisation and relevant changes in auditing standards, industry developments, etc.

It is also recommended that the practice of regularly conducting audits is a prerequisite to the maintenance and improvement of auditor competence.

(iv) Auditor Evaluation

The standard recognises three phases of auditor evaluation;

- *Phase 1* – Initial evaluation;
- *Phase 2* – Further evaluation as part of the selection process of appropriate audit team members; and
- *Phase 3* – Continual evaluation to identify needs for maintenance and improvement of auditor knowledge and skills.

Phase 1 Initial Auditor Evaluation Process

This initial auditor evaluation phase is divided by the standard into four main steps;

1. *Identifying types and levels of knowledge and skills to meet requirements of audit programme:*

Guidance is provided within the standard for this step in the form that it regards factors such as;

- size and complexity of the organisation to be audited;
- objectives and extent of audit programme;
- certification, registration and accreditation requirements;
- role of the audit process in the management of the organisation;
- confidence required in the audit programme; and the
- complexity of the management system,

as being key benchmarks.

2. *Setting indicators of education, work experience, auditor training and experience:*

The standard recommends that these indicators should be formulated, based on the outcome of the base developed in accordance with the detail of the preceding paragraph.

3. *Selecting appropriate evaluation method*

The standard recommends a series of methods for auditor evaluation that are presented overleaf in *Table 3.1-Evaluation Methods.* In referring to these methods, the standard advises that;

- The methods outlined may not apply in all situations;
- The reliability of the various methods outlined may differ; and
- Typically, a combination of methods should be used to ensure a fair, consistent and objective outcome.

Table 3.1 Evaluation Methods		
Evaluation Method	**Objectives**	**Examples**
Records review	To verify background of the auditor.	Analysis of records of education, training, employment and audit experience.
Interview	To evaluate personal attributes, communication skills, verify information, test knowledge, acquire additional information	Face to face and telephone interviews.
Observation	To evaluate personal attributes and the application of skills and knowledge.	Role-playing, witnessed audits, on-the-job performance.
Post Audit Review	To provide information where direct observation may not be possible or appropriate.	Review of the audit report and discussion with colleagues, clients, auditees and with the auditor.
Testing	To evaluate personal attributes and knowledge and skills and their application.	Oral and written exams, psychometric testing.
Positive and negative feedback	To provide information about how the performance of the auditor is perceived.	Surveys, questionnaires, personal references, testimonials, complaints.

4. *Completion of evaluation by comparing results against identified indicators*

The standard recommends that a 'performance evaluation sheet' should be drafted for the purposes of evaluating the auditor against the pointers identified. An example of a performance evaluation sheet is provided overleaf in *Table 3.2– Example of a Structure for Auditor Evaluation in an Internal Audit Programme.*

Table 3.2 Example of a Structure for Auditor Evaluation in an Internal Audit Programme			
Areas of Knowledge and Skills	**Identified Level of Knowledge and Skills**	**Identified indicator of education, work experience, auditor training and audit experience**	**Evaluation Methods**
Audit procedures, processes and techniques	Ability to conduct an audit according to in-house procedures, communicating with known workplace colleagues.	Have completed an in-house auditor training course. Have performed three audits as a member of an internal audit team.	Review of training methods. Observation. Peer review.
Management systems and other reference documents	Ability to apply the relevant parts of the Management System Manual and related procedures.	Read and understood procedures relevant to the audit objectives, scope and criteria.	Review of training records. Testing. Interview.
Organisational Structures	Ability to describe the organisations local structure and culture and any demarcation issues.	Worked for the organisation for at least one year.	Review of employment records.
Laws. Regulations and other requirements	Ability to identify and understand the application of the relevant laws and regulations related to the processes, products and/or discharges to the environment.	Attended a training course on the laws relevant to the activities and processes that are the subject of this audit.	Review of training records.
Quality related tools and techniques	Ability to describe the in-house quality control methods. Ability to differentiate between the Quality Control Manual requirements for in-process and final testing.	Have been trained in the application of quality control methods. Have demonstrated workplace use of in-process and final testing procedures.	Review of training records.
Products, services and operational processes	Ability to discuss the products their manufacturing process, specifications and end-use.	Have worked in the production planning office as a planning clerk. Have worked in the service department.	Review of employment records.
Environmental management principles and techniques	Ability to understand the importance of environmental protection/pollution prevention.	Have received environmental awareness training.	Review of training records.
Environmental science and technology	Ability to identify the pollution prevention methods relevant to the organisations processes, products or services.	Have successfully completed a chemistry course.	Review of records of education.
Technical and environmental aspects of operations	Ability to list the organisations environmental aspects (e.g. chemicals in use, their reactions with one another and potential impact on the environment in the event of spillage or release). Ability to describe the organisation's environmental protection methods.	Have completed an in-house training course on chemical storage, mixing, use and environmental impacts. Have demonstrated workplace use of correct methods of storing, mixing and using chemicals.	Review of training records, course content and results.

3.3 ECO-MANAGEMENT AND AUDIT SCHEME

3.3.1 EMAS I

Under a European Union incentive to promote continual environmental performance in selected industrial activities, the Eco-management and Audit Scheme (EMAS) regulation (EC regulation 1836/93) was drafted. In June 1993, the European Council adopted a proposal from the European Community allowing voluntary participation by companies in selected industrial sectors in an EU Eco-management and Audit Scheme commonly referred to as EMAS (Official Journal of the European Communities, 1993). The Regulation details that the key to continuous improvement is by;

- ❖ The establishment and implementation of an environmental policy, programmes and management systems by companies in relation to their sites;
- ❖ The systematic, objective and periodic evaluation of such elements; and
- ❖ The provision of information on the company's environmental performance by the publication of an environmental statement.

Annex II and Article 4 of the EMAS Regulation sets out the requirement for an environmental audit.

The Regulation defines the "environmental audit" as a management tool comprising a systematic, documented and periodic evaluation of the performance of the organisation, management system and processes designed to protect the environment. The aim of the audit is two-fold;

(i) to exercise management control over activities in the company which may have an impact on the environment;
(i) to assess compliance with the company environmental policy. (Bouchier *et al,* 1998)

3.3.2 EMAS II

In March 2001, a review of the original European Council EMAS regulation was published (*Regulation [EC] No. 761/2001 allowing participation by organisations in a Community eco-management and audit scheme [EMAS])* known as EMAS II.

The scope of improvement of EMAS II over the original EMAS includes the following;

- Increasing the scope of participation to all organisations;
- Creating better integration with ISO 14000 series of standards;
- Verified annual updates of environmental statement; and
- Setting of audits at intervals of no longer than 3 years.

A slight alteration was made to the definition of the environmental audit, in that the aim of complying with the company policy was extended to include the environmental aims and objectives of the targets. This addition in effect, means that a valid audit must determine the effectiveness of the agreed environmental management programme in conjunction with the general policy statement.

In *Annex II-Requirements concerning internal environmental auditing*, Section 2.1-*General Requirements* specifies that internal audits shall be carried out by persons sufficiently independent of the activity being audited to ensure an impartial view. They may be carried out by employees of the organisation or by external parties (employees from other organisations, employees from other parts of the same organisation or consultants.

Section 2.2-Objectives describes that the environmental auditing programme shall define in writing, the objectives of each audit or audit cycle, including the audit frequency for each activity. Listed as inclusions in the objectives are;

- Assessing the environmental management systems in place; and
- Determining conformity with the organisations policy and programme (including compliance with relevant environmental regulatory requirements).

Section 2.3-Scope states that the scope of the audit should be explicitly laid out and should include;

- Subject areas to be covered;
- Activities to be audited;
- Environmental criteria to be considered;
- Period covered by the audit.

The regulation states that the audit should include assessment of the factual data to evaluate performance.

Section 2.4-Organisations and Resources states that environmental audits shall be performed by persons or groups of persons with appropriate knowledge of the sectors and fields audited, including knowledge and experience on the relevant environmental, management, technical and regulatory issues, and sufficient training and proficiency in the specific skills of auditing to achieve the stated objectives. The resources and time allocated to the audit shall be commensurate with the scope and objectives of the audit.

The requirement for top management support for the auditing programme is detailed in this section as is the requirement that auditors should be deemed sufficiently independent of the activities they audit such that an objective and impartial judgement can be drawn.

The planning and preparation for an audit is detailed in Section 2.5, detailing the requirement to ensure that appropriate resources are allocated and that all auditors, management and staff are aware of their roles and responsibilities. Preparation for the audit should also include familiarisation with the activities of the organisation, the environmental management system and the findings of previous environmental audits.

In conducting the audit, Section 2.6 of the Regulation advises that the audit should include discussions with personnel, inspection of operating conditions and equipment and reviewing of records, written procedures and other relevant documentation. The purpose of the audit is detailed as the *'...evaluation of the environmental performance of the activity being audited to determine whether it meets the applicable standards,*

regulations or objectives and targets set and whether the system in place to manage environmental responsibilities is effective and appropriate'.

Section 2.7 of the Regulation requires that a written report be drafted in an appropriate form with the appropriate content to document the findings and conclusions of the audit, at the end of each audit and audit cycle. This document should be circulated to top management.

The fundamental objectives of the written audit reports are described in the Regulations as follows;

- To document the scope of the audit;
- To provide management with information on the state of compliance with the organisations' environmental policy and the environmental progress at the organisation;
- To provide management with information on the effectiveness and reliability of the arrangements for monitoring the environmental impacts of the organisation; and,
- To demonstrate the need for corrective action, where appropriate.

Section 2.8 of the Regulation requires a follow-up action plan of corrective action while Section 2.9 details the influences on determining the audit cycle frequency, including;

- Nature, scale and complexity of the activities;
- Significance of associated environmental impacts;
- Importance and urgency of the problems detected by previous audits
- History of environmental problems.

3.4 ACCREDITATION OF ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) CERTIFIERS

A topic worth mentioning at this stage is that while guidance is provided in the ISO 14000 series of standards and EMAS I and II for conducting internal audits, there also

exists a forum for maintaining the standard to which the environmental management system certifiers must maintain.

The European Cooperation for Accreditation (EA) has, within the framework of the International Accreditation Forum (IAF), published guidelines for the Accreditation of Certified Bodies for EMS. This guide specifies requirements, the observance of which is intended to ensure that certification bodies operate third party certification/registration systems in a consistent and reliable manner (European Cooperation for Accreditation, 1998).

In Ireland, the National Accreditation Board (NAB) is the Government approved body to accredit environmental management system auditors. NAB has approved Certification Europe only as an accredited environmental verifier for ISO 14001 (Hussey, *pers comm,* 2002.). An environmental verifier of a management system to the ISO 14001 standard only has to be accredited by a single approved body internationally to conduct certification practices in Ireland. In the case of EMAS, if an environmental verification company is accredited in a European Union member state, then subject to notification of their intent to NAB, they are permitted to verify EMAS accredited environmental management systems in Ireland (Hussey, *pers comm,* 2002). This augments the justification to query the quality of environmental auditing and certification practices of EMAS and ISO 14001 environmental management system standards.

3.5 INTERNATIONAL CASE STUDY: ENVIRONMENTAL AUDITING PROGRAMME IN INDIA

The concept of environmental auditing first developed in the 1990s in India as a tool to assist Indian industry to optimise production processes, thereby reducing generation of wastes at source and reducing/eliminating conventional end-of-pipe treatment of wastes. The development of this tool was also acknowledged to be beneficial in promoting sustainable development. This development process was initiated by the Ministry of Environment and Forests (MoEF), Government of India leading to the publication of a discussion paper on the 'Outline of Environmental Auditing' in November 1991. The resulting discussions among concerned regulatory agencies

finally resulted in the issuing of a gazette notification (Gazette Notification No. GSR 329(E), 1992 by the MoEF in March 1992), making the submission of annual 'Environmental Audit Reports' (later renamed 'Environmental Statement) a mandatory requirement for all the industries (Mashwar, Verma, Chakrabarti and Biswas, 1997).

The Indian Central Pollution Control Board (CPCB) conducted environmental auditing studies in a number of industries located in various parts of the country in the period 1991 to 1993. These studies were conducted with a view to informing the categories of industry that needed priority attention for pollution control about environmental auditing as well as why and how it was to be conducted. Audit teams were set up for each of the industries selected for the study, comprising mainly of Scientific and Technical persons from the CPCB and the concerned Pollution Control Board/Committee. Team numbers varied from four to seven.

Questionnaires were forwarded to the selected industries for the purposes of background information collection, requiring details on site history, production activities, environmental discharge consents, water pollution, air pollution, solid waste management, hazardous waste management, hazardous chemicals management, noise pollution, environmental management responsibilities and associated documentation. The auditing programme proceeded to give guidance on steps to be taken during site visits (e.g. assessment of environmental control systems) as well as the format of general recommendations (focussing on education and training, good housekeeping practices, etc.).

Following the completion of these environmental audits, the CPCB proceeded to develop standard methodologies for conducting environmental audits in each of the identified highly polluting categories of industries. The purposes of these guidelines was envisaged to enable the industry operators to 'assess the environmental performance and to identify the economic returns and environmental benefits that accrue out of the audit scheme'. By the time of publication of the Mashwar paper in the journal 'The Science of the Total Environment' in 1997, guidelines for conducting an environmental audit had been published for the pesticide industry ('Guidelines for Environmental Audit', Raghu Babu et al., 1993) with guidelines under development for

the cement, pulp and paper, dyes and dye intermediates and distilleries industries. (Mashwar *et al*, 1997).

3.6 RESPONSIBLE CARE ©

Responsible Care is the worldwide chemical industry's commitment to continual improvement of all aspects of Health, Safety and Environment performance and to openness in communication about its activities and achievements. National chemical industry associations are responsible for the detailed implementation of Responsible Care in their countries (*www.cefic.be*, 2002).

The aim of Responsible Care is to earn public trust and confidence through a high level of health, safety and environmental performance in order to maintain the industry's licence to continue to operate safely, profitably and with the due care for future generations (*www.cia.org.co.uk*, 2002).

In 1994, the principles of Responsible Care were adopted in Ireland on the establishment of the Irish Pharmaceutical and Chemical Manufacturers Federation (IPCMF)(CEFIC, 1999). Subscribing to Responsible Care is a condition of membership for the IPCMF. The IPCMF members, through the Responsible Care programme demonstrate their strong commitment to preservation of the environment. This preservation of the environment is achieved through striving for compliance with environmental regulations, investment in clean technology, waste minimisation and safe disposal of waste (*www.ibec.ie/sectors/IPCMF*, 2002). In 1999, IBEC (Irish Business and Employers Confederation) adopted the ICMA (Irish Chemical Marketers Association) Responsible Care Programme (Grimes, 1999).

On a global scale, improved environmental performance through Responsible Care © has been achieved by, for example;

- Community Advisory Panels are well established in many countries, including recently, Thailand Germany and Taiwan;

- New Zealand Chemical Industries Council has developed a comprehensive national performance standard for hazardous substances, which became legally enforceable in 1999;

- The Japanese Consumers Council has held discussions with the Japanese Responsible Care Council members on environmental and consumer affairs, in particular, recycling of plastic bottles and recyclable materials; and

- The UK Chemical Industries Association (CIA) has introduced *"Responsible Care Guidance"*- a Responsible Care code of practice that can be verified by an external audit body. This guidance standard incorporates all the key requirements of environmental management standards ISO 14000, EMAS and the health and safety specification OSHAS 18000, in conjunction with other requirements to Responsible Care relating to product stewardship, distribution, chemical emergencies and community liaison.

(ICCA, 2000)

The CIA have adopted a number of Indicators of Performance to record the chemical industry's progress with improving its health, safety and environmental performance under the Responsible Care programme (*www.cia.org.co.uk*, 2002).

The environment section of these performance indicators obliges members to report on emissions of 'Red List' substances which are identified as being of concern if discharged to natural waters or sewer. These indicator emissions include, Phosphorous and Nitrogen compounds, compounds that create Chemical Oxygen Demand (COD), Heavy Metals (including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Mercury and Zinc), selected pesticides and selected volatile organic compounds.

There is also a requirement under the scheme to report on emissions to atmosphere of volatile organic compounds, specific waste generation figures and water consumption figures. This reporting exercise is conducted with a view to sharing industry knowledge through a national network of members, aiming to reduce emissions of pollutants to the environment and minimising the consumption of utilities where

possible. This reporting is conducted via Responsible Care Management System and a mandatory self-assessment process.

3.7 ENVIRONMENTAL AUDITOR REGISTRATION SCHEMES

There are currently no Irish schemes for registering accredited environmental auditors in Ireland. However, there are three schemes based in the UK, which are open to individuals conducting environmental audits in Ireland to register with. These are, what was formerly known as the Environmental Auditors Registration Association (EARA) which is currently known as the Institute of Environmental Management and Assessment (IEMA), the Association of Environmental Consultancies scheme (AEC) and the Royal Society of Chemistry's Eco-Auditor Scheme (which is only opened to Chartered Chemists) (Savage, 1995).

3.7.1 Institute of Environmental Management and Assessment (IEMA)

Registration with the IEMA can be made at one or more of the following five levels;

- Associate Environmental Auditor (trainee level);
- Environmental Auditor;
- Principal Environmental Auditor;
- EMS Auditor; and
- Lead EMS Auditor.

The application for registration involves the completion of a detailed application form which requests information on academic qualifications, membership of other professional bodies, completed training courses, relevant experience, relevant EMS auditing experience, overview of appropriate work experience, references and declaration.

All applicants to the scheme are required to pass a rigorous assessment process involving a combination of references, external verification checks, peer review and, for the higher levels, successful completion of an oral examination.

Registrants are required to demonstrate a commitment to maintaining professional competence.

3.7.2 Association of Environmental Consultancies Company Registration Scheme (AEC).

In the UK, the Environmental Auditing sub-committee of the Association of Environmental Consultancies has developed a registration based on a code of practice and external verification. The scheme is aimed at those AEC members (all of which are environmental consultancies) who provide environmental auditing services (Savage 1995).

Registration of a firm as a registered Environmental Audit Practice requires;

- ❖ Independently assessed compliance with the AEC Code of Practice;
- ❖ A declaration about its audit staff and audit work.

(Savage, 1995)

3.7.3 Royal Society of Chemistry "Eco-Audit Specialists Register"

Applicants for registration on the Royal Society of Chemistry's "Eco-Audit Specialist's Register" must be Chartered Chemists (Members of Fellows of the Royal Society of Chemistry) and have a minimum of two years experience of conducting environmental audits, either individually or as part of a team. Individuals may be required to undertake a specialist assessment in order to demonstrate an adequate knowledge and appreciation of the competence requirements identified in the Standards of Competence for the Register.

The Register identifies two groups of practitioners;

- ❖ Those who undertake the audit function (auditors) and;
- ❖ Those who could act additionally as verifiers (NAB is the final arbiter of those who can be named verifiers in Ireland).

Registrants are required to demonstrate a commitment to maintaining professional competence by participating in the Society's professional development scheme.

Overall, it is considered that with membership of registration schemes such as those outlined above, environmental auditors and their companies can demonstrate a level of competency in the market to prospective clients. The dual benefits are that via membership of accredited schemes, environmental auditors and their companies can advertise themselves as being competent practitioners in the field, while the consumer can take confidence when contracting an environmental auditor or auditing company that the auditors have obtained a level of competency in the field and are subjected to both peer review and a requirement to maintain continued professional development.

While there is currently no Irish based registration scheme, and due to the relatively small numbers of environmental auditors in the country, this situation is unlikely to change, it is considered that remote registration with an environmental auditing accreditation scheme should be seen as a benefit to the consumer and practitioner a like.

SECTION 4

CONDUCTING AN ENVIRONMENTAL AUDIT

4.1 INTRODUCTION

There are a number of key steps required in conducting an effective environmental audit or audit programme. These steps can be best discussed by referencing the stage of the audit in which they are conducted. These stages of an environmental audit can be described as follows;

- Pre-Audit Activities;
- Audit Activities; and
- Post Audit Activities.

This section details the topics to be addressed in each individual stage of an environmental audit or audit programme.

4.2 PRE-AUDIT ACTIVITIES

Pre-audit activities are considered as being the issues that need to be addressed prior to arriving on site for the purpose of conducting the audit. It is critical that at the earliest possible stage in the audit programme, the motivating factors for the auditee requesting the audit are assessed. A number of factors should be considered with the auditee prior to the commencement of the programme such that a successful audit programme can be implemented.

The Confederation of British Industry (CBI) identifies three factors in establishing an environmental audit programme;

- Commitment
- Resources
- Leadership

Overall factors contributing to the success of an environmental audit programme include;

- A solid base of support throughout management, and particularly by upper management;
- Agreement by all levels of management that the programme is a valuable function that enhances management effectiveness;
- Useful information provided to many levels of management and many levels of management sharing that information;
- Making changes only after comments from each level are considered;
- Clearly defined roles and responsibilities;
- Clear operational systems and rules in place;
- Competent and trustworthy participants; and
- Programmes that are natural outgrowths of other company systems.

(ICC, 1991)

While individually, all of the above factors are of their own importance, if one of the factors could be singled out as being 'more important' than the others, then this would be management commitment and support.

The International Chamber of Commerce (ICC) position paper on Environmental Auditing notes the following;

"It is important that management from the highest levels overtly supports a purposeful and systematic environmental auditing programme. Such commitment is demonstrated by, for example, personal interest and concern, the adoption of high standards, the

allocation of appropriate manpower and resources and the active follow-up of recommendations".

The necessary planning, negotiation and agreement on the goals to be attained from implementing the environmental audit programme need to be determined prior to an audit commencing,

In the draft international standard (ISO 19011) published by the ISO entitled *Guidelines for Quality and or Environmental Management Systems Auditing,* issues outlined that require agreement with the auditee prior to commencement of the audit programme include;

- ❖ Objectives and extent of the audit
- ❖ Responsibility, resources and procedures
- ❖ Implementation of the audit programme
- ❖ Monitoring, reviewing and improving the audit programme
- ❖ Ensuring appropriate records are being maintained

(ISO, 2001)

4.2.1 Objectives and Extent of the Audit Programme

It is a critical component of the pre-audit activities that the extent and objectives of the audit programme are agreed with the client. These items vary from the obvious issues such as what sites are to be audited, what language the audit is to be conducted in and over what time period the audit is to be conducted, to less obvious issues such as what the client hopes to attain from the audit.

The ISO 14010 standard *Guidelines for Environmental Auditing-General Principles* clearly outlines in Clause 4.1 that the audit should be based on objectives defined by the client. The scope is determined by the lead auditor in consultation with the client. The scope describes the extent and boundaries of the audit (ISO, 1996). This is echoed in the draft standard ISO 19011,

"The standard acknowledges the fact that the objective of the audit programme may not necessarily be limited to compliance with the management system standard but may also address issues such as commercial requirements, management priorities, regulatory requirements and customer requirements. Thus the objectives can be clearly delineated at a preliminary phase".

(ISO, 2001)

Objectives should be controllable, meaningful, specific, achievable and based on measurable factors (McKenna & Co., 1993). This statement is qualified in Welford and Gouldon's book, *Environmental Management and Business Strategy* where they noted that;

"Clear and explicit objectives need to be formulated before the commencement of the audit. In addition there needs to be a clearly defined benchmark in terms of environmental legislation, standards and the best practice of other companies in order that audit results can be assessed"

(Welford and Gouldon, 1993)

It is important also, that in large organisations where there may be a plethora of requirements arising from a corporate environmental policy, that these requirements are prioritised prior to commencement of the audit.

Defining the boundaries or objectives of the environmental audit should be outlined in a step by step approach.

- *Identify the Client*

  Particularly in the case of multi-site clients, it is very important that the auditor is fully aware of who the client is. Senior management may have requested the audit to be conducted, therefore, when dealing with an individual site's personnel, while it is recommended that all comments and inputs generated by on-site management should be considered as an invaluable input into

conducting an effective environmental audit, their priorities may differ from senior management.

- *Verify Compliance with Standards*

While environmental audits generally require a review of the performance of sites' activities concerning relevant legislation, it may not be limited to same. Organisations may have internal standards that exceed the requirements of legislation that the client may want evaluation against.

- *Assess Good Management Practices*

In a number of cases, the client may not be satisfied with a 'black and white' approach to compliance with pertinent legislation or corporate requirement. Typical requirements of the client may include an assessment of the management practices conducted in the company compared to what the client determines as the auditor's experience in industry best practice.

- *Make Specific Recommendations for Corrective Action*

This is another frequent request from auditees. It is a common occurrence that since the auditee may have many years of experience in his/her/their field, it should be considered that if a weakness is identified in the environmental management of the company, there may be a lack of knowledge internally as to how to resolve this. Therefore, it may be a requirement of the auditee, that an appropriate corrective action is outlined per weakness identified during the audit.

- *Assess the Ability of the Systems in place to Ensure Future Compliance*

Clients may also require that the audit report outlines the 'spare capacity' of existing environmental controls to absorb stricter requirements of legislation or best practice in the foreseeable future.

- *Assess the Risk from Unregulated Materials and Practices*

  While there is a significant number of environmental legislative tools that impart limits and controls on certain practices concerning environmental impact, it should be noted that many other practices conducted in an organisation may not be controlled by specific legislation. However they may have the potential to have an impact on the environment. The client may want these activities to be assessed for any related risk to the environment.

(Adapted from ICC, 1991)

Finally, in the case of multi-site audits, the frequency of auditing individual sites should be determined. Methods of determining auditing frequency include;

- Defined return frequency (e.g. all sites audited every two years);
- Random selection;
- Populations segregated by risk categories placed on return frequency;
- Risk-based sampling; and/or
- Core subjects reviewed annually, other subjects less often

(ICC, 1991)

Under the requirements of the Eco-management and Audit Scheme audits should be conducted no less frequently than every three years.

It should be noted that the environmental audit is an iterative procedure. That is, the quality of its findings improve with multiple, increasingly refined repetitions of its procedure and data analysis. In this key respect an environmental audit differs from a financial audit. It consists of not arriving at a single best answer, but instead of approximating over time a series of increasingly more accurate data and better environmental practices. The volume and level of detail of information provided should be sufficient for fully informed decision making, without being excessive. (Ledgerwood, Street and Therivel, 1994).

4.2.2 Responsibility, Resources and Procedures

Once an agreement has been achieved concerning the scope and objectives of the environmental audit programme, the auditor should set about agreeing responsibility, resources and procedures.

(i) Responsibilities

It is critical that responsibility is assigned for the individual facets of the audit programme. The responsible parties should be competent and have a general understanding of the audit principles. The function(s) of the person(s) assigned responsibility for the audit programme should embrace the policies of implementing an effective environmental audit programme, e.g. definitions, monitoring, reviewing and improving the audit programme as well as assigning the requisite resources (e.g. human, financial) (ISO, 2001).

Each auditor should be assigned specific environmental management system elements, functions or activities to audit and be provided a specific audit methodology to follow (SQT, 1995).

(ii) Resources

Resources are not only limited to human or financial, but include identifying appropriate audit techniques, identifying methods of continual improvement for the auditors utilised, allocating the necessary time to complete the audit programme and the necessary consumables (ISO, 2001).

This is supported by the ICC which identified that the following resources limit the scope of an environmental auditing programme;

- Staff size;
- Staff capability;
- Outside consultant capability;
- Money; and
- Time.

Essentially what is required is a budget for the audit programme. Procedures should be established to ensure that adequate resources are available to accomplish the environmental audit objective. Auditing is a labour intensive activity and therefore may be expensive to put into place.

Internal audits should ensure that the management and staff selected for inclusion in the audit team are provided with adequate time to be able to conduct the audit in conjunction with their day to day responsibilities. Furthermore, the team should have technicians, experts and functional and technology specialists for each of the audit areas (McKenna & Co. 1993).

(iii) Procedures

Once the background of the audit programme has been formulated, the responsibilities have been identified and the resources attained, the procedures for initiating the audit programme should be delineated. These should clearly identify the protocol for formulating plans and schedules, ensuring the competence of the audit team members, selecting appropriate audit teams, conducting the audit and the associated follow-ups, maintaining necessary programme records, monitoring and improving the audit programme (ISO, 2001).

4.2.3 Implementation of the Environmental Audit Programme

To ensure complete implementation of the environmental audit programme, it should be ensured that;

- The programme is effectively communication to relevant parties;
- Audits and related activities are coordinated and scheduled;
- Auditor improvement mechanisms are evaluated and implemented;
- Effective progress with the audit schedule is maintained;
- Appropriate records are maintained;
- Effective review and distribution of audit reports is effected; and
- Audit follow-ups are conducted as required. (ISO, 2001)

4.2.4 Monitoring, Reviewing and Improving the Audit Programme

As part of the effective implementation of an audit programme, the programme itself should be continually monitored as well as its implementation being reviewed at frequent intervals.

The continual monitoring aspects should include the use of 'performance indicators' such as;

- Effective implementation of the plan by the auditors
- Conformity with associated programmes and schedules
- Feedback from clients, auditees and auditors
- Time taken to implement identified corrective actions.

The programme review should also address wider scope issues such as ;

- Results and trends from monitoring
- Conformity with detailed auditing procedures
- Addressing newly identified needs as identified from comments of auditors, auditees, or new developing auditing practices
- Audit consistency.

Based on the results of the review, effective corrective and preventive action plans can be assigned with a view to improving the suitability, competence, effectiveness or otherwise of the audit programme (ISO, 2001).

4.2.5 Ensuring appropriate Records are being Maintained

The records that should be maintained to track effective implementation of the audit programme include;

- Audit records (including plans, reports and reviews)
- Non-conformity reports (including corrective and preventive action reports)
- Audit programme reviews

- ❖ Personnel reports (including individual and team evaluations, training).

(ISO, 2001)

4.3 AUDIT ACTIVITIES

Once the environmental audit programme has been agreed upon with the client the next step involves initiating the audit itself. The audit can be divided into three subsidiary sections. These are the preliminary activities, the site audit and the post-audit activities.

4.3.1 Preliminary Activities

Prior to arriving on-site, a number of activities have to be conducted. These pre-site visit activities include;

- ❖ Appoint Audit Team leader;
- ❖ Agree the Audit Plan;
- ❖ Select the Audit Team;
- ❖ Establish Effective Communication links; and
- ❖ Collate and Review Site Specific Information relevant to the Audit.

(i) Appoint an Audit Team Leader

The appointment of the audit team leader is a key issue in ensuring the effectiveness of the audit. It should be envisaged that the audit team leader has overall responsibility for liasing with the client, agreeing the audit plan, selecting and supervising the audit team, ensuring that the scope and objectives of the audit are attained and ensuring that an accurate and timely report is submitted to the client. The responsibilities of the lead auditor are clearly defined in the following list;

- ❖ Consulting with the client in determining the scope of the audit;
- ❖ Obtaining relevant background information necessary to meet the objectives of the audits, such as details of the auditee's activities, products, services, site and immediate surroundings, and details of previous audits;

- ❖ Determining whether the requirements for an environmental audit as set out in ISO 14010 (now to be superseded by ISO 19011) have been met;
- ❖ Forming the audit team, given consideration to potential conflicts of interest, and agreeing on its composition with the client;
- ❖ Directing the activities of the audit team in accordance with the guidelines of ISO 14010 and ISO14011 (now to be superseded by ISO 19011);
- ❖ Preparing the audit in consultation with the client, auditee and audit team members
- ❖ Communicating the final audit plan to the audit team, auditee and client;
- ❖ Seeking to resolve any problems that arise during the audit;
- ❖ Recognising when the audit objectives become unattainable and reporting the reasons to the client and the auditee;
- ❖ Representing the audit team in discussions with the auditee, prior to, during and after the audit;
- ❖ Notify the auditee of audit findings of critical non-conformities without delay;
- ❖ Reporting to the client on the audit, clearly and conclusively and within the time agreed in the audit plan;
- ❖ Making recommendations for improvements to the EMS, if agreed in the scope of the audit.

(Bouchier, Higgins and Walsh, 1998)

(ii) Agree the Audit Plan

Particularly in the case of an audit in which the auditee and the client are different entities, an audit plan should be agreed in advance such that the audit programme can be fulfilled as agreed with the client (*see Section 4.2-Pre-Audit Activities*).

The audit plan should outline the objective(s) and scope of the audit, the feasibility of completing an effective audit regarding issues such as availability of information, co-operation of the auditee and availability of resources. The auditee (or client) should be advised as to the outcome of this feasibility assessment and in the event of shortcomings being identified, these shortcomings should be resolved to the satisfaction of the audit team leader and the auditee (or client) (ISO, 2001).

Bouchier in his book *The Irish Guide to Environmental Management Systems (*Bouchier *et al,* 1998) states that the audit plan should detail the following;

- Audit objectives;
- Audit scope;
- Appointment of audit team;
- Appointment of lead auditor;
- Appointment of local coordinator;
- Arrangement of interview schedule;
- Review of pre-audit information by all audit team members;
- Audit protocol/checklist;
- Questionnaire;
- Audit procedure as per site requirements;
- Confidentiality agreements;
- Expected time and duration of major audit activities; and
- Report content, format and structure, expected date of issue and distribution of audit report.

Bouchier proceeds to state that the plan should be communicated to the client, to the auditors and the auditee. The client should then review and approve the plan.

The recommended content of the audit plan as per the draft international standard ISO 19011 makes the same general recommendations for the content of the audit plan.

(iii) Select the Audit Team

In selecting the audit team, the audit subject and scope should be the primary determining factors. In general, the audit scope and objectives will determine the nature and composition of the audit team (Bouchier *et al, 1998).*
The selection of the audit team should "*..include consideration of experience of previous facilities and similar processes."*
(www.europa.eu.int/comm/development/sector/environment, 2001).

While some organisations wish to employ external consultants for the reasons of accuracy and independence in the auditing process, it is essential that they ensure that the audit team are able to demonstrate the necessary range of backgrounds and disciplines to undertake an audit (Sheerin, 1997).

The draft international standard ISO 19011 recommends that when selecting the audit team, consideration should be given to the following factors;

- ❖ Audit objectives, scope and time frame;
- ❖ Required competence of the audit team;
- ❖ Accreditation/certification requirements;
- ❖ Required independence of the audit team from the audit subject matter;
- ❖ Ability of audit team to work effectively together; and
- ❖ Language, culture or other social influences.

Section 4-Environmental Audit and Auditor Standards appraises the existing and proposed standards for environmental auditors.

(iv) Establish Effective Communication Links

The audit team leader should be the official point of contact between the audit team and the auditee, and the audit team and the client, if these are separate groups. As required, lines of communication between audit team members; the board, staff and external consultants should be developed. The audit team should be ware of the objectives and time scale involved so that they can make appropriate contributions (McKenna & Co., 1993).

(v) Collate and Review Site Specific Information relevant to the Audit

There are differing schools of thought as to the benefits of reviewing site information prior to conducting the on-site audit. Generally, questionnaires are used to request site specific information concerning site history, processes and activities, environmental management system information, environmental monitoring data, etc. The consensus being, that the opportunity to review site specific information related to the audit topic will speed up the auditing process, minimise time on-site discussing 'non-issue topics' and maximising the focus of the audit team on the 'important issues' on the occurrence of the site audit.

McKenna & Co., 1993 in *Environmental Auditing-A Management Guide* suggest that the experience of some companies has shown that issuing the pre-audit questionnaire approximately three months prior to the site audit is a useful way of focusing the site auditors on the essential issues relating to the forthcoming audit. The framework of the questionnaire should be determined as part of the planning and preparation stage. Requested documentation and completed pre-audit questionnaires should be circulated to the audit team immediately prior to the site visit. This will provide background information about the site and the activities that are to be audited and allow auditors to focus on areas of particular importance, thereby making the audit more effective and efficient in terms of time.

In Bouchier *et al,* 1993 regarding the use of a questionnaire, it is stated that it sometimes is administered in advance of the on-site audit, however it is also used during the opening meeting.

Following the collation of the requested information, while referencing the agreed environmental audit programme, Bouchier recommends that an audit protocol is generated for use by the audit team to serve as an outline for the team of the audit plan.

Formal protocols vary greatly in specificity from audit programme to audit programme, ranging from general guides to the auditor to lists of specific questions to be answered. Protocols provide the structure for an orderly, efficient information gathering effort and

a basis for review by both the auditor and audit team leader confirming that each step has been satisfactorily completed (ICC, 1991).

4.3.1 The Site Audit

To conduct an effective environmental audit of a company, a number of basic steps are outlined by the ICC;

- Understand Management Systems

  To conduct an effective environmental audit, it is important to understand the existing operational controls and management systems in place in the company. Interviews, questionnaires and plant tours can be used to generate this information.

- Assess the Strengths and Weaknesses

  It is necessary to probe for strengths and weaknesses in the management systems being audited. This investigation should cover training, defined responsibilities, controls and their secondary checks, authorisation levels, protective measures, non-conformance/exception documentation.

- Gathering Audit Evidence

  Audit evidence can be gathered by enquiries (formal/informal questioning), observation and verification testing of management systems and control equipment.

- Evaluate Audit Findings

  Audit findings are assembled from the individual members of the audit team. The significance of the findings should then be interpreted using the experience and technical knowledge available to the team.

❖ Reporting Audit Findings

The ICC recommends that identified audit deficiencies should be directed to the attention of the facility personnel by the auditor(s) as they are identified. Bouchier recommends that any deficiencies identified should be reported to the company management on the occurrence of the closing meeting. While the ICC recommendation that deficiencies are pointed out on identification may contribute to better relations with the accompanying facility personnel, the author considers that the delay in presentation of this information until the closing meeting as recommended by Bouchier would be the more prudent option. This is for two reasons, i) because the auditor may have drawn a conclusion based on insufficient evidence, which should be clarified following a meeting with the other audit team members and ii) that pointing out deficiencies to facility personnel in the middle of an audit may influence the voluntary provision of information concerning other aspects of the environmental management of the plant.

Findings should be summarised in the closing meeting, where ambiguities can be clarified and all findings and discrepancies discussed with the appropriate auditee personnel.

(Adapted from ICC, 1991 and Bouchier *et al,* 1998)

The site audit is generally composed of four different activities;

(i) Opening Meeting
(ii) Information Gathering
(iii) Evaluation of Audit Evidence
(iv) Closing Meeting

(Bouchier *et al, 1998)*

(i) OPENING MEETING

The scope of the opening meeting generally includes the following;

- Introduce the members of the audit team to the auditee's management;
- Review the scope, objectives and audit plan and agree on the audit timetable;
- Provide a short summary of the methods and procedures to be used to conduct the audit;
- Establish the official communication links between the audit team and the auditee;
- Confirm that the resources and facilities needed by the audit team are available;
- Confirm the time and date for the closing meeting;
- Promote the active participation of the auditee;
- Review relevant site safety and emergency procedures for the audit team.

(Bouchier *et al,* 1998)

The opening meeting should also be used to modify the audit plan as required due to modification in the company activities and/or environmental management since the agreement of the audit programme with senior management. This is detailed in ISO 19011 where it details that it is envisaged, that on the occurrence of this meeting, the audit plan is reviewed, including a summary of how the audit will be conducted. It is important that the auditee be provided with the opportunity of asking questions as required (ISO, 2001).

The opening meeting should be used as an opportunity to waylay any apprehension that the auditee may be having and to develop a productive and 'friendly' working relationship with the auditee representatives.

(ii) INFORMATION GATHERING

The nature of the information to be gathered is dependent on the objectives of the audit, however in most cases, information gathering should be conducted via;

- Site Inspection;

- ❖ Reviewing of documentation such as environmental monitoring data, correspondence with regulatory authorities, complaints, etc. This should not be permitted to turn into a comprehensive affair unless deemed necessary due to the time requirement of same. An alternative approach would be to select a sampling method appropriate to the data under review (Bouchier *et al,* 1998); and

- ❖ Interviews should be conducted with a cross-section of the staff and management levels responsible for the subject area(s) of the audit. The purpose of these interviews is to evaluate the competence of the individuals involved, their ability to follow, and knowledge of, the existing operational controls, their knowledge of their responsibilities and to determine the strengths and weaknesses of the company in general concerning the subject matter.

If deemed necessary, due to the complexity of the audit and number of audit team members, the audit team should liaise regularly to monitor progress, exchange information and observations as well as reassigning work between auditors as required (ISO, 2001).

(iii) EVALUATION OF AUDIT EVIDENCE

Prior to conducting the closing meeting, the audit team should meet to discuss the individual findings of the audit. All auditors individually should determine the completeness of their individual audit protocols and bring to the audit team leader's attention any of the following issues;

- ❖ Omissions in the audit protocol;
- ❖ Ambiguities detected during the audit between the audit team and the accompanying facility personnel; and
- ❖ Findings requiring corrective action during the audit process.

All auditors should be prepared to present the evidence to substantiate any of the above issues. Similar discrepancies identified by individual auditors should only be presented to the auditee management in the closing meeting as individual issues.

Conformities or non-conformities should be classified, referencing the locations, activities, functions, processes or requirements being audited against (ISO, 2001).

Audit evidence should be evaluated against the agreed audit criteria and determined as being conforming or non-conforming. Audit evidence can be classified as either;

Physical Evidence- can be observed or touched, such as manhole covers for oil interceptors, though this information alone is insufficient to verify compliance.

Documentary Evidence- is traceable through a paper trail, though cannot confirm that an activity occurred, such as a maintenance record.

Circumstantial Evidence-such as a well maintained record system, is limited to indicating an impression and cannot be used as audit evidence.

Evidence from discussions and interviews is admissible evidence, when a verbal statement is given by management or supervisor responsible for an area (SQT, 1995).

The International Standard *ISO 14010-Guidelines for Environmental Auditing-General Principles* (ISO, 1996) in Clause 4.5 states that audit evidence should be of such a quality and quantity that competent environmental auditors working independently of each other will reach similar audit findings from evaluating the same audit evidence against the same audit criteria.

The determination of evidence collated as being conforming or non-conforming should only be decided upon following addressing all reference material decided upon in the audit plan and the input of all the team members (ISO, 2001). This should be conducted where possible before the closing meeting, however any situations that need

longer consideration off-site should be brought to the attention of the auditee management as an unresolved issue.

ISO 14010 goes on to state in Clause 4.6 that the audit evidence collected during an environmental audit will inevitably be only a sample of the information available, partly due to the fact that an environmental audit is conducted during a limited time period and with limited resources. It subsequently continues to draw the conclusion that there is therefore an element of uncertainty inherent in all environmental audits and that all the users of the results of environmental audits should be aware of this uncertainty.

The audit team leader should generate a summary report of the audit for presentation to the auditee management during the closing meeting.

(iv) CLOSING MEETING

The closing meeting should be attended by the same personnel that were present at the opening meeting. The purpose of the meeting is to communicate the audit findings to the auditee management. The close out meeting is the forum where any disagreement or conflict relating to audit findings are discussed in a calm and sensible manner and any exceptions should be recorded (Bouchier *et al, 1998*).

4.4 POST-AUDIT ACTIVITIES

Post audit activities include;

(i) Preparing, Approving and Distributing the Audit Report
(ii) Audit Follow-Up

(i) Preparing, Approving and Distributing the Audit Report

The key challenge of this stage is to translate and interpret findings in ways that are relevant to the decision-makers (Ledgerwood *et al,* 1994).

The ISO 19011 standard recommends that the audit report contents and preparation is the responsibility of the audit team leader. Within the standard, it is detailed that the audit report should be clear, concise, accurate and complete.

The main reasons for drafting an audit report are as follows;

- To furnish company management with information on the results of the audit;
- To act as a catalyst for the initiation of corrective action to address the discrepancies detected during the audit and for the development of action plans; and
- To document the audit scope and objectives and the auditor's conclusions regarding the company's compliance status.

(Bouchier *et al,* 1998).

ISO 14010 outlines recommendations for the content of the audit report, including but not being limited to;

- The identification of the organization audited and of the client;
- The agreed objectives and the scope of the audit;
- The agreed criteria against which the audit was conducted;
- The period covered by the audit and the date(s) the audit was conducted
- The identification of the audit team members;
- The identification of the auditee's representatives participating in the audit;
- A statement of the confidential nature of the contents;
- A summary of the audit process, including any obstacles encountered; and
- The audit conclusions.

As footnote to this content list, the lead auditor in consultation with the client should determine which of the above items, together with any additional items, should be included in the report.

A similar content list is recommended in ISO 19011 with the recommendation that the audit report should also detail any issues arising from the completion of the audit such as difficulties completing the audit, unresolved issues, areas not covered as well as

whether the audit objectives were attained or not. Following agreement on these and/or other related issues, an agreed follow-up plan should be drafted.

Bouchier states that the submission of the first draft of the audit report to the client should be submitted in the main, two weeks post the completion of the audit for review by the client, with the final report being issued within about six weeks of completion of the audit, having assimilated any relevant comments/modification from the company (Bouchier *et al,* 1998). While the author acknowledges the reasonable time frames outlined, it should be considered that the submission of the draft and final reports will primarily be a function of the time frames agreed in the audit programme.

The identification of the audiences for various versions of the audit report as well as technical appendices, is an important and sensitive issue. There are strengths and weaknesses relating to all different audiences. The use of **S***trengths,* **W***eaknesses,* **O***pportunities and* **T***hreats (SWOT)* analysis to consider and test implications of different audiences reactions can be useful (Ledgerwood *et al,* 1994).

Depending on the circulation of the audit report, an executive or non-technical summary should be included with the report. It is important to be able to communicate the results meaningfully to a non-specialist management committee (SQT, 1995).

It is stated specifically in the ISO 19011 standard that the audit report is the property of the client. Confidentiality should be respected and appropriately safeguarded by the audit team and all those on the audit report circulation list.

Finally as detailed in ISO 19011, documents related to the audit should be managed as agreed with the client. These documents should be retained locally or by the audit team or destroyed in accordance with the procedures as outlined in the audit programme or with reference to regulatory or contractual agreements.

(ii) Audit Follow-Up

The submission of the audit report should not be considered as the end of the auditing process as the audit will have identified issues that require corrective actions. This is supported by Ledgerwood *et al*, when they describe that the environmental report is a starting point, triggering a sharing of information and ideas, focussing discussion and debate into a decision making mode.

The ICC address this issue by suggesting that most companies have established formal procedures for responding to the audit report. This typically includes assigning responsibility for the corrective action, determining potential solutions and preparing recommendations to correct any deficiencies noted in the audit report. Timetables should be drafted for the implementation of these recommendations (ICC, 1991). This is supported by Bouchier *et al*, 1998, however, they also recommend that even though the company management is responsible for the audit follow-up, the audit team can and should render every assistance to the company for the successful implementation of the audit plan.

McKenna & Co., 1993 consider the effectiveness of an environmental audit to depend on;

- Its acceptability to the board, the managers and the company as a whole;
- Acknowledgement by the company and its employees that lessons have to be learned; and
- Rectification of problems highlighted.

McKenna & Co, 1993 go on to say that corporate environmental audits take time and input from many people, however if the audit is of a high quality, useful information will be obtained, giving management confidence in their merits with further resources being more likely to be committed to the audit programme. The overall benefits to the company, being ultimately in the long term, rather than in the short term.

SECTION 5

TOOLS FOR ENVIRONMENTAL AUDITING

5.1 INTRODUCTION

So far, we have identified the background to environmental auditing, the types of environmental audits that can be conducted, the existing standards for environmental auditing and the format of conducting the environmental audit. Overall in environmental auditing, there is one significant area that creates a considerable amount of confusion and conflict- that is the concept of assessing the impact of a company's environmental aspects on the receiving environmental media.

In the case of conducting a *compliance audit* confusions may not exist, as the environmental management process of the company tends to result in either compliance or non-compliance with say, an emission limit value or condition of an Integrated Pollution Control Licence. However, it should be acknowledged that in a significant number of environmental audits, the scope tends not to be limited to compliance with regulatory obligations, but includes areas such as best practice, remaining spare capacity of environmental controls and management systems, predicted impact of new activities, etc.

To eliminate these grey areas, a number of 'tools' are available for environmental auditing. The readers attention however is drawn to the following important comment; '*The choice of technique or method used in an assessment depends on the time and the resources available; what goals the assessment is required to meet (e.g. is it to brief planner or public and planners?) what criteria are to be assessed; and what personnel comprise the assessment team*', (C.J. Barrow, 1997).

The following tools will be discussed briefly, however they should not be considered as being exhaustive, with the aim being to present a snapshot of the current methodologies used in assessing environmental impact;

- ❖ Environmental Risk Assessment;
- ❖ Environmental Impact Assessment;
- ❖ Strategic Environmental Assessment;
- ❖ Green Accounting;
- ❖ Life Cycle Assessment;
- ❖ Environmental Performance Indicators; and
- ❖ Prepared Protocols.

5.2 ENVIRONMENTAL RISK ASSESSMENT

The European Commission on their web site *www.europa.eu.int* define environmental risk assessment as;

"An objective, scientific process of identifying and evaluating the adverse risk associated with a hazardous substance, activity, lifestyle or natural phenomenon that may detrimentally affect the environment, and/or human health".

They key words to consider in this definition to assist in the execution of an environmental risk assessment are 'risk' and 'hazard'.

Hazards are the potential for adverse consequences of an event, sequence of events or combination of circumstances, with a potential for damaging human health and/or the environment. Risk is the likelihood of a specific effect occurring within a specified time period or under certain circumstances, a combination of consequences and the probability of occurrence of that consequence (*www.europa.eu.int*, 2002). There are many types of risk assessment, including;

- ❖ Heath and Safety Risk Assessment;
- ❖ Contaminated Land Risk Assessment;
- ❖ Pollution Risk Assessment; and
- ❖ Natural Disaster Risk Assessment (e.g. flooding, volcanic eruptions).

As there are a number of types of risk assessments, there is also a range of techniques, varying from simple, qualitative analysis to semi-quantative and fully quantified risk assessment (*www.europa.eu.int*, 2002).

In conducting an environmental risk assessment, there are generally three steps to be completed;

- ❖ Identification of Hazards and Dangers;
- ❖ Risk Estimation and Evaluation; and
- ❖ Risk Control.

(i) Identification of Hazards and Dangers

The identification of hazards can be conducted using, for example, **Haz**ard and **O**perability study (HAZOP) or Fault Tree Analysis (FTA).

HAZOP studies were developed during in the early 1970s by Imperial Chemical Industries. The HAZOP study focuses on specific nodes of a process and examines each section for potentially hazardous process deviations. The basis for the study commences with a Piping and Instrumentation (P & ID) diagram (Lamprecht, 1997). The method for conducting the HAZOP study is via systematically looking at hazardous processes and identifying hazardous scenarios through brainstorming potential scenarios that could occur.

FTA is a deductive technique that uses Boolean *AND OR* logic to break down the causes of a specific hazardous situation known as the *top event* into basic equipment failures and human errors (Lamprecht, 1997).

(ii) Risk Estimation and Evaluation

Risk estimation involves risk characterisation, including exposure period, potency of toxic material, number of people involved and determining the probability of occurrence. Risk evaluation requires determining the significance of the risk, including its range, distribution, severity and the perception of the risk (Lamprecht, 1997).

(iii) Risk Control

When the risk has been estimated and evaluated it can then be controlled, i.e. risk management (Lamprecht, 1997).

5.3 ENVIRONMENTAL IMPACT ASSESSMENT

The development of environmental impact assessment can be traced back to the United States National Environmental Policy Act (NEPA) of 1969. In Europe, an Environmental Impact Statement (EIS) is a statutory requirement as part of the planning process for certain major activities under the *European Communities (Environmental Impact Assessment) Regulations, 1989* as amended in 1994, 1996 and 1998.

Environmental Impact Assessment (EIA) is the systematic evaluation of the potential adverse and beneficial environmental effects of a proposed development or activity. The purpose of an EIA is to ensure that development proposals and activities are environmentally sound and sustainable (*www.europa.eu.int*, 2002).

An expansive quantity of literature and methodologies have been postulated and composed since the introduction of environmental impact assessment. Therefore it is considered to be beyond the focus of this thesis to detail all methods available to the auditor. To this extent, it is proposed to outline some of the key methodologies employed and their content. The EIA methodologies to be discussed include;

- Checklists;
- Matrices; and
- Network Methodologies.

5.3.1 Checklists

Checklists for environmental auditing can vary from the basic to the highly detailed and complex. The purpose of checklists can be considered as being mainly for the orderly and comprehensive review of all pertinent data related to possible environmental impacts associated with the subject of the audit. Examples include, Simple Checklists

and the 'Oregon Method' (comprehensive questionnaire checklist developed by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) for the identification of impacts associated with small reservoir projects (Grimes, 1999).

Checklists mainly serve to;

- Order thought;
- Aid data gathering;
- Help ensure that the assessor does not overlook a possible impact; and
- Assist the assessor to screen large amounts of data so that impact assessment can be focussed.

Simple Checklists can help to describe impacts and give some measurement and prediction. More sophisticated checklists may apply scaling or weighting techniques to try to give some measurement of impact or a utility function (Barrow, 1997).

5.3.2 Matrices

Matrices are some of the older tools devised for the identification of environmental impacts, being utilised for this purpose since the introduction of the environmental impact concept in the United States since the 1970s. Examples of matrices are the *Simple Matrix* and the *Leopold Matrix.*

(i) SIMPLE MATRIX

The simple interaction matrix generally consists of a two-dimensional matrix for the identification of environmental impacts associated with the project activities. There is no reference to magnitude of impact in a two dimensional matrix in that an impact is either identified or not identified. An example of a simple matrix is illustrated below in *Table 5.1-Simple Matrix.* Matrices thus list potential impacts of a development's effects, showing simple causal relationships. Simple matrices generally do relatively little to help in interpretation, as they may give no indication of whether impacts are delayed or instantaneous, long term or short term (Barrow, 1997).

Table 5.1- Simple Matrix					
Environmental Component	Project Action				
	Construction		Operation		
	Utilities	Residential and Commercial Buildings	Residential Buildings	Commercial Buildings	Parks and Open Spaces
Soil and Geology	x	x			
Flora	x	x			x
Fauna	x	x			x
Air Quality				x	
Water Quality	x	x	x		
Population Density			x	x	
Employment		x		x	
Traffic	x	x	x	x	
Housing			x		
Community Structure		x	x		x

(Source Glasson, Therievel and Chadwick, 1994)

(ii) LEOPOLD MATRIX

The Leopold Matrix is the best known type of simple interaction matrix. Leopold *et al.* were the first to suggest the use of a matrix method for EIA (Wathern, 1988). The Leopold Matrix was developed for the US Geological Survey by Leopold, Clarke, Hanshaw and Balsley (1971). The matrix is composed of a list of one hundred project activities (columns) and a vertical list of eighty-eight environmental factors (rows),

resulting in eight thousand, eight hundred cells. The rows are grouped into physical, chemical, biological and ecological factors.

Impacts identified between the individual sections of the project being assessed and an environmental receptor result in the correlating cell being marked with a diagonal line. The top left section of the halved cell is used to represent the magnitude of the impact, the bottom right half of the cell is used to represent the impacts importance. A numeric value should be assigned to the magnitude and importance of the impact varying between one and ten (depending on an objective evaluation). Positive and negative impacts can be described by the use of positive and negative symbols before each assigned score.

Other well know types of matrices used include the Sphere Impact Matrix, Optimum-Pathway Matrix and the Saratoga Associates matrix (Barrow, 1997).

5.3.3 Network Methodologies

Network methodologies are one of the more complex methods in aspect identification in that they were designed acknowledging the fact that complex interactions exist in the environment. Network methodologies attempt to address this fact by facilitating the development of an 'interaction web' of impacts. Networks are relatively effective at revealing indirect impacts as the ramifications of a change can be followed through a chain of intermediaries (Wathern, 1987). One of the earliest types of network methodologies developed was that of the *Sorenson Network.*

Sorenson (1971) developed a system of 'linear graphs' for identifying impacts in the Californian coastal zone. Using a matrix format, the method begins by identifying potential causes of environmental change associated with the development, e.g. ranching and dairying is shown to result in the erection of fences, the introduction of grazing stock, irrigation and the use of herbicides and fertilisation. These changes result in specific environmental impacts. For example, the introduction of irrigation could result in an increased flow of fresh water, which could in turn endanger cliff structure.

Network diagrams are unlikely to give information on impact probability, relative importance or magnitude. The Sorenson network identifies impacts but does not accurately quantify them (Barrow, 1997).

In general, however, it is considered that that networks can become complex and difficult to follow, thus by maintaining a simple approach where possible, a good visual presentation can generally be created.

5.4 STRATEGIC ENVIRONMENTAL ASSESSMENT

Strategic environmental assessment is a method of identifying environmental impacts on a regional or national scale for 'high level' decisions such as policy development on a governmental level of decision making.

"Strategic Environmental Assessment (SEA) is a systematic process for evaluating the environmental impacts of proposed policies, plans and programmes. It is a strategic level assessment using high-level data. The aim of SEA is to assess the potential significant environmental impacts of implementing proposed policies, plans, programmes and groups of projects at a strategic level to encourage environmental good practice throughout the planning process. There are several forms of SEA, which must be adapted depending on the form of decision making and the national or institutional sustainability policies and strategy"

(*www.europa.eu.int*, 2002)

Strategic Environmental Assessment has historically been conducted for the following activities;

- Physical planning policy, housing policy and energy policy;
- Regional plans, city plans, community plans, redevelopment plans; and
- Coastal development programmes.

(*www.europa.eu.int*, 2002)

By utilising environmental assessment on a strategic basis, sustainable development can be actively pursued on a regional or national level by assisting in the development of environmentally conscious planning protocols for planning authorities and regional development plans. It compliments the general environmental impact assessment (EIA) approach by streamlining and strengthening EIAs through early identification of potential environmental impacts and reducing resources required to assess individual schemes.

5.5 GREEN ACCOUNTING

The USEPA in 1990 identified more than 30,000 potential clean-up sites of which more than 1,200 were placed on the National Priority List (NPL). The average cost to clean-up a site on the NPL is estimated to be $25 to $30 million (Rezaee and Elam, 2000).

In the United States, the Federal Deposit Insurance Corporation (FDIC) issued guidelines in February 1993 for an environmental risk program. These guidelines require banks to periodically investigate the hazardous waste conditions of property held as security by the lending institution. The purpose of this programme is to identify and assess potential environmental concerns pertaining to lending practices and liabilities associated with holding real property as collateral (Rezaee *et al*, 2000).

Closer to home, existing environmental legislation [e.g. Local Government (Water Pollution) Acts, 1977 and 1990, Environmental Protection Agency Act, 1992 and the Waste Management Act, 1996] has allowed the Government through the auspices of the Local Authorities and the Environmental Protection Agency to compel those entities deemed responsible for contamination of environmental media to clean up the contamination or to seek recovery for the costs of the clean up from the responsible parties.

The basic purpose of environmental management accounting is to account for the financial impacts of environmentally related activities such as environmental protection activities and investment.

The concept of linking environmental and economic or financial concerns through one reporting mechanism is not as alien a concept as one may be led to believe from media hype.

Indeed, the international standard for environmental management ISO 14001 alludes to this link. For example, one of the opening paragraphs of ISO 14001 (introduction) states that "*[I]nternational environmental standards are intended.....to assist organisations to achieve environmental and* economic *goals*". Paragraph 4.3.3 *Objectives and Targets*, states that "*[W]hen establishing and reviewing its objectives, an organisation shall consider the legal and other requirements, its significant environmental aspects, its technological options and its* financial, operational and business requirements *and the views of interested parties*". Paragraph 4.4.1 *Structure and responsibility* states that "*[R]esources include human resources and specialised skills, technology and* financial *resources*" (Lamprecht, 1997).

Lamprecht (1997) however acknowledges that paragraph A.3.3 of Annex A states "*[T]he reference to the financial requirements of the organisation is not intended to imply that organisations are obliged to use environmental cost accounting methodologies*".

As indicated by Lamprecht (1997), there appears to be a form of contradiction in the standard arising possibly from the fact that the ISO 14001 technical committee did not want to be perceived as endorsing or favouring, and thus requiring the use of environmental cost accounting for compliance with the standard.

From an accounting perspective, traditional cost accounting methods allocated 'environmental costs' as overheads. While this caters for financial cost 'balancing' exercises, it does not assign costs appropriately to individual departments, processes or other cost centres. Therefore, no account is taken of the improved financial performance of departments or activities through effective environmental controls and management. This thought frame resulted in the development of Total Cost Accounting that was designed to facilitate efficient environmental cost tracking and allocation.

In the last couple of years, many companies have recognised that the structure of accounting systems might be useful to organize environmental information systems efficiently (Schaltegger *et al,* 1996). Schaltegger refers to the fact that prior to the 1980s, environmental compliance costs and impacts were marginal in comparison with the costs of environmental monitoring and recording. However this relationship has inverted due to the wide acceptance of the 'polluter pays principle'. Therefore, Schaltegger contends that the development of environmental accounting has been due to changed relative costs rather than 'green idealism'.

There are many methods available for environmental accounting however the general approach involves placing a financial figure on the different environmental aspects of the operation being audited. One of the greatest difficulties encountered in the field of environmental accounting is that of the allocation of costs arising from environmental expenditure. For example, a rough schematic detailed in *Figure 5.1 Environmental Impact Added Units Graphical Representation* below is included. Consider product A being manufactured in Plant A. Production waste of product A is burnt in a large incinerator. The total environmental impact added of the incinerator is 66 EIA units (40 air emissions plus 26 wastewater emissions). 26 EIA units in the form of hot wastewater leave the incinerator. The installation of a new heating system for Plant B would results in an emission of 30 EIA units. Plant B discharges 20 EIA units after using the wastewater for heating.

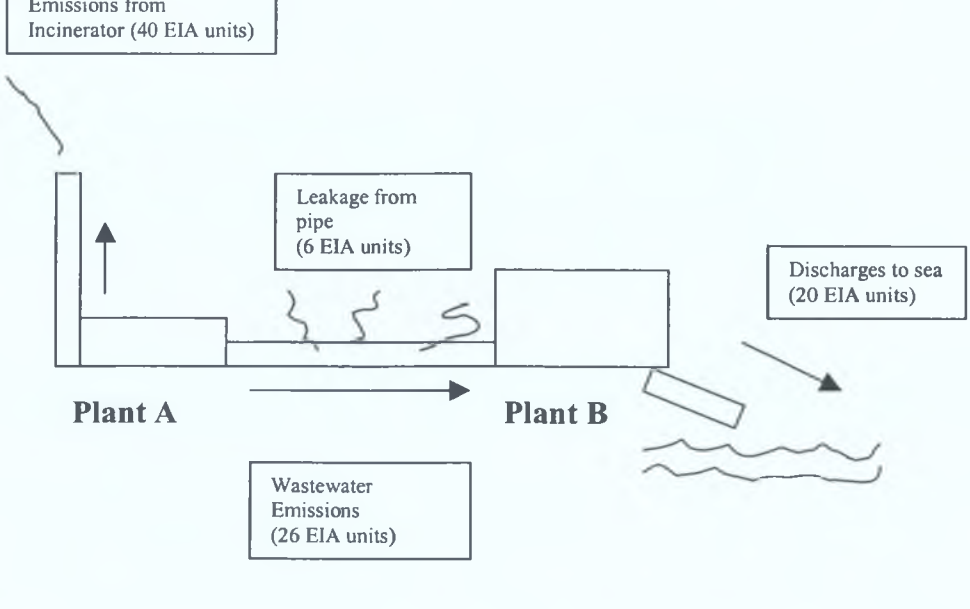


Figure 5.1 Environmental Impact Added Units Graphical Representation

To determine a method of calculating environmental costs for Plant A and Plant B a selection of allocation rules for environmental interventions have been formulated, e.g.

Full Charge

All environmental interventions are charged to the product. The EIA of product A is therefore 40 + 6 + 20 = 66 EIA units.

Passing On

As the incinerator is producing heating water for Plant B, the end-user is responsible for all emissions. The environmental impact added of product A is calculated as 0, while Plant B is charged 66 EIA units.

Partition allocation

As both parties are linked in the generation of the emissions, the pollution added should be divided between the two plants, i.e. 50% allocated to each plant or 33 EIA units.

Substitution Bonus

The environmental impact added of the incinerator is reduced by the EIA which would be caused if Plant B had its own water heating (30 EIA units) but the leakage is a result of the transport to Plant B which would be unnecessary if it had its own heating system. The pollution added of the incinerator is therefore calculated as 66 – 30 + 6 = 42, and only the actually released pollution (20 EIA units) would be charged to Plant B.

Difference Bonus

Because the decision not to install a heating system for Plant B, only reduced pollutants that would arise from that heating installation (e.g. SO_2), the incinerator may not be relieved of all its emissions but only by the difference of actually saved pollutants (e.g. SO_2 but not NO_x). The environmental impact added of the incinerator would thus be smaller than 60 (<60 = 40 + the pollution that is untypical for the heating system[<20]).

The EIA of Plant B would be smaller than 26, that is 6 from the pipe plus less than 20 from the heating systems typical pollution (<26 = 6 + <20).

Cascade Use Bonus

The wastewater of the incinerator which is forwarded to Plant B is treated as a raw material. No wastewater emissions of the incinerator are charged to the product. The incinerator and therefore the product, is assigned responsibility for all air emissions from the incinerator (40). Production Plant B is charged its own wastewater emissions plus the emissions from the wastewater pipeline (26 = 20 + 6 units).

(adapted from Schaltegger *et al, 1996*)

From the above, the versatility of environmental accounting should be acknowledged, allowing for cost allocation to be superimposed on environmental management of a company's processes and activities. The advantage of this is that non-technical personnel can relate to the 'real-time' environmental issues arising from the day to day operation of the plant.
In any event, the number of companies introducing environmental monetary accounting is expected to increase with increased environmental compliance costs and, in the United States, new regulations requiring the proper allocation of environmental compliance costs (Baumann and Cowell, 1999).

5.6 LIFE CYCLE ANALYSIS

Life-cycle analysis (LCA) is a tool for assisting the examination of the environmental impacts of a process, product or activity. The Society of Environmental Toxicology and Chemistry (SETAC) defines LCA at the;

'process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials used and wastes released to the environment; to assess the impact of those energy and material uses and releases to the environment; and to identify and evaluate opportunities to effect environmental improvements. The assessment includes the entire life-cycle of the product, process, or

activity, encompassing extracting and processing raw materials; manufacturing; transportation and distribution; use, re-use, maintenance; recycling; and final disposal".

The basic principles were first used in the USA in 1963 by Harold Smith, however in 1969 the process gained higher profile exposure when utilised by researchers for Coca-Cola Company. During the early 1960s, the process of quantifying the resource use and environmental resources during the manufacturing of products came to be known in the United States as Resource and Environmental Profile Analysis (REPA) or 'cradle to grave' analysis and in Europe as Ecobalance (Lamprecht, 1997).

Interest in REPAs in the United States waned after 1975, however in Europe the process gained momentum resulting in the development of a series of ISO standards in 1997. These standards included;

- ISO 14040: Environmental Management – Life Cycle Assessment – Principles and Guidelines;
- ISO 14041: Environmental Management – Life Cycle Assessment – Goal and Definitions/Scope and Inventory Analysis;
- ISO 14042: Environmental Management – Life Cycle Assessment – Life Cycle Impact Assessment; and
- ISO 14043: Environmental Management – Life Cycle Assessment – Interpretation.

ISO 14040 defines LCA as a technique for assessing the environmental aspects and potential impacts associated with a product by:

- Compiling an inventory of relevant inputs and outputs of a product system;
- Evaluating the potential environmental impacts associated with those inputs and outputs; and

- Interpreting the results of the inventory analysis and impact assessment phases in relation to the objectives of the study (NSAI, 1997).

A number of EMS practitioners have found it very useful to undertake LCA where the impacts associated with the product are not exclusively related to the manufacturing process. In particular, those impacts connected with the supply and use of raw materials and with end-use and disposal of the final product (Bouchier *et al, 1998*). Due to the holistic nature of the assessment from cradle-to-grave, LCA cannot be restrained to just one site or indeed to one company. It requires significant co-operation down the supply chain to produce a product LCA (Hutchinson, 1997).

5.6.1 Components of a Life-Cycle Assessment

The product life-cycle system is depicted diagrammatically below in *Figure 5.2 Product Life Cycle System.*

A properly conducted LCA should consist of four components;

(i) Goal and definition scoping;

(ii) Inventory Analysis;

(iii) Impact Assessment; and

(iv) Interpretation

(i) Goal and Definition Scoping

Goal and definition scoping involves defining the scope and purpose of the study as well as the functional unit. The scope defines the system's boundaries, geographical scope, data requirements, assumptions and limitations. The functional unit is the measure of performance of the various input and output data attained during the study (e.g. kgs emissions per unit product delivered to the consumer, etc.).

(ii) Inventory Analysis

This is considered the most intensive part of the study in that it involves the collation of the qualitative and quantative data for the inputs and outputs as agreed during the determination of the project goals and boundaries. A model of a typical LCA database can be reviewed in the publication Centre for Corporate Environmental Management (CCEM), 1998.

(iii) Impact Assessment

This stage of the LCA involves the assessment of the environmental impacts of the burdens identified in the inventory analysis. ISO 14040 recommends that the method employed for this impact assessment is transparent to ensure that all assumptions are clearly labelled and reported.

(iv) Interpretation

At this stage the results of the inventory compilation and impact assessment are combined and evaluated to produce conclusions and recommendations for decisions-makers. The role of interpretation will depend on the purpose of the study, methods and nature of the inputs and outputs (*www.europa.eu.int*, 2002).

Interpretation of the data incorporates the following four activities;

- Classification;
- Characterisation;

- ❖ Valuation; and
- ❖ Improvement Assessment.

CLASSIFICATION involves delineating and grouping the data determined from the impact assessment into a number of impact categories (e.g. NO_x has both acidifying and eutrophication effects).

CHARACTERISATION is the activity by which an *impact profile* such as Global Warming Potential and Ozone Depletion Potential is determined.

VALUATION is whereby various impact categories are weighted and compared utilising agreed criteria.

IMPROVEMENT ASSESSMENT involves the identification and evaluation options for reducing the environmental impact of the system under study.

(Adapted EEA, 1997 and Lamprecht, 1997)

5.6.2 Life Cycle Assessment Methodologies

There are a selection of LCA methodologies available, involving all or some of the steps outlined in *Section 5.6.1*. Some methods are based on detailed research while others only involve a cursory overlook of the subject topic.

There are four main categories of LCA;

(i) Life Cycle Review

A life cycle review comprises of a simple flow chart or process diagram which includes the main components of a product's life cycle. It is essentially qualitative and subjective due to its reliance on professional judgement. A review is also a useful place to start undertaking any level of LCA and provides sufficient information for issues that may be addressed at a strategic level.

(ii) Comprehensive LCA

A comprehensive LCA requires precise quantitative data and calculations concerning all environmental effects. A comprehensive LCA is generally conducted where the environmental considerations of a product are far-reaching or topical, however, there is considerable cost associated with the completion of same.

(iii) Streamlined LCA

This is a simplified form of the complete LCA methodology, qualitatively assessing all interactions with the environment and quantitatively assessing a smaller number of more relevant aspects. Streamlined LCA is conducted where there is reason to believe that it will not be possible to secure enough data on all environmental issues or that the particular study does not require a great deal of study. Streamlined LCA provides a reasonably reliable picture of a product's environmental impact quickly and relatively cheaply.

(iv) Bottleneck LCA

Attention is confined to the environmental area that is felt to offer the greatest scope for improvement. In certain situations, one particular aspect of a product's environmental impact can be so important that a quantitative analysis of that particular aspect is sufficient. Other aspects still need to be quantitatively assessed to preserve the life cycle principle. This is the basis for the approach.

(Adapted from Grimes, 1999 and *www.europa.eu.int*, 2002)

In practice, these methodologies are generally employed in accordance with the stage of the LCA. Some 'high risk' portions of an overall LCA may be subjected to a complete LCA while others may require more qualitative investigation.

5.7 ENVIRONMENTAL PERFORMANCE INDICATORS

Environmental Performance Indicators are becoming increasingly important at company level. This is in part due to the stakeholders demanding environmental improvements and proof that these have been made.

Bartolomeo (1995) defines environmental performance indicators as the quantitative and qualitative information that allow the evaluation, from an environmental point of view, of company effectiveness and efficiency in the consumption of resources.

A report from the World Resources Institute (Ditz and Ranganathan, 1997) *Measuring Up-toward a common framework for tracking corporate environmental performance,* stresses that for EPIs to be effective, a common set of metrics must emerge that are universally adopted and understood by all (EEA Technical Report No. 54, 2001).

ISO 14031:Standard for developing environmental performance indicators

ISO uses the term environmental performance evaluation (EPE) as an all encompassing term for the development of performance indicators. ISO/DIS 14031 defines EPE as;

'a process to facilitate management decisions regarding an organisation's environmental performance by selecting indicators, collecting and analysing data, assessing the information against environment performance criteria, reporting and communicating, and periodic review and improvement of this'

ISO 14031 standard states that;

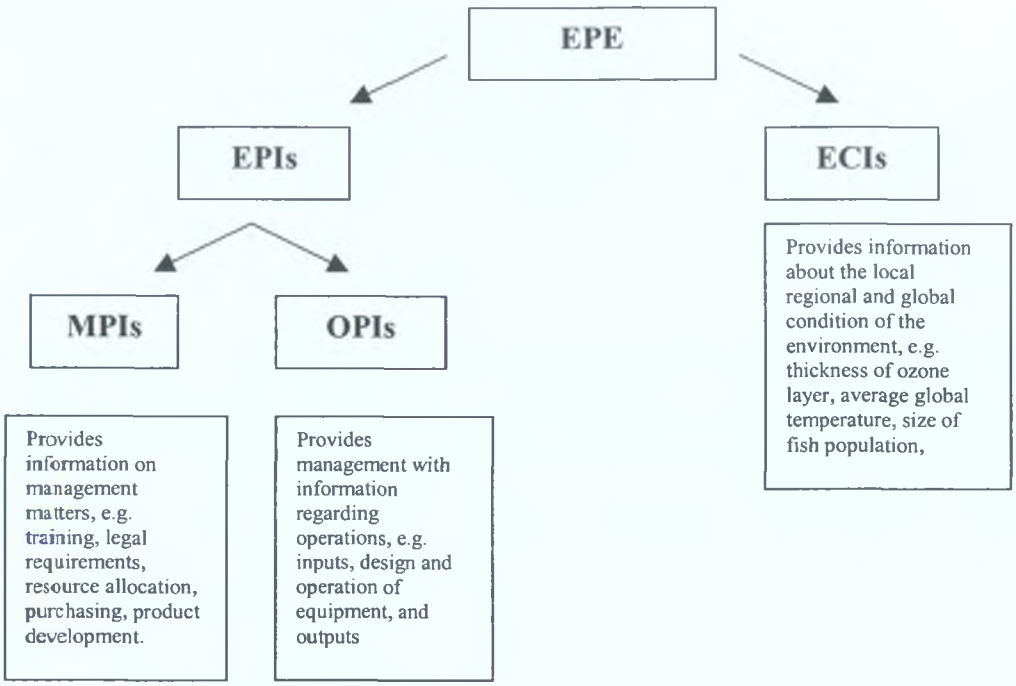
'Indicators of EPE are selected by organisations as a means of presenting quantative or qualitative data or information in a more understandable and useful form. They help to convert relevant data into concise information about management's efforts to influence the organisation's environmental performance, the environmental performance of the organisation's operations, or the condition of the environment. An organisation should select a sufficient number of relevant and understandable indicators to assess its environmental performance'.

ISO 14031 identifies five kinds of quantative measures;

- direct
- relative
- normalised/index
- aggregated
- weighted

The basic thrust of the guidance is that the more indicator categories covered, the better the measurement system, resulting in a list of greater than 100 indicators. However, ISO/DIS divides these indicators into two distinct categories;

- environmental performance indicators (EPIs), further divided into management performance indicators (MPIs) and operational performance indicators (OPIs); and
- environmental condition indicators (ECIs).



Key **EPE:** environmental performance evaluation

EPI: environmental performance indicators

ECI: environmental conditions indicators

MPI: management performance indicators

OPI: operational performance indicators.

(**Figure 5.3-The ISO/DIS 14031 environmental performance evaluation** – EEA Technical Report No. 54, 2001)

Due to the wide variety of indicators that can be used, it is difficult to compare and allow harmonisation and credibility. Most corporate environment reports now include some quantative data but very few reports contain indicators that allow for easy comparison. This is one of the most important areas for improvement if environmental reporting is to promote cleaner production and 'eco-efficiency'.

The UK Chemical Industries Association (CIA) have adopted a number of Indicators of Performance to record the chemical industry's progress with improving its health, safety and environmental performance under the Responsible Care programme (www.cia.org.co.uk, 2002).

In 1996, forestry companies in Sweden agreed on a format to present their environmental performance data for comparative purposes.

Anglian Water won a commendation on winning the UK ACCA award in their 1998 activity report for efforts to benchmark across the industry.

The World Business Council for Sustainable Development (WBCSD) launched an eco-efficiency metrics project in June 2000. Eco-efficiency is promoted by the council as a major driver in enabling corporate progress towards sustainability.

Eco-efficiency can be reached;

*'By the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impact and resource intensity throughout the life-cycle, to a cycle at least in line with the Earths' carrying capacity' (*WBCSD, 2000*)*

In this eco-efficiency project, a number of principles are recommended for the development of performance indicators.

Table 5.2 Core Eco-Efficiency Indicators proposed by the WBCSD

Product/service value category
• Unit/number/mass of product or service made or sold
• Net sales
• Value added
• Gross margin
• Profit/earnings/income
• Product/service creation environmental burden category
• Energy (gigajoules) consumed
• Materials (tonnes) consumed
• Water (m^3) consumed
• Green house gas (GHG) emissions (tonnes of CO_2 equivalents)
• Acidification emissions (tonnes of proton equivalents)
• Nutrification emissions (tonnes N & P substances) in water effluents
• COD/BOD in water effluents
• Volatile organic compound (VOC) emissions
• Persistent organic pollutant (POP) emissions
• Priority heavy metals emissions
• Land use

These indicators are classified as follows;

- product/service value (*refer Table 5.2 above*);
- product/service creation; and
- product/service use.

These indicators provide succinct guidelines for the business community, although the metrics are limited to environmental issues rather than sustainability issues. The WBCSD has now begun to address corporate social responsibility (WBCSD, 1999).

Dow Chemical has developed an Eco-compass to provide a simple summary of life cycle data analysis. This is based mainly on the WBCSD's eco-efficiency indicators, with some minor amendments. The eco-compass has six poles;

- energy intensity;
- mass intensity;
- environmental and health risk potential;
- sustainability of resource usage;
- extent of revalorisation (reuse, remanufacturing and recycling); and
- service intensity.

On a basic level, this will help highlight areas of concern and is a useful communication tool for interested stakeholders. It can be used for product assessment, but this requires extensive life cycle data. (EEA, 2001).

Sony Europe's Resource Productivity Index is another example of eco-efficient models at work in industry.

The American Institute of Chemical Engineers Centre for Waste Reduction Technologies are developing a project to design sustainability metrics. The project aims to develop a group of core and optional metrics for each of the seven areas of eco-efficiency that are put forward by the World Business Council on Sustainable Development. The project group consists of chemical companies, Department of Energy/Office of Information Technologies, USEPA, and the World Resources

Institute. The working group has agreed on the impact categories for which metrics should be sought or constructed (mass, energy, pollutants/toxics dispersion and resource depletion) (EEA, 2001).

The World Resources Institute and the WBCSD are currently working in collaboration with many other businesses and organisations to design and promote the use of an internationally accepted protocol for measuring and reporting greenhouse gas emissions. The aim is to produce a standardised protocol that could be used by businesses and others, across national borders and industries to improve credibility, comparability and utility of information (www.ghgprotocol.org).

The UK Department of Transport and the Regions has produced '*Guidelines on comparing and reporting on greenhouse gas emissions*'.
(*www.environment.detr.gov.uk/envrp/gas/index.htm*)

A wide number of environmental performance indicators are in use with a range of guidelines developing. A consensus needs to be reached addressing qualitative, quantative and monetary standardisation. These need to address both environmental performance and environmental impact. They need to focus on process, product and system. The draft standard on environmental performance evaluation, ISO 14031 and the WBCSD eco-efficiency metrics are in the right direction (EEA, 2001).

The Association of Chartered Certified Accountants organised a study to be conducted to determine the existing status, current practices and their relationship with the ISO 14031 model in 1998. The target companies were the top 100 UK companies. Interviews with 54 environmental managers yielded results indicating that only a minority of respondents used any type of environmental condition indicator (ECI), the most frequent being Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) indicators for the impacts of effluent discharges to waters. Three kinds of operational performance indicators (OPIs) (solid wastes, resources and effluents to waters) were used to some degree by more than 80% of the respondents. Almost all respondents were using resource consumption indicators such as energy, material and water. In general however it was concluded from the study that use of management performance indicators (MPIs) were less well developed than the use of OPIs and that

only a minority of the respondents felt that they had comprehensive indicators in place (from Bennett and James, 1998).

In the field of environmental auditing, the use of environmental performance indicators allows for possible benchmarking of auditing subject matter. It is conceivable that in the future, a series of internationally or industry agreed performance indicators could be used to form the template of an environmental audit.

Bennett and James (1998) concur stating "*standardisation of measurement is difficult or impossible for individual companies to achieve. Actions by groups of companies, and, still more, sectoral associations will be vital. The industry sector is the best unit for comparative analysis and industry sector associations therefore have a dual role in adopting broad standards or criteria for environment related performance measurement to individual sectors and also ensuring consistency within them*".

5.8 PREPARED AUDIT PROTOCOLS

5.8.1 Overview

The use of a prepared audit protocol is another tool that can be used by the environmental auditor. In general, prepared audit protocols are drafted for in-house usage, providing specific indicator topics for the audit to address. While specific protocols are generally generated for medium term site specific usage, audit protocol templates have been developed by environmental consultancies for conducting generic type environmental audits. The Environmental Protection Agency (Ireland) have developed generic audit protocols for conducting compliance or issue audits, however these protocols are not for public consultation and are generally significantly modified by the auditor for his/her own purposes whilst embracing the spirit of the original protocol (Stafford *pers comm*, 2002).

One organisation however, which embraces the usage of comprehensive environmental audit protocols is the United States Environmental Protection Agency.

The following information was sourced and is referenced from the '***Protocol for Conducting Environmental Compliance Audits under the Comprehensive Environmental Response, Compensation and Liability Act'*** (EPA-305-B-98-009, EPA Office of Compliance, December 1998***).***

The USEPA are responsible for ensuring that businesses and organisations comply with federal laws that protect public health and the environment. In its Strategic Plan, the Agency recognises the need to assist the regulated community by providing compliance assistance and guidance that will promote improved compliance and overall environmental performance. As part of that effort, the USEPA is encouraging the development of self-assessment programmes at individual facilities.

Over the years, the USEPA have encouraged regulated entities to initiate environmental audit programmes that support and document compliance with environmental regulations. The USEPA has developed audit protocols to provide regulated entities with specific guidance in periodically evaluating their compliance with federal environmental requirements.

In 1986, in an effort to encourage the use of environmental auditing, the USEPA published its "*Environmental Auditing Policy Statement (ref. 51 FR 25004)*". The 1986 audit policy states that "*it is EPA policy to encourage the use of environmental auditing by regulated industries to help achieve and maintain compliance with environmental laws and regulations as well as to help identify and correct unregulated environmental hazards.*" In addition, the USEPA defined environmental auditing as a "*systematic, documented, periodic and objective review of facility operations and practices related to meeting environmental requirements.*" The policy also identified several objectives for environmental audits;

- Verifying compliance with environmental requirements;
- Evaluating the effectiveness of in place environmental management systems; and
- Assessing risks from regulated and unregulated materials and practices.

In 1995, the USEPA published "*Incentives for Self-Policing; Discovery, Disclosure, Correction and Prevention of Violations*" which both reaffirmed and expanded its 1986 audit policy. The 1995 audit policy offers major incentives for entities to discover, disclose and correct environmental violations. Under the 1995 policy, the USEPA will not seek gravity-based penalties or recommend criminal charges be brought for violations that are discovered through an environmental audit (as defined in 1986 policy) or management system reflecting "due diligence" and that are promptly disclosed and corrected, provided that other important safeguards are met. These safeguards protect health and the environment by precluding policy relief for violations that cause serious environmental harm or may have presented an imminent and substantial endangerment.

There are a series of protocols that are area or statutory specific. Each protocol provides guidance on key requirements, defines regulatory terms, and gives an overview of the federal laws affecting a particular environmental management area. It also includes a checklist containing detailed procedures for conducting a review of facility conditions. For the protocols to be used effectively, familiarity is required with basic environmental auditing practices and the relevant regulations under Title 40 of the *Code of Federal Regulations (CFR)*. The audit protocols are not intended to be exclusive or limiting with respect to procedures that may be followed. The USEPA recognises that other audit approaches and techniques may be effective in identifying and evaluating a facility's environmental status and in formulating recommendations to correct observed deficiencies.

The environmental audit is deemed to function best when the organisation identifies the 'root causes' of each finding. Root causes were defined are *"those breakdowns in management oversight, information exchange, and evaluation that allow environmental problems to recur"*. Thus, while an organisation may have developed an excellent record of dealing with symptoms, such as spill response, the underlying problem or 'root cause' has not been addressed. This can mean identifying not only the failures that require correction but also the successes. In each case, a root cause analysis should reveal both the positive and negative aspects of environmental management on-site such that an organization can continue with its continual improvement goal.

The audit protocols express the opinions that the auditor or audit team need to possess sound working knowledge of the operations and processes to be reviewed, the relevant regulations that apply to a given facility, and acceptable auditing practices. The aim of the protocol therefore is as a support mechanism to assist in conducting a comprehensive environmental audit. Specific issues arising from the application of the protocol should then be investigated more thoroughly.

Each protocol contains the following information;

- List of acronyms and abbreviations used in the document;
- Applicability-provides guidance on the major activities and operations included in the protocol and a brief description of how the protocol is applied;
- Review of federal legislation-identifies key issues associated with the subject protocol area;
- State and local regulations-identifies typical issues normally addressed in state and local regulations but does not present individual state/local requirements;
- Key compliance requirements-summarises the overall thrust of the regulations for that particular protocol;
- Key compliance definitions-defines important terms;
- Typical records to review-highlights documents, permits and other pertinent paperwork that should be reviewed by an auditor and reconciled against regulatory requirements;
- Typical physical features to inspect-highlights pollution control equipment, manufacturing and process equipment and other areas that should be visited and evaluated during an audit;
- Index for checklist users-outlines different areas of the checklist that may pertain to the facility being audited;
- Checklist-matches the regulatory requirements with the tasks that should be accomplished by the auditor;
- Appendices-supporting information for the checklist (e.g. regulatory deadlines, lists of contaminants, wastes, and, required testing procedures). Note: information contained in the appendices is dated and should be verified with a current version of the applicable federal regulations;

The checklist delineates what should be evaluated during an audit. For each issue, the checklists states either a requirement mandated by a regulation or a good management practice that exceeds the requirements of the federal regulations, as deemed appropriate. Good management practices are distinguished from regulatory requirements by the acronym (MP) and are printed in italics. The regulatory citation is given in the parentheses after the requirement. The checklists also give instructions to help conduct the evaluation. These instructions are performance objectives that should be accomplished by the auditor.

The USEPA is currently in the process of developing a series of audit protocol application guides to serve as companion documents to the protocols.

5.8.2 Examples of Audit Protocols

(i) Protocol for Conducting Environmental Compliance Audits under the Comprehensive Environmental Response, Compensation and Liability Act (EPA-305-B-98-009, EPA Office of Compliance, December 1998).

(ii) Protocol for Conducting Environmental Compliance Audits of Hazardous Waste Generators under the Resource, Conservation and Recovery Act (EPA-305-B-98-005, EPA Office of Compliance, December 1998).

(iii) *Protocol for Conducting Environmental Compliance Audits of Treatment, Storage and Disposal Facilities under the Resource Conservation and Recovery Act. (EPA-305-B-98-006, EPA Office of Compliance, December 1998).*

The protocol is generally divided into ten sections, e.g.

- Applicability;
- Federal Legislation;
- State and Local Regulations;
- Key Compliance Requirements;
- Key terms and definitions;
- Typical Records to Review;

- ❖ Typical Physical Features to Inspect;
- ❖ Index for Checklist Users;
- ❖ Checklist; and
- ❖ Appendices.

For explanatory purposes, the application of these key sections in;

Protocol for Conducting Environmental Compliance Audits under the Comprehensive Environmental Response, Compensation and Liability Act (EPA-305-B-98-009, EPA Office of Compliance, December 1998), hereafter referred to as CERCLA compliance protocol.

and additional sections pertinent to the audit protocol will be interpreted below in Section 5.8.3.

5.8.3 CERCLA Compliance Protocol

(i) Applicability

This section of the protocol defines the nature of the activity to which the protocol applies, e.g. facilities where hazardous substances were released or pose a threat of release. It may also detail the limitations of the protocol with regard to activities for which separate reporting may be required under different Acts of legislation. Generally this section advises that there may be several regulatory requirements administered under federal, state and local government auspices which, although not referred to in the protocol, the auditors are advised to review same locally in order to perform a comprehensive audit.

Under the CERCLA compliance protocol, the focus is facilities where hazardous substances were released or pose a substantial threat of release. However it is noted that the protocol does not address compliance with the *Emergency Planning and Community Right-to-Know Act (EPCRA).*

(ii) Federal Legislation

The pertinent federal legislation to the nature and content of the audit is listed in this section, e.g. *Comprehensive Environmental Response and Liability Act (CERCLA) of 1980.* The relevance of the listed legislation is generally cited here, however as mentioned previously, care should be taken to ensure that all relevant federal legislation related to the audit scope is identified and reviewed to ensure comprehensiveness of the audit engaged.

(iii) State and Local Regulations

This section also advises as to the importance of identifying indigenous state and local government legislation, compliance with which may be essential in conducting a thorough audit.

(iv) Key Compliance Requirements

As part of ensuring a standardised audit mechanism and reporting of same, the protocol in this section details the key requirements for maintaining compliance with the pertinent legislation related to the activity.

In the case of the CERCLA compliance protocol these include;

Hazardous Substance Release Report (under CERCLA Section 103)

Under CERCLA Section 103, facilities are required to notify the National Response Center (NRC) as soon as possible after the event, if they release hazardous substances in excess of or equal to reportable quantities. Facilities with continuous and stable releases have limited notification requirements.

National Contingency Plan (under CERCLA Section 104)

In the event of a "*release or substantial threat of a release of any pollutant or contaminant to the environment or which may present an imminent or substantial danger to the public health or welfare"* the President may respond as per the National

Contingency Plan (NCP). The NCP details the standard methods for clean-up and releases and hazardous waste sites, site evaluation, remedial investigations/feasibility studies, remedy selection and design, removal activities, community involvement and administrative records.

(v) Site Evaluation

Following a release or threat of same involving a hazardous substance, the first step is the completion of a site evaluation to determine the magnitude of the release and its potential impacts on the environment and public health. This site evaluation incorporates the following three components;

- ❖ Preliminary Assessment, to review existing site information and off-site reconnaissance as deemed necessary to determine if further investigations or response actions are necessary;
- ❖ Site Inspection, which is conducted on-site to determine whether a release has occurred, to identify the public health and environmental impacts of same, including sampling as deemed necessary; and
- ❖ Review to ascertain whether the site should be included on the National Priorities List (NPL).

If remediation is required, then the 'lead agency' is obligated to conduct a remedial investigation/feasibility study (or equivalent) unless the release *'may present an imminent and substantial danger to public health, welfare or the environment'*. If the release can be classified as the latter, the lead agency is obligated to mitigate the threat via removal action or to oversee implementation of the removal action by the potentially responsible party (PRP).

(vi) Remedial Investigation/Feasibility Study (RI/FS)

A Remedial Investigation/Feasibility Study is conducted to assess site conditions and evaluate remedial alternatives such that an appropriate site remedy can be selected. An RI/FS consists of the following four steps;

- ❖ Project scoping to ensure that the detail of the analysis is appropriate to the nature and extent of the site problems being addressed;
- ❖ Remedial investigation, involving the collection of necessary field data to characterise the site in order to provide the necessary information to aid the selection and evaluation of the remedial alternatives;
- ❖ Risk assessment, delineating potential environmental and human health risk associated with the release without site remediation; and
- ❖ Feasibility study of potential remedial options to address site risks.

(vii) Remedial Selection and Design

The lead agency must, in conjunction with the lead regulatory agency, select a preferred remediation option which can be presented to the public and the site for comment. Commentary from the public must be reviewed and responded to prior to the publication of the Record of Decision (ROD) by the lead agency.

(viii) Removal Actions

If it is determined that a removal option must be progressed, the following steps are required to be undertaken as soon as possible;

- ❖ Undertake a removal preliminary assessment including all readily available information (e.g. site management practices, information from waste generator, document review and facility interviews).
- ❖ Engage in a removal site inspection, as required, to gather all information not obtained during preliminary assessment; and
- ❖ Complete the removal action performed in response to a specific release.

(ix) Community Involvement (under CERCLA Section 117)

Under this section of CERCLA, the lead agency is obligated to promote and involve community interest throughout the waste site evaluation process. The principle behind this involvement is that the local community should be educated about, and involved in any decision that is made concerning the release site.

(x) Administrative Record

A record of all pertinent information concerning any documentation previously mentioned should be maintained in an easily accessible manner at a central location adjacent to the release site.

(xi) Key Terms and Definitions

This section of the protocol defines specific definitions for technical terms, job descriptions, key phrases related to the focus of the protocol, etc., e.g. CERCLA Information System, Release, Site Inspection, etc.

Release as defined by Section 10(22) of CERCLA means *"any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant), etc."*.

(xii) Typical Records to Review

Guidance is provided as to what records should be reviewed to ensure compliance under the scope of the protocol.

In the case of the CERCLA compliance protocol, these include;

- Spill/release records
- Hazardous substance inventory records
- National Response Center Notification Document
- Preliminary Assessment (CERCLA)
- Remedial Investigation documentation
- Soil sample and groundwater monitoring data related to areas targeted for removal and clean-up
- Engineering and cost evaluations
- Sampling and analysis plans.

(xiii) Typical Physical Features to Inspect

As part of the audit protocol, there tends to be a number of recommended physical aspects of the audit to be surveyed.

In the case of CERCLA compliance audits, these include;

- ❖ Cleanup sites
- ❖ Disposal sites
- ❖ Groundwater monitoring wells
- ❖ Contaminated areas
- ❖ Treatment technologies employed for site cleanup.

(xiv) Checklist

The remainder of the protocol comprises of a range of explicit questions and prompt notes, to assess, in an in-depth fashion, the compliance of the auditee/audit subject with the guiding legislation.

The format of the checklist consists of two columns, one detailing the regulatory requirement or management practice, the second detailing the specific reviewer checking requirements to ensure compliance with same. These questions tend to be very specific with little room for evasive answers, e.g. in the CERCLA compliance audit protocol in the section of the Checklist entitled Release Discovery and Notification

"Confirm that the facility has procedures in place to identify areas where hazardous substances are or may have been stored, treated, or released at the facility.

Confirm that the facility maintains an inventory of potential inactive waste sites and determine whether the inventory contains the following information for each site:

-the site location,

-the site history (i.e. the types of waste or hazardous substance that may have been released),

-facility responses to environmental problems"

The remainder of the protocol tends to comprise of supporting reference materials in the form of appendices. In the case of the CERCLA compliance audit e.g. Appendix A-Consolidated List of Hazardous Substances and Reportable Quantities under the CERCLA and EPCRA details intimately the classification of a wide range of chemicals with respect to pertinent legislation in the event of an accidental release.

SECTION 6

ENVIRONMENTAL AUDITING SURVEY

6.1 INTRODUCTION

To determine the extent and nature by which environmental auditing is implemented in 'the field' by Irish companies it was decided that the most appropriate mechanism by which to obtain this information would be by circulating a questionnaire to a targeted group of companies.

The objectives of conducting the survey were;

- To determine the presence or absence of a dedicated environmental department in each of the targeted companies;
- To establish the number of companies within the target group which were maintaining a certified environmental management system;
- To ascertain to what extent environmental auditing, both general and management system focussed, is conducted by internal dedicated personnel or contracted external specialists, and to determine what 'environmental auditing tools', if any, are employed;
- To determine the criteria by which the suitability and competence of environmental auditors is assessed;
- To gather information on environmental issues generally addressed by the targeted companies when conducting an 'environmental audit'; and
- To establish the general educational and personal characteristics existing and required for 'competent auditors'.

Once the objectives of the survey had been determined it was necessary to identify the target group. In formulating a target group, a number of issues needed to be considered. These issues can be delineated as follows;

- Likelihood of response;
- Quality of information returned in that some companies may not by either size, operation or nature, have a requirement for environmental auditing;
- Comparability of results obtained as various industries have varying impacts on the environment and thus varying focus on environmental issues.

To this extent the target group selected was chemical industries operating under an Integrated Pollution Control Licence by the Environmental Protection Agency. This target group was selected for the following reasons;

- This group is well defined under the Environmental Protection Agency Act, 1992;
- Company names and addresses were easily obtained from the Environmental Protection Agency website (www.epa.ie);
- This group has been exposed to at a minimum the requirement to determine and quantify its environmental impacts as part of the Integrated Pollution Control (IPC) Licensing application process;
- This group will, at a minimum, have been subjected to an environmental audit by the Environmental Protection Agency;
- Responses to public enquiries on environmental issues were expected to be more forthcoming than non-IPC licensed companies due to the requirements under the terms of the IPC licence regime to respond to same; and

- The generally proactive nature of the chemical industry to environmental issues, for example, the voluntary Responsible Care© programme.

6.2 CONTACT APPROACH

All companies licensed with an Integrated Pollution Control Licence in accordance with the provisions of the *Environmental Protection Agency Act (Licensing) Regulations, 1994* and designated as a company within Class 5 of the First Schedule of the Environmental Protection Agency Act, 1992 are considered to belong to the Irish chemical industry. The names and addresses of these companies are available for reference on the Environmental Protection Agency's web-site (*www.epa.ie*).

A total of 94 companies' names and addresses were obtained and a letter explaining the reason for the survey and requesting completion of the questionnaire was forwarded marked for the attention of the *IPC Coordinator* in mid-March 2002. A list of the companies and their Integrated Pollution Control Licence register numbers is included in *Appendix 1-Survey Catchment-* A copy of the letter circulated with the questionnaire is included in *Appendix 2-Copy of Cover Letter.*

Follow up telephone calls were made to 50% (47 no.) of the targeted companies to ensure high return rates and to determine any confusion, difficulty or reluctance in completing any aspect of the questionnaire circulated.

6.3 QUESTIONNAIRE CONTENT

The questionnaire circulated consisted of 56 questions divided into 6 sections. The design of the questionnaire was formulated such that all questions were concise and unambiguous. 'Yes' and 'No' style answers were used in numerous sections to ensure clarity of answers. Other mechanisms employed were the used of 'tick boxes' and numeric rating systems. By minimising the amount of text required to be compiled by the reader, it was anticipated that a greater return rate would be achieved. It was also anticipated that the use of this format would assist in the collation of a clearly comparable results matrix. It is worth noting that respondees were also presented with the option to use text as well as appendicing extra information, if required, and actively

encouraged to do so in selected sections of the questionnaire to maximise the quality and quantity of information returned.

The six sections of the questionnaire and their general content are detailed hereunder. A copy of the questionnaire is included as *Appendix 3-Environmental Auditing Questionnaire.*

6.3.1 Section A- General Information

This section of the questionnaire requested the furnishing of details about the company, including the name, address, number of employees, etc. Scope was provided in this section for the option of anonymity in completing the questionnaire.

6.3.2 Section B- Regulatory and Voluntary Controls

The purpose of this section was to determine to which category of the greater chemical industry each respondent company belonged. This section also requested details concerning the general environmental management system voluntarily implemented on-site.

6.3.3 Section C- Conducting Initial Environmental Review

Respondents to the questionnaire were directed to this section on the basis that their environmental management system had been certified to an internationally recognised environmental standard. The section was designed to gather details concerning the number of companies which conducted the baseline environmental review required to become certified to an international environmental management standard either in-house or using external consultancy companies in the completion of this review. The method by which companies selected consultancy companies to provide assistance on this project was also questioned. This section also requested information concerning the scope of the initial environmental review conducted on-site.

6.3.4 Section D- Integrated Pollution Control Licence Application

As it was anticipated that not all companies targeted as recipients to the questionnaire would have a certified environmental management system in place, questions concerning the completion of the Integrated Pollution Control Licence (IPC) application were posed. As in Section C, the questions probed areas such as the in-house capability to complete the IPC application form as well as the extent to which external consultancy services were employed and the method by which they were selected.

6.3.5 Section E- Auditing of Environmental Management and Control Systems

This section was designed to determine the method by which environmental auditing is conducted in individual companies. Details such as development of the audit programme, techniques employed, members of the audit team and frequency of auditing were requested.

6.3.6 Section F- Competence of Auditors

Section F required that the respondent to detail the educational standards amongst auditors utilised, the pertinent qualifications and skills deemed appropriate to audit the company, as well as professional training or qualifications of the audit team. The questionnaire was then completed with questions concerning the perceived competence of the environmental audit team and how frequently this competence was reviewed.

6.4 PRESENTATION OF RESULTS

6.4.1 Introduction

This section describes the results obtained from the questionnaires returned. Results are presented in a combination of graphs, tables and text to minimise the influence of the author's opinion on the reader.

In a number of responses to some questions, there was some confusion encountered. Where answers were deemed to be confused or irrelevant, they were omitted from the interpretation to maintain the quality of results obtained.

6.4.2 Response Rate

In total 94 companies were forwarded questionnaires. Follow-up telephone calls were made to 50% (47 no.) of the targeted companies to ensure high return rates and to determine any confusion, difficulty or reluctance in completing any aspect of the questionnaire circulated. In the case of 2 no. companies, the questionnaires were returned as the businesses had ceased operations. In one case, a recipient of the questionnaire contacted the author to advise that the company would not complete the questionnaire due to company policy. Of the remaining 91 questionnaires, 66 were completed and returned. This figure reflects a satisfactory 73% response rate.

6.4.3 Section A- General Company Details

In 50 of the 66 completed questionnaires (75.8%) the company identified itself and provided contact details. In good faith, the author advised all companies that none would be identified in the interpretation of the results obtained.

In 25.9% of cases, the companies contacted were indigenous with the remaining 74.1% being non-indigenous.

The number of employees in any company can be taken as a general indicator of the size of a company. 25.8% of the companies surveyed had less than 50 persons employed and can therefore be considered as being small enterprises. 48.4% of the companies had employee numbers varying between 50 and 250 (medium size enterprises) with 25.8 % of the companies being large-scale enterprises (>250 employees) (CCEM, 1998).

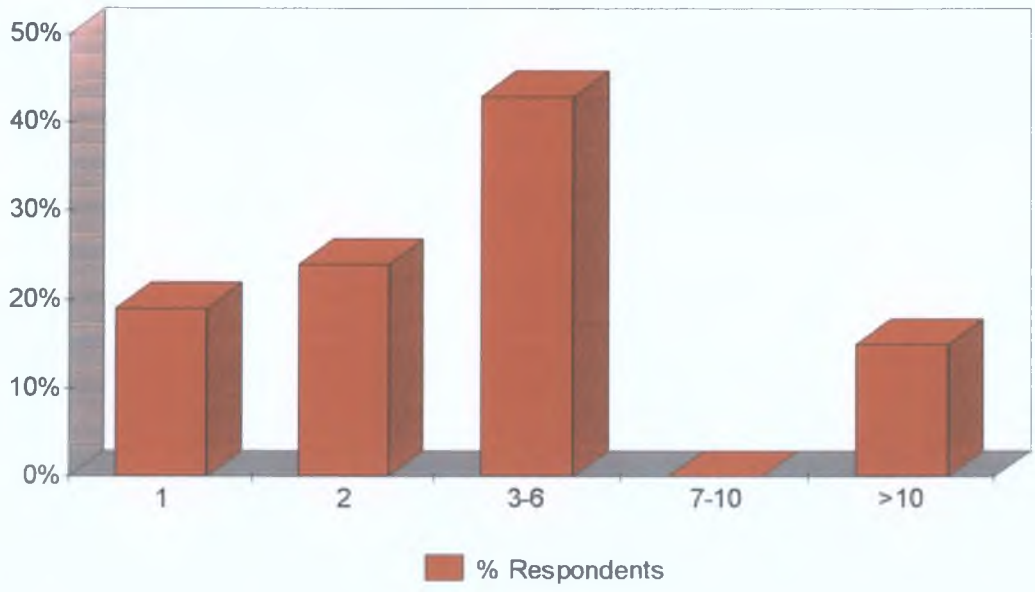
31% of the companies indicated the existence of an environmental department within their company management structure, with only 5% of these being amalgamated as part

of a multi-functional department (e.g. Quality and Environmental, Safety, Health and Environmental).

The number of personnel employed within these departments is displayed below in *Figure 6.1-Number of Personnel in Environmental Department.*

Figure 6.1

No. Personnel in Environmental Dept.



6.4.4 Section B- Regulatory and Voluntary Controls

The function of this section of the questionnaire was to determine which subsection of Class 5 of the First Schedule of the Environmental Protection Agency Act, 1992 each company belonged to. Under *Condition 2-Management of the Activity* of an Integrated Pollution Control Licence, companies are obliged to implement an environmental management system. Companies were queried upon whether the environmental management system in place at their facility was certified to an internationally accepted environmental management standard (i.e. EMAS, ISO 14001). This section then asked the respondents whether there were other quality and/or health and safety management systems in operation on-site.

The target group of the questionnaire were all companies licensed under Class 5 of the First Schedule of the Environmental Protection Agency Act, 1992. The table overleaf, *Table 6.1-Sub-class of Activity under which the Company is licensed by the*

Environmental Protection Agency provides a breakdown of the sub-classes to which each company indicated they were licensed under.

The largest proportion of companies were licensed under was *Sub-class 5.6-The manufacture of pesticides, pharmaceutical or veterinary products and their intermediates* with 39.4% of all respondents. The next most significant sub-classes were *Sub-class 5.2-The manufacture of olefins and their derivatives of monomers and polymers, including styrene and vinyl chloride* and *Sub-class 5.7-The manufacture of paints, varnishes, resins, inks, dyes, pigments or elastomers where the production capacity exceeds 1,000 litres per week* with 12.1 and 9.1% of the respondents licensed as being under these classifications respectively.

Interestingly, 24.2% of the respondents did not answer this question. The lack of response to this question would suggest to the author that either the respondents to the questionnaire were unaware of which class of activity under which their company was licensed (considered a highly unlikely scenario) or disappointingly, that the readers were not motivated enough to check the number or wording of sub-class under which they were licensed.

Table 6.1-Sub-class of Activity under which the Company is licensed by the Environmental Protection Agency.		
Sub-class Reference Number	Number of Companies	Percentage
5.1-The manufacture of chemicals in an integrated chemical installation.	*2*	*3.0*
5.2-The manufacture of olefins and their derivatives of monomers and polymers, including styrene and vinyl chloride	*8*	*12.1*
5.3-The manufacture by way of chemical reaction processes, or organic or organo-metallic chemical products other than those specified at 5.2	*0*	*0.0*
5.4-The manufacture of inorganic chemicals	*2*	*3.0*
5.5-The manufacture of artificial fertilisers	*2*	*3.0*
5.6-The manufacture of pesticides, pharmaceutical or veterinary products and their intermediates	*26*	*39.4*
5.7-The manufacture of paints, varnishes, resins, inks, dyes, pigments or elastomers where the production capacity exceeds 1,000 litres per week.	*6*	*9.1*
5.8-The formulation of pesticides	*2*	*3.0*
5.9-The chemical manufacture of glues, bonding agents and adhesives	*2*	*3.0*
5.10-The manufacture of vitamins involving the use of heavy metals	*0*	*0.0*
5.11-The storage in quantities exceeding the values shown ,of any one or more of the following chemicals (other than as part of any other activity)- *Methyl acrylate (20 tonnes); acrylonitrile (20 tonnes); toluene di-isocyanate (20 tonnes); anhydrous ammonia (100 tonnes); anhydrous hydrogen fluoride (1 tonne).*	*0*	*0.0*
Don't know/Didn't complete	*16*	*24.2*

Companies were queried whether the environmental management system in place at their facility, as required under Condition 2 of an IPC licence, was certified to an internationally accepted environmental management standard (i.e. EMAS, ISO 14001). 63.3% of the respondents responded that their environmental management system was certified to an internationally recognised standard. Of these respondents, 89.5% of the environmental management systems were certified to the ISO 14001 standard with 10.5% certified to the Eco-management and Audit Scheme (EMAS).

73.7% of the companies stated that they had a certified quality management system (e.g. ISO 9002) in place, while 16.7% of the respondents indicated that they had an certified health and safety management system in place (e.g. International Safety Rating System, OSHAS 18001).

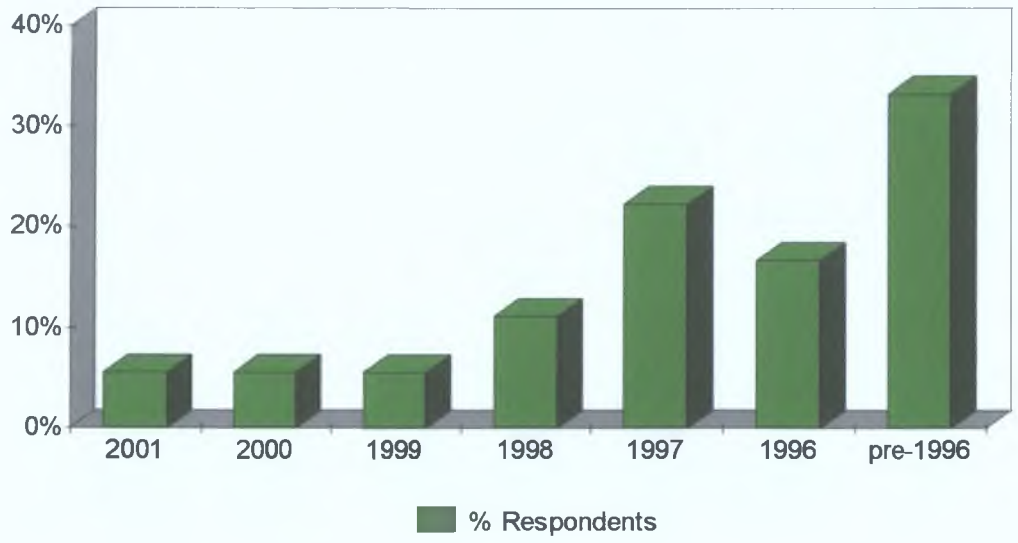
6.4.5 Section C- Conducting Initial Environmental Review

All the respondents that operated an certified environmental management system were requested to answer questions concerning the completion of their 'Initial Environmental Review' as required under the certification process. Companies operating a non-certified environmental management system were diverted from this series of questions.

Firstly respondents were asked to furnish details regarding which year their initial environmental review was conducted. Details of the responses are outlined below in *Figure 6.2-Completion Year of Initial Review.*

Figure 6.2

Completion Year of Initial Review



The general trend in completion of the initial environmental reviews, which can be deemed to be loosely indicative of preparation for certification of a company's environmental management system, has been declining since 1997 and indeed seems to have stabilised over the past three years for chemical industries licensed under the IPC regime. This apparent decline may be as a result of the initial flurry of certifications to

the, at that time, recently published ISO 14000 series of environmental management standards (1996) and EMAS standard (1993) or quite possibly may just be due to IPC licensing timeframe (*see Figure 6.6-Year in which First IPC licence Granted*) or the establishment date of the company.

Responding to the question, whether the review was conducted by in-house personnel primarily, a considerable 70% of respondents agreed with this statement, with 58.8% of this figure acknowledging the use of external consultancy services in some part of the review process. Therefore, in conducting the initial environmental review, the use of external consultancy services to some degree was required by 71.6% of respondents.

Figure 6.3

Consultancy Services used in Review

Of notable interest is the scope to which external consultancies were used in the preparation of the initial environmental review. The areas in which external consultancies were employed for assistance with the completion of the initial environmental review are displayed below in *Table 6.2.* In environmental monitoring, only 5.5% of the respondents used external consultants. This is a surprisingly low figure considering some of the complex monitoring that may have had to be conducted on-site, for example, stack emissions to atmosphere or noise monitoring.

Table 6.2-Areas of Initial Environmental Review for which External Consultants were contracted for Assistance.		
Subject Matter	Number of Companies	Percentage
Consultancy only	*12*	*33.3*
Verification	*8*	*22.2*
Site auditing	*8*	*22.2*
Environmental Monitoring	*2*	*5.5*
Combination of Above	*6*	*16.7*

22.2% of the respondents contracted external consultancy assistance for the completion of a site environmental audit, which is also considered a low number. Attention is drawn to the fact that 16.7% of respondents used external consultancy services for a selection of issues and this may be why individual aspects scored poorly.

The next element of this section concerned how individual companies selected an 'appropriate' consultancy for the specialist assistance required. The results are displayed in *Table 6.3-Techniques for Sourcing Environmental Consultancy Services.*

Table 6.3-Techniques for Sourcing Environmental Consultancy Services		
Technique	Number of Companies	Percentage
Previous experience of consultancy on non-environmental project	*2*	*8.0*
Previous experience of consultancy on environmental project	*12*	*48.0*
Environmental Magazines/Advertising	*4*	*16.0*
Trade Exhibitions	*1*	*4.0*
Word of Mouth	*6*	*24.0*

Approximately half (48%) of the respondents were exposed to their consultancy of choice as a result of previous work completed on an environmental project for the company. 24% of companies who selected their environmental consultancy based their selection on word-of-mouth recommendation.

To probe the selection criteria by which consultancy services were contracted, the respondents were asked to rate in order of importance, using the number 1 to 7 (1 being most important, 7 being the least important), the importance they placed on the following criteria;

- Profile of the consultancy;
- Independent recommendation of the consultancy;
- Appropriate experience of the consultancy;
- Cost
- Previous work history (environmental) with the consultancy;
- Previous work history (non-environmental) with the consultancy;
- Other.

Figure 6.4

Selection Criteria for Consultancy-I

In creating the above *Figure 6.4-Selection Criteria for Consultancy*, all criteria which were assigned the rating 1,2 or 3 were regarded as the most important selection criteria per respondent. As can be seen, the two most significant criteria for selecting a consultancy in assisting with the preparation of the environmental review were *Cost* and *Experience of the Consultancy* being considered (25% each). The next most significant selection criterion at 19.4% was that of a *Recommendation* for a consultancy

followed by previous experience of the consultancy on environmental projects completed historically for the respondents. Lesser rated selection criteria include Profile of the consultancy being considered (8.3%) followed by experience of the consultancy on non-environmental projects for the company (relevant in the case of say large consultancy firms which offer say, engineering and environmental consultancy services) at 5.5%. No other selection criteria were volunteered by the respondents as being a major influence on choosing one consultancy service from the next.

In completing the Initial Environmental Review, respondents were provided with a list of environmental aspects and asked to identify which of the aspects were addressed in completing the Environmental Review. The results are presented below in *Table 6.4- Environmental Aspects addressed in Environmental Review.*

Table 6.4- Environmental Aspects addressed in Environmental Review

Aspect	Addressed by Percentage Respondents
Energy Consumption	*100*
Storage of Hazardous Materials	*100*
Waste Handling on-site	*100*
Emissions to Atmosphere	*94.4*
Noise/Vibration	*88.9*
Waste Disposal	*88.9*
Water Consumption	*88.9*
Trade Effluent/Wastewater Discharges	*83.3*
Risk of Contaminated Firewater Generation	*83.3*
Raw Material Consumption	*77.8*
Visual Impact	*66.7*
Historical Site Contamination	*61.1*
Odour Generation	*61.1*
Dust / particulates emissions	*55.6*
Occupational Exposure	*50.0*
Traffic/Transportation/Product Distribution	*33.3*
Social Impact	*27.8*
Radiation Sources	*16.7*
Impact on Material Assets	*11.1*

As can be seen from the above table, Energy Consumption, Storage of Hazardous Materials and Waste Handling on-site were the only aspects of the above list which

were addressed by all the respondents. One of the issues that should be noted from the above is that although 100% of respondents addressed the issue of Waste Handling on-site, only 88.9% of respondents addressed the final disposal of their waste (i.e. where its ultimate destination was).

Also of note is that the visual impact of a company's presence on the environment was addressed by more companies (66.7%) than a more 'traditional' issue of historical site contamination (61.1%). Of interest also was the significant number of companies (83.3%) which addressed the area of fire-water risk assessment as part of their environmental review.

Of note also, the social impact, the impact on material assets and the issue of radiation sources were addressed by a significant number of respondents (27.8%, 11.1% and 16.7% respectively).

Of particular interest was the next question in the questionnaire;

"In the case of the aspects identified above, how many of these were actually quantified as opposed to being subjectively reviewed?

The results of the responses to this question are presented below in *Table 6.5- Environmental Aspects Quantified in Environmental Review.*

Table 6.5- Environmental Aspects Quantified in Environmental Review	
Aspect	Addressed by Percentage Respondents
Energy Consumption	*88.9*
Waste Disposal	*83.3*
Trade Effluent/Wastewater Discharges	*72.2*
Emissions to Atmosphere	*72.2*
Water Consumption	*72.2*
Storage of Hazardous Materials	*72.2*
Noise/Vibration	*66.7*
Raw Material Consumption	*66.7*
Waste Handling on-site	*61.1*
Dust/particulates emissions	*50.0*
Occupational Exposure	*38.9*
Risk of Contaminated Firewater Generation	*33.3*
Historical Site Contamination	*27.8*
Visual Impact	*27.8*
Radiation Sources	*22.2*[Note 1]
Odour	*16.7*
Traffic/Transport/Distribution	*16.7*
Impact on Material Assets	*11.1*
Social Impact	*11.1*

Note 1 *The number of respondents which replied that they quantified radiation sources on-site was greater than the number of respondents that addressed them. It is assumed that this was an error by some of the respondents.*

Overall, on average, the number of respondents that quantified an aspect as opposed to subjectively reviewing it, was 31.9% lower. The aspects which were 'addressed' but not quantified by a significant number of respondents are presented below in *Table 6.6- Percentage of Aspects addressed which were Not Quantified*;

Table 6.6- Percentage of Aspects addressed which were Not Quantified	
Aspect	Percentage Not Quantified
Odour	*72.7*
Risk of Contaminated Firewater Generation	*60.1*
Social Impact	*60.1*
Visual Impact	*58.4*
Historical Site Contamination	*54.6*
Traffic/Transport/Distribution	*49.9*
Waste Handling on-site	*38.9*
Storage of Hazardous Materials	*27.8*
Noise/Vibration	*25.0*
Emissions to Atmosphere	*23.5*
Occupational Exposure	*22.2*
Water Consumption	*18.8*
Raw Material Consumption	*14.3*
Waste Disposal	*16.7*
Energy Consmption	*11.1*
Dust/particulates Emissions	*10.1*
Trade Effluent/Wastewater Discharges	*10.1*
Impact on Material Assets	*0.0*

Reviewing the information in Table 6.6 it is clear that only in the case of Material Assets did all respondents who addressed this aspects quantify it as well. In the case of Odour, 72.7% of respondents who stated that they addressed this aspect in their environmental review did not quantify it, a very significant number. In each of the following aspects, at least 50% of respondents who stated that they addressed them in their environmental review, did not quantify them;

- Odour, Contaminated Firewater Generation, Social Impact, Visual Impact, Historical Site Contamination.

The next question in this section of the questionnaire asked the respondent whether any modifications were requested to their initial environmental review when undergoing the certification process. The results of the responses is presented below in *Figure 6.5- Changes requested to Initial Review.*

Figure 6.5

Changes Requested to Intial Review

As can be seen from the above, in almost one of five initial environmental reviews, modifications were requested by the certification company. Issues that were raised for modification included the absence of significant aspects and the validation of the weighting mechanism employed for determining the significance of identified aspects.

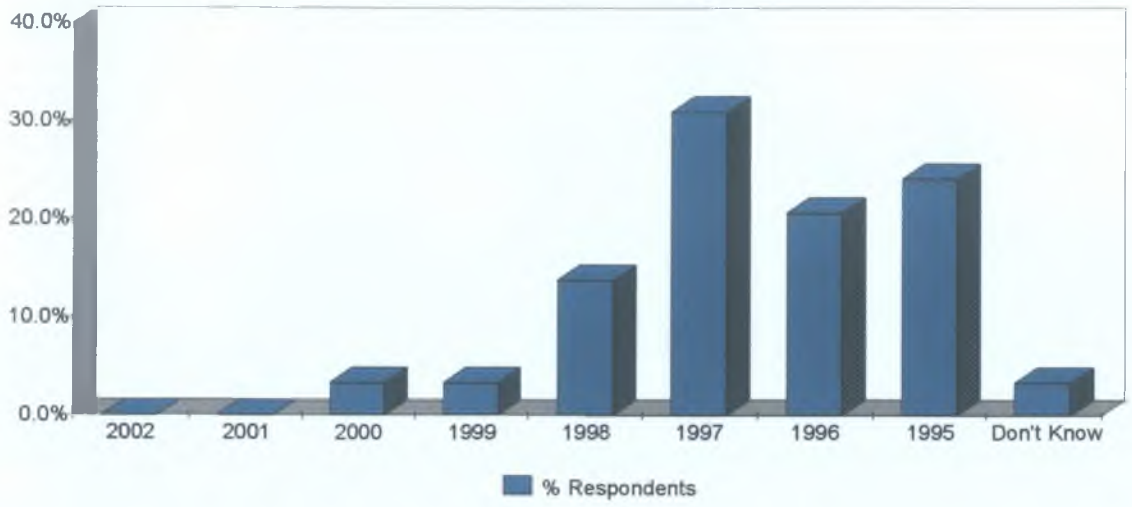
6.4.6 Section D- Integrated Pollution Control Licence Application

While Section C of the questionnaire focussed on the companies in the chemical industry which operated a certified environmental management system, Section D focussed on an area common to all the respondents-the completion of the Integrated Pollution Control (IPC) Licence application form.

The first question in this section asked the respondents in which year were they granted their IPC licence. The answers forwarded by the respondents are presented below in *Figure 6.6- Year in which IPC licence were Granted.*

Figure 6.6

Year in which First IPC Licence Granted

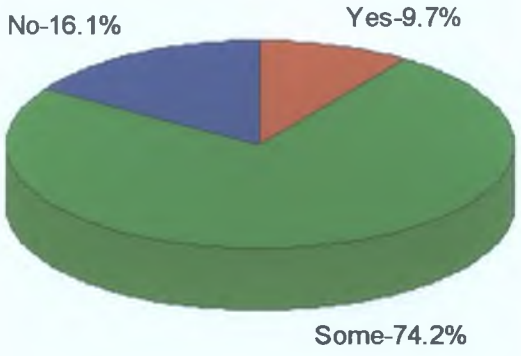


Referring to the above graph, the years 1995 to 1998 were those in which most of the respondents were awarded their first or existing IPC licence (89.6%).

In completing the IPC licence application, respondents were asked to what degree they employed external consultancy services for assistance. A very significant proportion of respondents (74.2%) used theses services to some degree, as is reflected in *Figure 6.7- Use of Consultancy Services.*

Figure 6.7

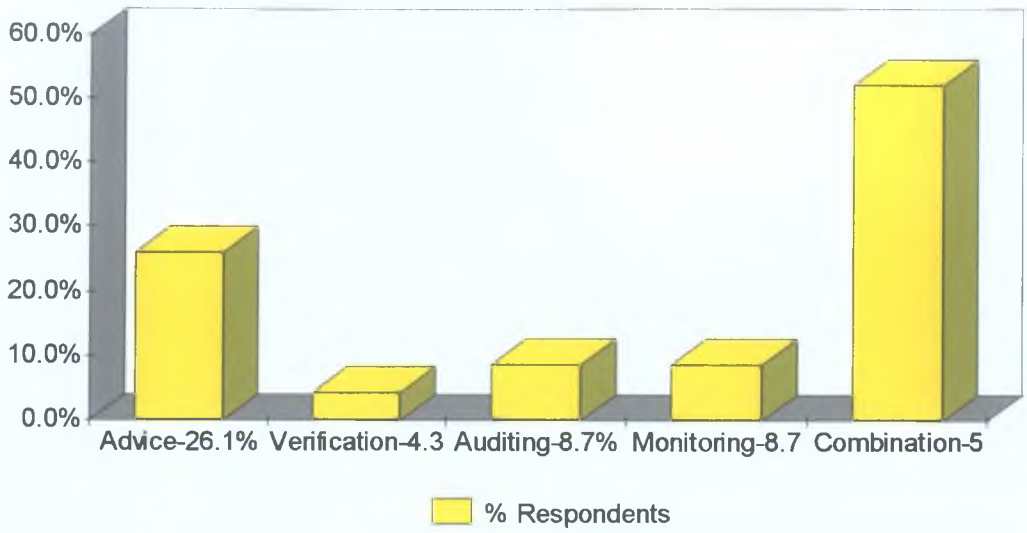
Use of Consultancy Services



To determine the nature of the consultancy services employed, respondents were asked whether consultancy was sought to advise on completion of the IPC application, verification of the completed IPC application, conducting an environmental audit of the site, environmental monitoring or a combination of these tasks.

Figure 6.8

Areas of Consultancy



In over 50% of the cases, a combination of services (52.2%) were contracted, with the next most significant statistic being that consultants were employed for some form of advice concerning the application only (26.1%).

To determine how individual companies selected an 'appropriate' consultancy for the specialist assistance required in completing the IPC application, readers were asked to select from a number of techniques. The results are displayed below in *Table 6.7-Techniques for Sourcing Environmental Consultancy Services.*

Table 6.7-Techniques for Sourcing Environmental Consultancy Services

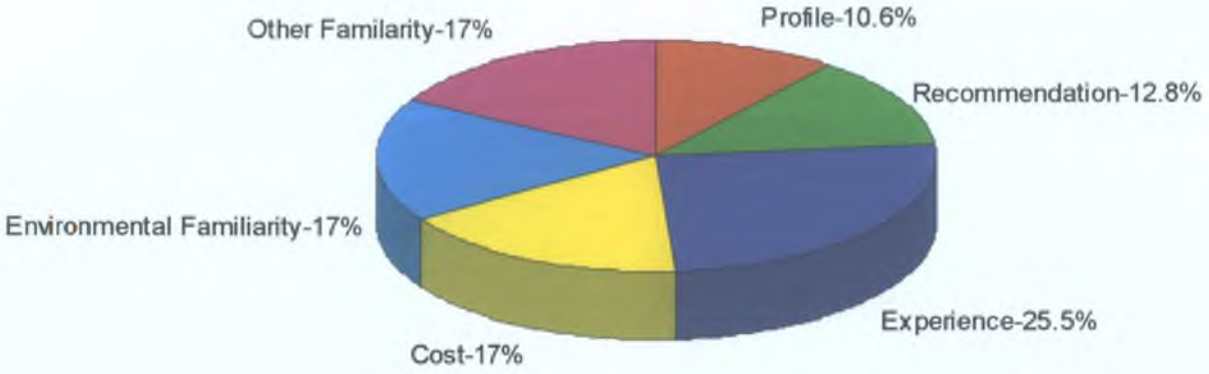
Technique	Number of Companies	Percentage
Previous experience of consultancy on an environmental project	*42*	*63.6*
Previous experience of consultancy on a non-environmental project	*9*	*13.6*
Environmental Magazines/Advertising	*3*	*4.6*
Trade Exhibitions	*3*	*4.6*
Word of Mouth	*9*	*13.6*

The most significant sourcing technique was previous experience of the consultancy on a previous environmental project on-site (63.6%). Other significant techniques

included, previous experience of the consultancy on a non-environmental project (13.6%) and word of mouth (13.6%).

Respondents were again, similar to the question in Section C-Conducting Initial Environmental Review, asked by what criteria they selected an appropriate consultancy to provide assistance with the completion of the IPC application.

Figure 6.9
Selection Criteria for Consultancy-II



6.4.7 Section E- Auditing of Environmental Management and Control Systems

This section of the questionnaire probed respondents concerning environmental auditing programmes in their company, their nature, who conducts them and their content.

Firstly respondents were asked if the company had a formalised environmental auditing programme in place on their site. 76.7% of respondents indicated that they had.

This section proceeded to ask the respondent if the auditing programme addressed a series of selected topics as detailed below in *Table 6.8-Scope of Environmental Auditing Schedule.*

Table 6.8- Scope of Environmental Auditing Schedule	
Topic	Percentage Respondents
Environmental Policy	*95.7*
Environmental Aspects	*91.3*
Environmental Legislation	*82.6*
Environmental Management Programme	*100.0*
Managerial/Supervisory Control Procedures (e.g. IPC compliance, environmental complaints, etc.)	*91.3*
Primary Control Procedures (e.g. Waste handling, chemical handling, emergency response)	*100*

Very high results were obtained in response to this question with all respondents reviewing their Environmental Management Programme and Primary Control procedures in their auditing programme. However the topic least addressed was environmental legislation with only 82.6% of the respondents addressing it in their auditing schedule.

To determine who in fact conducts the environmental auditing on-site, respondents were asked if the auditors were;

- External Consultants;
- Internal Environmental Department;
- Cross section of staff from within Company;
- Other.

Figure 6.10-Conductees of Auditing Programme shows that the most significant auditing groups are a cross-section of personnel from within a particular company (41.9%) and the internal Environmental Department (25.8%) with a significant

percentage of respondents being audited by both corporate representatives (12.9%) and external consultants (19.4%).

Figure 6.10

Conductees of Auditing Programme

Considering that 41.9% of respondents detailed that a cross-section of personnel were responsible for conducting the environmental auditing programme the next question presented interesting findings. Respondents were asked whether it was the policy of the companies auditing programme for functional staff within a particular area to be responsible for auditing that area. Statistical analysis yielded results indicating that in 17.4% of the responses, individuals were responsible for auditing the areas for which they were responsible.

When asked what format the audit takes, the results are presented below in *Table 6.9- Format of Environmental Audit*

Table 6.9- Format of Environmental Audit

Audit Format	Percentage Respondents
Review of associated documentation by auditor/audit team.	*100.0*
Completion of Questionnaire designed to test subject matter	*19.2*
Interview of personnel with responsibility for subject matter	*84.6*
Other	*15.4*

All the respondents stated that their audit involved a review of documentation associated with the audit subject matter, with a high percentage also (84.6%) for the use of some form of personnel interviewing techniques. The use of a questionnaire was not

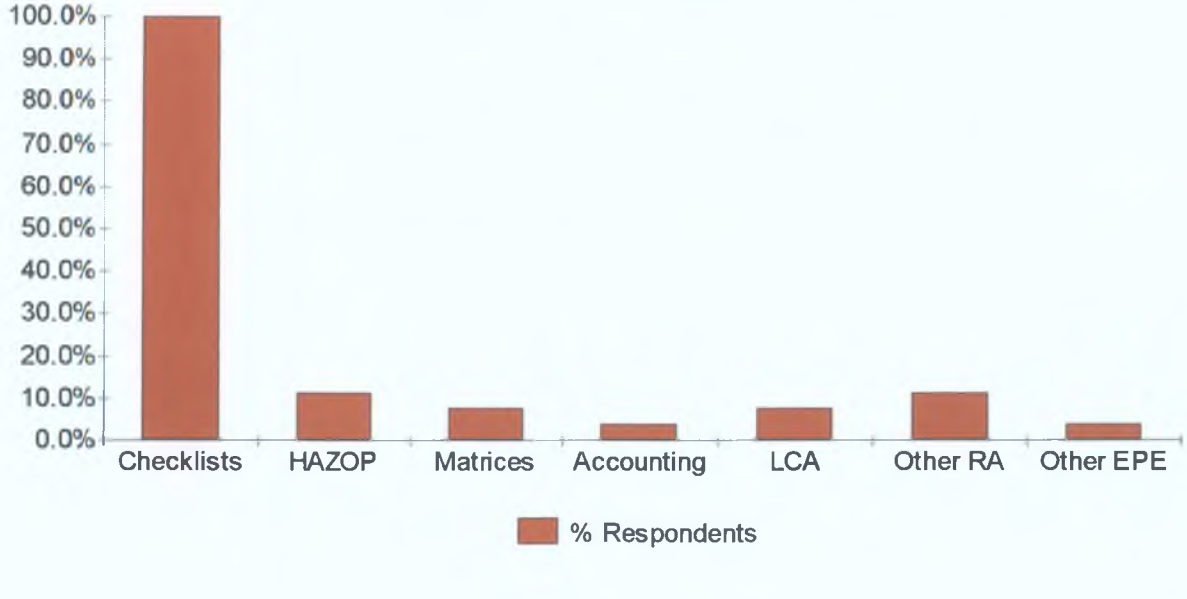
a common technique (19.2%) with other techniques (including observations and International Safety Rating System template) accounting for 15.4% of the techniques employed.

To determine the use in the field of 'standard' auditing tools, respondents were requested to select from a list, which if any of the tools they employed for quantifying/delineating audit observations. This list included;

- Checklists;
- Matrices;
- HAZOP/HAZAN;
- Green Accounting;
- Life-cycle Analysis;
- Other Risk Assessment Technique; and
- Other Environmental Performance Indicator.

Figure 6.11

Auditing Tools used by Respondents



As can be seen from *Figure 6.11* above the use of checklists was acknowledged by all respondents with only small numbers of respondents acknowledging use of the other techniques. Of interest were the other risk assessment techniques suggested by respondents, including environmental licence compliance and an internal process hazard scoring system. The annual management review was detailed as an environmental performance indicator in one completed questionnaire.

Concerning the design and content of the environmental audit programme for the site, readers were asked to prioritise a selection of influences in order of their importance. *Table 6.10-Auditing Programme Influences* delineates the percentage of respondents who rated the individual influences in their top three.

Table 6.10- Auditing Programme Influences

Influence	Percentage Respondents
Management Priorities	*53.8*
Commercial Intentions	*0.0*
Environmental Management System Requirements	*92.3*
Regulatory and Contractual Requirements	*88.5*
Customer Requirements	*7.7*
Potential Risks to the Organisation	*65.4*
Views of Interested Parties	*3.8*
Other	*0.0*

Respondents in 92.3% of the replies to the questionnaire stated that maintaining their environmental management system was in the top three of their greatest influences to maintaining an environmental auditing programme. This was followed by 88.5% for regulatory and contractual requirements with 65.4% for potential risks to the organisation and 53.8% for management priorities. The influence of views of interested parties accrued 3.8% of the first three preferences with no respondent detailing commercial intention as a significant influence on the design and maintenance of the environmental auditing programme.

Reviewing the responses to the questionnaire, the information presented indicated that in 76.7% of the companies responding, a manager with the overall responsibility on-

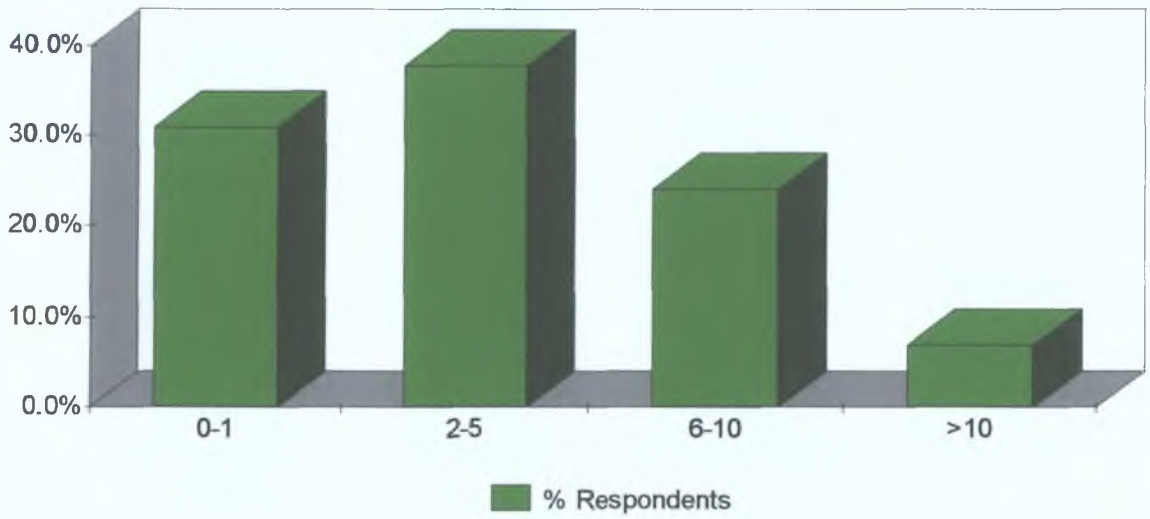
site for environmental auditing was responsible for maintaining the environmental audit programme. In 16.7% of the cases, this responsibility was delegated to individuals/departments being responsible for maintaining the audit programme in their individual areas, with the balance (6.6%) being a combined responsibility of both.

6.4.8 Section F- Competence of Auditors

The final section of the questionnaire was designed to assess what the respondents considered was a 'competent' auditor and by what means this competency was assessed.

Respondents were initially asked how many individuals were involved in environmental auditing in their company. The results are presented in *Figure 6.12- Auditor Numbers.*

Figure 6.12
Auditor Numbers



In relation to education and training of auditors, 66.6% of the respondent companies indicated that all the auditors had received post secondary education, while in 33.4% of cases, some to none had this level education.

Respondents to the questionnaire were asked to identify from a list of disciplines, which discipline they determined was the most relevant to environmental auditing within their company. The results are presented in *Table 6.11-Selected Relevant Auditor Disciplines.*

Table 6.11-Selected Relevant Auditor Disciplines		
Discipline	Sub-discipline	Percentage
Engineering	*Civil Engineering*	*12.9*
	Mechanical Engineering	*16.1*
	Chemical Engineering	*25.8*
	Other	*3.2*
Science	*Environmental*	*48.4*
	Chemistry	*38.7*
	Other	*3.2*
Quality Control	-	*9.7*
Business	-	*0.0*
Health and Safety	-	*19.4*
Marketing	-	*0.0*
Other	-	*3.2*

Notably, when the above information is reviewed, the most common discipline selected as being pertinent to environmental auditing was Environmental Science with 48.4% of the respondents identifying it as a key discipline for conducting their environmental auditing programme. This was followed with Chemistry (38.7%) and the Engineering disciplines. When presented with the option of detailing an *Other* discipline, only 3.2% of the respondents completed this section with keen observational skills generally being presented as a key discipline.

In the case of 86.2% of the respondents, the staff involved in environmental auditing had received professional training in environmental auditing or environmental management systems.

When the respondents were asked whether any of their environmental auditing staff had any professional affiliation to an association for environmental auditors, 13.3% stated they had, namely the *Environmental Auditors Registration Association (EARA)* affiliation.

Respondents to the questionnaire were asked to rank in order of importance the list of characteristics presented in *Table 6.12-Auditor Characteristics* for an auditor in their facility. The percentage of respondents who ranked the individual characteristics in their top three in order of importance are presented below.

Table 6.12- Auditor Characteristics	
Influence	Percentage Respondents
Time Management	*7.1*
Effective Report Writing	*14.3*
Effective Communication	*46.4*
Ethical	*7.1*
Diplomatic	*17.9*
Tenacity	*14.3*
Ability to focus/prioritise on significant issues	*71.4*
Confidentiality	*3.6*
Experienced in similar industries	*32.1*
Open-mindedness	*25.0*
Observant	*64.3*
Decisive	*17.9*

Surveying the data above, the three most important characteristics identified by the respondents as being key characteristics of an auditor were as follows;

1) Ability to focus/prioritise on significant issues (71.4%),
2) Observant (64.3%), and
3) Effective communication (46.4%).

The three least important characteristics following statistical analysis were;

1) Time management (7.1%),
2) Ethical (7.1%),
3) Confidentiality (3.6%).

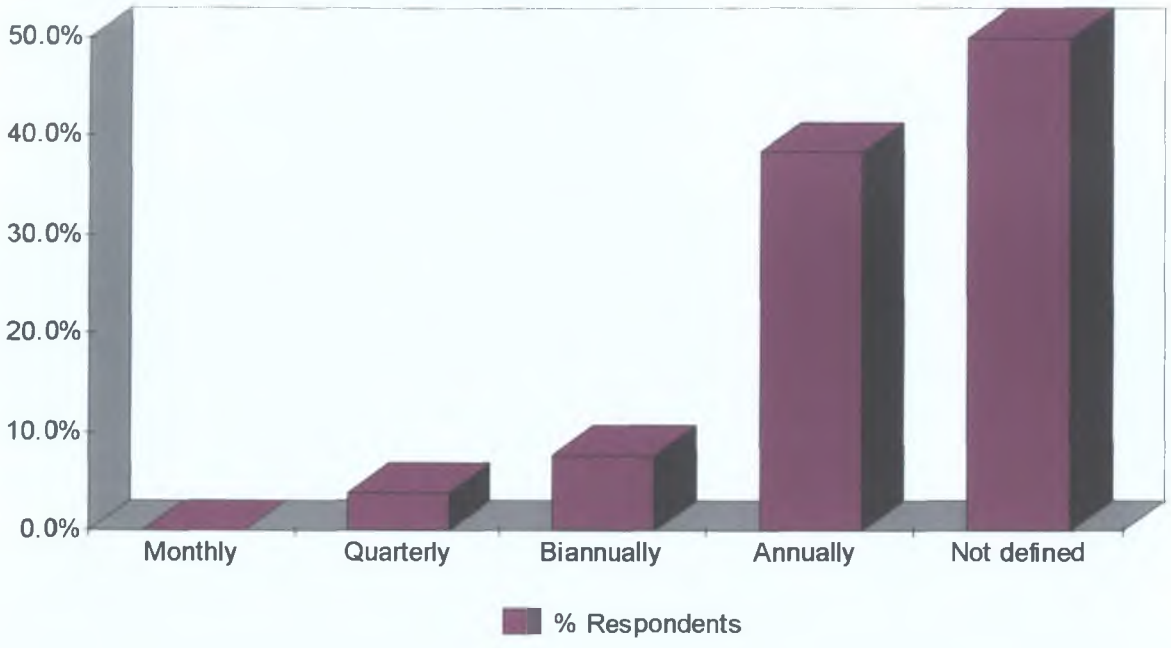
The respondents were subsequently questioned concerning their personal opinions regarding environmental auditing and auditors within their facility. The responses are detailed below in *Table 6.13-Environmental Auditing On-site.*

Table 6.13-Environmental Auditing On-site		
Question	Yes	No
Do you feel that every member of your environmental auditing team.....		
Has a good understanding of the requirement to audit on-site?	*85.7*	*14.3*
Has received sufficient training to be an effective auditor on-site?	*85.7*	*14.3*
Is aware of the benefits of auditing?	*85.7*	*14.3*
Understands the risks of poor auditing on-site?	*85.7*	*14.3*
Feels that they are involved in the development of the audit programme on-site?	*85.7*	*14.3*
Actively suggests modifications and improvements to the audit programme?	*74.1*	*25.9*

When asked how often the competence of the environmental auditing team is reviewed the respondents answered as detailed below in *Figure 6.13-Competency Assessment.* As can be clearly seen, competency of environmental auditors is more frequently reviewed annually or with no defined frequency than biannually, quarterly or monthly.

Figure 6.13

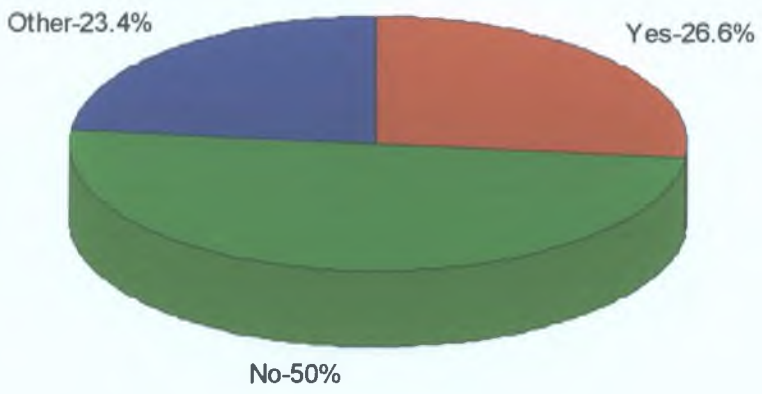
Competency Assessment



The final question of the survey asked whether the respondent was aware of any published standards for environmental auditing. Responses are presented graphically in *Figure 6.14-Awareness of Environmental Auditing Standards.*

Figure 6.14

Awareness of Standards for Auditing



In 26.6% of the responses, respondents were able to state a recognised standard for environmental auditing (acceptances included EMAS, ISO 14010/11/12 or draft

standard ISO 19011). In 23.4% of the responses, respondents detailed that they were aware of such standards but named them incorrectly or provided no title at all. The remaining 50% of respondents were not aware of any such standards.

6.5 INTERPRETATION OF RESULTS

The following is a summary interpretation of the data presented previously.

6.5.1 Section A-General Company Details

A satisfactory 75.8% return rate was enjoyed for questionnaires sent to companies licensed with an IPC licence and classed as an activity within the chemical industry. 74.1% of the respondent companies were non-indigenous with the majority of these companies (48.4%) classified as a medium sized enterprise (employee numbers varying between 50 and 250).

31% of the respondents detailed that their company had an environmental department within their management structure, with 45% of these having between 6 and 10 employees within this department.

6.5.2 Section B- Regulatory and Voluntary Controls

The largest sub-class of activity of the chemical industry as classified by the *Environmental Protection Agency Act, 1992* represented by the respondents was *Sub-class 5.6- The manufacture of pesticides, pharmaceutical or veterinary products and their intermediates* at 39.4%.

What is considered a high figure of 63.4% of the respondent companies stated that the environmental management system requirement under Condition 2 of their IPC licence was certified to an internationally accepted standard.

6.5.3 Section C- Conducting the Initial Environmental Review

It was deemed that one method by which individual companies would have had some exposure to environmental auditing and the contracting of environmental consultancies was in preparing the Initial Environmental Review. Conducting an environmental review is a generally recommended preliminary step in the development of a management control system for certification. Results obtained from the survey indicated that the number of companies conducting an initial review has stabilised over the last three years with the largest number of respondents conducting their reviews in 1998 and the years previous to that. This was not a surprising statistic as ISO 14001 was published in 1996 and EMAS in 1993. However, as stated previously, the initial environmental review is typically a "once-off" exercise and was likely to coincide with the application for an IPC licence which were issued to the target group in or around the this time period.

In completing this initial review 71.6% of the respondents used some form of consultancy assistance. Of interest was, when queried as to what form of assistance was received, tangible environmental monitoring was only requested by 21.5% whereas the most frequent form of assistance was that of general consultancy (33.3% of the responses).

When questioned, respondents advised that, in 48% of the responses, the environmental consultancy selected was scoped from previous environmental project work conducted for the individual companies. This portrays a sensible statistic with reliance on advertising and trade exhibitions being the less frequent method of sourcing suitable environmental consultancy services. Another source of information worth mentioning is the fact that in 24% of the responses, consultancy services were sourced based on 'word of mouth' recommendations. It is in this field that the industry as a whole can benefit from experience of fellow companies in contracting effective environmental consultancy services (including environmental auditing, monitoring, etc.).

Once the techniques for sourcing potential environmental consultants had been addressed, the questionnaire then queried the mechanisms by which one consultancy was deemed to be more suitable than the next. As one might expect, and in the author's opinion, rightly so, 25% of the responses selected *Cost* and a further 25% selected appropriate *Experience* of the consultancy in question as being amongst their top three selection criteria. Influences such as the profile of the consultancy, familiarity with the consultancy on environmental and non-environmental projects previously conducted on-site and recommendations contributed to the remaining 50% of responses.

Concerning the scope of environmental aspects that companies addressed in their environmental review, to a defined list of aspects, a relatively high proportion were addressed. Care must be exercised in interpreting these results as the temptation to include all the aspects (respondents had to place a tick in a box to acknowledge an aspect was addressed) may have cloaked the actual number that were addressed. To determine how well these aspects were addressed, the author considers that all of the listed aspects can be quantified or assessed by numerous means, however, when companies were questioned as to whether the same list of aspects were quantitavely assessed as opposed to being subjectively reviewed, on average there was a reduction in the number of positive responses by 31.9%. Considering that this review is anticipated to have been assessed by an independent certification company, the quality of these reviews should have been assured. However, based on the previous statistic, the quality of this review process may be questionable. To validate this, recipients of the questionnaire were asked, for those companies who have completed an environmental review for certification purposes, in how many cases were modifications requested to the initial environmental review. To this extent, 18.5% of respondents were asked to modify the content of their review. Modifications requested included addressing aspects that were not previously addressed.

6.5.4 Section D- Integrated Pollution Control Licence Application

Section C of the questionnaire was only completed by 63.3% of the respondents (those who maintained an environmental management system certified to an international

standard). These 63.3% of the respondents could be considered as being more environmentally proactive than the balance, and so this section was designed to gauge exposure to environmental auditing and exposure to environmental consultancy across the whole respondent group. In stating this, it is acknowledged that some of the more proactive companies within the chemical industry may not maintain a certified environmental management system for reasons not determined within the scope of the survey.

The vast majority of respondents (89.6%) attained their first IPC licence (this was deemed to be the critical event, as it was suspected that subsequent licence applications would not present the same difficulties as the original) between 1995 and 1998. In these cases, environmental consultancy services were contracted for assistance by 83.9% of the respondents, indicating a heavy dependence on external environmental consultancy services. Unlike the case of the initial environmental review for a certified environmental management system where 16.7% of respondents utilised consultancy services for monitoring and consultancy services, this figure swelled to 52.2% for the IPC application. It is considered that the psychological influence of the regulatory nature of an IPC licence and the Environmental Protection Agency is more than likely to have been the greatest influence on this statistic, as it is considered that the application form for an IPC licence displays greater clarity of what is required compared to ISO 14004 or EMAS.

Trends for the techniques by which companies identified environmental consultancy services display a similarity for those identifying consultancy services to assist in the completion of an initial environmental review. This was reflected through the 63.6% of the responses which detailed that the environmental consultancy selected was scoped from previous environmental project work conducted for the individual companies. Other selection techniques preferred included 13.6% each for previous experience of the consultancy on non-environmental projects and 'word of mouth' recommendation. As was the case in selecting an environmental consultancy for an initial environmental review project, the influence of advertising and trade exhibitions reflected a lower percentage response with 4.6 % each.

When respondents were asked to choose the criteria which they felt were the greatest influence on selecting an environmental consultancy, interestingly the split was quite even. Cost was selected by 25.5 % of the respondents and drew the greatest percentage of responses. Profile (10.6%) was selected by the least number of respondents, but it is acknowledged that this is also quite a significant percentage of the respondents. When compared to the selected criteria statistic for Section C, the greatest fluctuation was that of the familiarity of the company with the consultancy on a non-environmental project (with 17% in the IPC section and 5.5% in the Initial Environmental Review Section).

6.5.5 Section E- Auditing Environmental Management and Control Systems

This section of the questionnaire was designed to determine the nature and content of environmental auditing programmes and practices in the field. The questionnaire probed both the nature and the contents of these environmental management programmes.

76.7% of respondents indicated that they maintained a 'formalised' environmental auditing programme in their companies. Environmental auditing programmes were in general focussed on the environmental management programme of the facility (i.e. the specified environmental plan of activities) and the primary control procedures (i.e. waste management, chemical handling). Of note was that the issue which the lowest number of respondent addressed in their environmental audit programmes was environmental legislation (82.6%).

Auditors involved in environmental auditing on-site in 41.9% of the responses were a cross section of staff from the company itself which is considered as being good practice. A notable 12.9% of respondents were audited by corporate representatives. Internal environmental departments conducted the auditing programme in 25.8% of the responses.

To assess what format audits generally take in the field respondents were asked to selected from a list the formats most applicable to their own environmental auditing

programme. All respondents stated that the audit was composed of a review of documentation (or desk-based approach). Interviews were employed by 84.6% of respondents with pre-designed questionnaires being employed by 19.2% of respondents. Purposely, an *Other* section was provided and in only one case did a respondent state that the audit involved observation of the activity being audited. Observation is considered as a key audit mechanism to assess what is actually happening as opposed to documented as happening.

SECTION 5 of this dissertation provided an overview of the existing tools available to environmental auditors. When respondents were presented with a list of tools which can be used to enhance the environmental audit, with the exception of checklists, the use of specified tools was generally poor.

Respondents also advised that maintaining the environmental management system was the greatest influence (92.2%) on maintaining the environmental audit programme. This was a greater influence than regulatory or contractual requirements (88.5%) or potential risk to the organisation (65.4%). Commercial intention, customer requirements and views of interested parties were deemed not to be significant influences with 0, 7.7 and 3.8% of respondents listing them as a significant influence.

In the greatest number of responses (76.7%), the manager with overall responsibility for environmental issues on-site was responsible for maintaining the environmental audit programme. This reflected the significant degree to which the audit programme was supported by senior management. However, it should also be considered that with one person responsible for both aspects the resulting possibility for conflict of interest and/or lack of independence cannot be discounted.

6.5.6 Section F- Competence of Auditors

69% of the respondents had more than two designated environmental auditing staff on-site with some facilities having in excess of ten auditors.

In 66.6% of the companies responding to the questionnaire, all members of the environmental auditing team had post-secondary education. Concerning post secondary education, the disciplines seen as being most relevant to the environmental auditing programme were Science (Environmental and Chemistry), which were selected by 90.3% of the respondents.

The majority of respondents' (86.2%) environmental auditing staff had received professional training in environmental auditing or environmental management systems, but only 13.3% had professional affiliation to an organised body (e.g. Environmental Auditors Registration Association [EARA]).

The four most important characteristics of an environmental auditor for auditing in the chemical industry were ranked in the following order of importance;

- Ability to focus/prioritise significant issues;
- Observant;
- Effective communicators; and
- Experienced in similar industries.

In approximately 86% of the responses, the respondent detailed that he/she felt that each member of the audit team had;

- A good understanding of the audit requirements for the company;
- Sufficient training to be an effective auditor;
- Was aware of the benefits of auditing;
- Understanding of the risks of poor auditing;
- A feeling of involvement in the development of the audit programme; and
- An active participation in suggesting modifications and improvements to the audit programme.

In half of the responses, the competence of auditors was not reviewed on a defined frequency.

In 73.4% of the responses, respondents were unable to detail the title of any published international standard for environmental auditing (ISO 14010/11/12, EMAS or draft ISO 19011).

SECTION 7

DISCUSSION

7.1 INTRODUCTION

At this stage of the dissertation, now is an opportunity to discuss the information presented previously. In *Section 1.2-**Targets and Objectives***, five individual milestones were outlined to achieve the objective of developing a standardised guidance note for conducting an environmental audit. These milestones are restated hereunder;

- Define an Environmental Audit
- Identify best practice standards for conducting an environmental audit;
- Identify tools available for the environmental auditing process;
- Assessment of current practice in the field of environmental audits; and
- Prepare a protocol standardising a suggested approach to conducting an environmental audit.

Section 1 introduced the dissertation topic, provided a background to environmental auditing, outlined the aims and objectives of the dissertation and presented the proposed methodology for achieving same.

Section 2 addressed the concept of environmental auditing, providing a definition of environmental auditing, a description of the different applications and presented some of the benefits of environmental auditing.

Section 3 presented a summary interpretation of existing publications describing how an environmental audit is best conducted.

Section 4 identified the existing tools designed for environmental assessment and conceived as being applicable to the environmental auditing field.

Section 5 assessed existing standards for environmental auditing and environmental auditors.

Section 6 presented the findings of a survey determining the extent and nature by which environmental auditing is implemented in 'the field' by Irish companies in the chemical industry operating under an IPC licence.

7.2 DEFINE AN ENVIRONMENTAL AUDIT

Research conducted for this dissertation revealed that the field of environmental auditing is approximately thirty years old, with the original audits being conducted in the United States to satisfy environmental disclosure requirements of the Securities and Exchange Commission. These original audits consisted of performance reviews or compliance audits aimed at reducing risk to investors. Since these initial audits, the concept has been applied to a wide range of applications with the scope being quite disparate. Historically, environmental audits, presumably as the term was borrowed from the financial field, tended to focus on compliance or non-compliance, right or wrong and black or white. While this application in the financial field is acceptable, where the base unit is clearly defined (i.e. money), in the field of environmental auditing it is much more difficult to identify the base unit. This difficulty arises from determining the scope of the audit. Is it limited to compliance or non-compliance with licences or permits, or achieving a status of zero complaints from regulatory bodies or neighbours or do such non-tangible issues such as impact on material assets or aesthetic need to be addressed. Obviously, this issue is one that should be agreed in advance between the client and the auditor.

In any event the most recent, and what the author considers as best, published definition for environmental audit is that published by the European Council which states that;

"An environmental audit shall mean a management tool comprising a systematic, documented periodic and objective evaluation of the performance of the organisation,

management system and processes designed to protect the environment with the aim of;

(i) facilitating management control of practices which may have an impact on the environment;

(ii) assessing compliance with the environmental policy. Including environmental objectives and targets of the organisation.

(Official Journal of the European Communities, L114, July 2001)

This definition identifies that an environmental audit is a tool which, through regular and controlled application, will assess the impact of a company, its management and its processes on the environment. Its function is also to determine compliance with the company environmental policy, however, its purposes is also to assess the company's success in attaining continual improvement through its environmental management programme.

While it is acknowledged that the scope of environmental auditing is ever increasing, with numerous off-shoot audits in vogue (due diligence, corporate, product, etc.) the consumer should ensure that the core content of the previous definition is applicable to any audit conducted on-site.

Overall, the environmental audit should not be seen as a once-off event. Its benefits are iterative and include amongst others, compliance, improved management awareness of environmental issues and cost minimisation through improved environmental performance

7.3 IDENTIFYING BEST PRACTICE STANDARDS FOR CONDUCTING AN ENVIRONMENTAL AUDIT

7.3.1 Published Standards

In conducting the literature review for this dissertation, it was noted that numerous authors (e.g. Bouchier *et al,* 1998) provided their own interpretation of guidance on

conducting an environmental audit. Identifying existing standards for environmental auditing from industry coalitions or other recognised bodies yielded three different types of standards;

- ❖ Audit Strategy;
- ❖ Auditor Competency;
- ❖ Specific Applications

AUDIT STRATEGY

This type of standard provided information on conducting the environmental audit. In general, it is considered that the information provided was very general, yet the information presented therein is invaluable as to the best policies and mechanisms of conducting an environmental audit. Unfortunately, as it was drafted considering universal application, there is no specific guidance towards specific technical aspects of conducting an environmental audit (e.g. ISO 14011 and ISO 19011).

AUDITOR COMPETENCY

This second type of standard encountered focussed specifically on the environmental auditor.

The type of standard addressed issues such as general skills required, auditor education and work experience, maintenance and review of auditor competence and auditor evaluation. Again, while the information, strategy wise is excellent, due to the scope of the field to which the standard is addressed, there is no specific guidance for any defined application (i.e. environmental auditor for the chemical industry) (e.g. ISO 14010, ISO 14012 and ISO 19011).

SPECIFIC APPLICATIONS

While the previous two types of standards addressed principles of auditing and recommended auditor traits and characteristics, the third type of standard researched was more focussed, technically, on the audit subject matter.

The international case study presented involved the development of guidelines for conducting an environmental audit by the Indian Central Pollution Control Board (ICPCB). This followed the issuing of a gazette notification (GSR 329[E], 1992) by the Indian Ministry of Environments and Forests making the submission of environmental audit reports a mandatory requirement for all industries. This resulted in the publication of guidelines for conducting an environmental audit in the pesticide industry in 1997 with guidelines under development for the cement pulp and paper, dyes and dye intermediates and distilleries industries (Mashwar *et al*, 1997).

The Responsible Care © initiative is the worldwide chemical industry's commitment to continual improvement of all aspects of Health, Safety and the Environment. In 1994, the principles of Responsible Care were adopted in Ireland on the establishment of the Irish Pharmaceutical and Chemical Manufacturers Federation (IPCMF) (CEFIC, 1999). The Responsible Care initiative involves reporting on a series of performance indicators. These performance indicators include identified 'Red List' substances in discharges to waters (e.g. Chemical Oxygen Demand, Heavy Metals), emissions to atmosphere of volatile organic compounds, specific waste generation and water consumption figures. By providing these statistics, the industry as a whole can identify its environmental impact. The use of performance indicators also provides a format by which individual companies can assess their environmental impacts with their neighbours.

The recently revised EMAS regulation (761/2001) outlines the requirements for organisations to become involved in a European Community Eco-management and Audit Scheme. These regulations set out the requirements which organisations must comply with. The regulation states what issues must be addressed in an organisation's initial environmental review, what topics the organisation's environmental management system must address, the requirements concerning environmental auditing and the content of the environmental statement which must be revised every three years.

It is considered that it is this with regard to this third type of standard, where the development of a standardised environmental audit protocol is best initiated. While the mechanisms of conducting an audit and the general traits and characteristics of potential environmental auditors have been well documented, it is the author's opinion that these standards alone do not provide adequate guidance in conducting a specific environmental audit. The use of performance indicators, such as those presented in the Responsible Care initiative, mean that members of the chemical and pharmaceutical industry know exactly what data must be reported on when completing their environmental report under the initiative. Also, the specific requirements as outlined in the EMAS regulation also provide more detailed information regarding reviewing environmental performance.

In developing industry specific environmental audit protocols, it is recommended that the forum of voluntary schemes and standards such as EMAS and in particular Responsible Care, is the best mechanism for deciding on the pertinent information to be addressed.

7.3.2 Environmental Auditor Registration Schemes

There are a number of environmental consultancy services currently available on the market. While in UK there are a number of voluntary registration schemes whose purpose is to provide a validation of competency for environmental auditors and environmental consultancies, no such scheme exists in Ireland to ensure the quality control of environmental auditing. The development of such a scheme in Ireland would be of benefit to the environmental auditing field in Ireland as it would provide some assurance as to the capability of the companies and individuals involved in environmental auditing in Ireland. The possibility of utilising the services of NAB to oversee the implementation of such a registration scheme should be given serious consideration.

7.4 IDENTIFYING TOOLS AVAILABLE FOR THE ENVIRONMENTAL AUDITING PROCESS

Arising from the field of environmental impact assessment, a number of tools have been developed to assist in the quantification of environmental impact. *'The choice of technique or method used in an assessment depends on the time and resources available; what goals the assessment is required to meet....what criteria are to be assessed; and what personnel comprise the assessment team'* (Barrow, 1997).

To standardise the environmental audit content, it is recommended that the less subjective the tool employed the better. This is because where opinions are presented instead of fact, there is a significant risk that two auditors will not present the same findings at the end of the audit. It is therefore considered that due to the subjective nature of using matrices and impact assessment rating mechanisms, tools better employed for the purposes of standardising the approach to conducting an environmental audit include the more objective examples such as prepared protocols, green accounting or environmental performance indicators. As determining cost ownership can result in an overly complex exercise when assigning environmental liability (e.g. the cost of pollutant abatement from one area as opposed to a second area when the abatement process is shared), and although being able to provide a monetary value on environmental issues has considerable benefits (e.g. when determining cost implications and capital expenditure payback periods) it is not considered that these benefits outweigh the set-up complexities.

This leaves two optional tools that are recommended to be employed as deemed appropriate in the environmental auditing process, prepared protocols and environmental performance indicators.

Appendix 4 of this dissertation entitled *Environmental Audit Template* provides a recommended prepared protocol for application in the chemical industry in conjunction with outlining the performance indicators which should be employed for comparative analysis purposes between industries or in one industry on an annual or other defined return period basis.

7.5 ASSESSMENT OF CURRENT PRACTICE IN THE FIELD OF ENVIRONMENTAL AUDITS

To determine how the concept of environmental auditing is perceived and operated in the field a prepared questionnaire was forwarded to a targeted group. This group consisted of all companies licensed with an Integrated Pollution Control Licence in accordance with the provisions of the *Environmental Protection Agency Act (Licensing) Regulations, 1994* and designated as a company within Class 5 of the First Schedule of the *Environmental Protection Agency Act, 1992* and are therefore considered to belong to the Irish chemical industry.

In this industry, there is a significant use of environmental consultancies for specialist assistance in delivering complex environmental projects. 71.6% of respondents who had a certified environmental management system in place used an environmental consultancy service for assistance. 83.9% of respondents contracted environmental consultancy services for assistance in completing the Integrated Pollution Control application form. These results presented a significant dependence on external consultancy skills.

76.7% of respondents to the questionnaire detailed that there was a formalised environmental auditing programme in place in their company. In the case of these responses, 17.4% of the respondents did not address environmental legislation in their auditing programme. This is considered to be a significant omission.

Companies generally employed internal employees for conducting the environmental auditing programme. The merits of this is that the employees are very familiar with the sites operations and are therefore in an enviable position of being readily able to identify reduction in performance of abatement systems, etc. The demerits of this are that internal employees may not have the expertise required to readily identify more elusive environmental impacts.

The format by which audits were generally conducted in respondent companies was a desk based review of existing information supported by selected interviews. It was

noted that tours and inspections were not documented as being an audit mechanism with the exception of one single respondent. This is considered to be an unwise lack of activity as the desk based review of data can take from the reality of the situation in day to day operations.

Apart from the use of checklists no other tool as identified in *Section 5-Tools for Environmental Auditing* was being used in the auditing process in respondent companies.

When questioned about the greatest influence on maintaining the environmental audit programme 92.2% of respondents stated maintenance of the environmental management system. Only 65.4% rated risk to the organisation as a significant influence on the environmental audit programme. It could therefore be considered that companies are not aware or do not agree with the well documented benefits of environmental auditing as presented in *Section 2.4-Benefits of Environmental Auditing*. If this is the case, and compliance with a requirement for auditing as specified in an environmental management procedure is the main driving force for conducting an environmental audit, there may be a risk that the motivation to conduct the audit may not be strong enough to gain the maximum benefit from the exercise.

With 76.7% of the respondents stating that the manager with the overall responsibility for environmental issues on-site was responsible for maintaining the audit programme, this is considered to present a satisfactory indication of support from senior management to the auditing programme within these companies.

Companies generally had a number of designated environmental auditing personnel, with 69% having greater than two auditors. Amongst these employees, there was a high standard of education with 66.6% having completed some form of third level education. In 86.2% of responses, environmental auditing staff had received further training in environmental auditing or environmental management systems. This presents an image of a well-educated and professionally trained environmental auditing staff in the chemical industry. However, the competency of these auditors was not reviewed at any defined frequency in half of the responses. There was also poor

awareness of the ISO 14010, 14011, 14012 and draft ISO 19011 standards on environmental auditing.

The weakness of the questionnaire was that it was anticipated that some form of information concerning auditing practices in companies would be obtained (i.e. internal questionnaires, checklists, procedures, etc.). This information was not forthcoming and when companies were directly contacted, either the information was not collated or formalised or it was against company policy to divulge this information.

It is recommended that if further research is conducted into this field, that it should focus on developing a site/issue specific protocol to enhance the general protocol included in *Appendix 4-Environmental Audit Template.* Another area deemed worthy of research is the flexibility and quality of reporting through the use of environmental performance indicators.

SECTION 8

CONCLUSIONS

Research conducted for this dissertation revealed that the field of environmental auditing is approximately thirty years old, with the original audits being conducted in the United States to satisfy environmental disclosure requirements of the Securities and Exchange Commission. These original audits consisted of performance reviews or compliance audits aimed at reducing risk to investors.

Since these initial audits, the concept has been applied to a wide range of applications with the scope being quite disparate (product audit, waste audit, due diligence audit, etc.)

An environmental audit is considered as a tool which, through regular and controlled application, will assess the impact of a company, its management and its processes on the environment. Its function is also to determine compliance with the company environmental policy, however, its purposes is also to assess the company's success in attaining continual improvement through its environmental management programme.

The benefits of environmental auditing are iterative and include amongst others, compliance, improved management awareness of environmental issues and cost minimisation through improved environmental performance.

Published standards for environmental auditing tend to focus on principles of audit conduct as opposed to providing specific guidance on the technical aspects required to be addressed.

Voluntary industry programmes such as Responsible Care© provide a support network and a mechanism to advise member companies as to what, technically should be addressed in an environmental audit.

There is an identified requirement to provide definitive guidance on the technical aspects of conducting an environmental audit.

In the Irish chemical industry, there is a significant dependency on environmental consultancies for specialist assistance in delivering complex environmental projects. There is no national registration scheme specifically addressing the ability or efficiency of the environmental consultancy companies and auditors.

In the Irish chemical industry, companies generally employed internal employees for conducting the environmental auditing programme.

Companies generally have a number of designated environmental auditing personnel which generally have completed some form of third level education. In most cases, environmental auditing staff had received further training in environmental auditing or environmental management systems.

There is also poor awareness of the ISO 14010, 14011, 14012 and draft ISO 19011 standards on environmental auditing in the Irish chemical industry.

There is a significant body of information available concerning the predicted environmental impacts from the chemical sector which provide sufficient information to assist in the generation of a template for which an individual company's environmental impact can be compared. This information is available from the Environmental Protection Agency and voluntary industry programmes such as Responsible Care©.

From the knowledge obtained in the preparation of this dissertation the author considers that to improve environmental auditing in general in Ireland there are two key aspects to be addressed. The first is the absence of a standard body of material to reference when conducting an environmental audit (a proposed environmental audit template designed by the author, has been presented in this dissertation, see Appendix 4, to address this specific requirement for the chemical sector), the second being the absence of a quality control system for environmental audits and auditors.

It is recommended that if further research is conducted into this field, that it should focus on developing a site/issue specific protocol to enhance the general protocol included as well as of research into the flexibility and quality of reporting through the use of environmental performance indicators. The development of a national certification scheme for environmental auditors or the introduction of a professional body to maintain auditing standards should also be considered as research topics.

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Appendix 1

Survey Catchment

Circulation Database of Companies licensed as an activity under Class 5 of the First Schedule of the Environmental Protection Agency Act, 1992

Company Name	Integrated Pollution Control Licence Register Number
Lawter International Luxembourg S.a.r.l.	*2*
SmithKline Beecham (Manufacturing) Limited	*4*
Schering-Plough (Brinny) Company	*5*
Novartis Ringaskiddy Limited	*6*
Yamanouchi Ireland Company Limited	*7*
Leo Laboratories Limited	*8*
Eli Lilly S.A. Irish Branch	*9*
Warner-Lambert Export Limited	*10*
Merck, Sharpe & Dohme (Ireland) Limited	*11*
Roche Ireland Limited	*12*
Pfizer Pharmaceuticals Production Corporation	*13*
Swords Laboratories	*14*
Schering-Plough (Avondale)	*15*
Janssen Pharmaceutical Limited	*16*
Cara Partners	*17*
Klinge Pharma & Company	*18*
Warner Lambert Manufacturing (Ireland)	*19*
SIFA Limited	*20*
IFI-Marino Point	*28*
Dynochem Ireland Limited	*34*
Mallinckrodt Medical Imaging-Ireland	*50*
BOC Gases Ireland Limited	*51*
Cognis Ireland Limited	*52*
ADM Ringaskiddy	*53*
Cold Chon (Galway) Limited	*56*

Company Name	Integrated Pollution Control Licence Register Number
Kingspan Insulation Limited	*57*
Kayfoam Woolfson	*58*
Fronville Limited	*59*
Olin Chemicals BV	*60*
Irish Oxygen Company Limited	*70*
Reheis Ireland	*71*
Devcon Limited	*72*
Cold Chon (Galway) Limited, Sligo Depot	*73*
Alumina Chemicals Limited	*74*
Burgess Galvin and Company Limited	*75*
Chemifloc Limited	*76*
Uisce Glan Teo T/A Galway Chemicals	*77*
Loctite (Ireland) Limited, Ballyfermot	*78*
Loctite (Ireland) Limited	*79*
Colfix (Dublin) Limited	*80*
Irish Asphalt Limited	*81*
Micro Bio (Ireland) Limited	*82*
Evode Industries	*83*
Road Binders Limited	*84*
Novartis Agribusiness Ireland Limited	*85*
Irish Tar and Bitumen Suppliers	*86*
Galvanocor Ireland Limited	*87*
Iropharm plc	*89*
Fort Dodge Laboratories Ireland Limited	*90*
Wexport Limited	*91*
Newport Synthesis Limited	*97*
Norbrook Manufacturing Limited	*101*
Pharmacia and Upjohn Limited	*103*
Arran Chemical Company Limited	*110*

Company Name	Integrated Pollution Control Licence Register Number
Helsinn Chemicals Ireland Limited	*125*
Servier International B.V.	*128*
Irotec Laboratories Limited	*134*
Warner-Lambert Export Limited	*136*
Schering-Plough (Avondale)	*155*
Leo Laboratories Limited	*158*
Swords Laboratories	*206*
Merck, Sharpe & Dohme (Ireland) Limited	*208*
Galoptical Teo	*210*
Syntheses Limited	*216*
Everlac Paints Limited	*220*
BASF Printing Systems Ireland Limited	*228*
General Paints Limited	*229*
Sun Chemicals Inks Limited	*230*
I.B.C. Limited	*231*
Trimite Truecoat Limited	*239*
Coates of Ireland Limited t/a Coates Lorrilleux	*241*
Henniges Elastomers Ireland GmbH	*243*
FSW Coatings Limited	*244*
Circle Paints Manufacturing Ireland Limited	*245*
Crown Berger (Ireland) Limited	*248*
Shamrock Aluminium Limited	*249*
Manders Coatings and Inks Ireland Limited	*250*
INX International Ink Company Limited	*252*
Packaging Inks and Coatings	*253*
L.P.D. (Ireland) Limited/Weathercrete Co	*257*
Devcon Limited	*260*
Warner-Lambert Export Limited	*299*
Barclay Chemicals Manufacturing Limited	*317*

Company Name	Integrated Pollution Control Licence Register Number
Hygeia Chemicals Limited	*324*
Protim Abrasives Limited	*326*
Randstone Limited T/A Stonearch Branch	*332*
Pfizer Pharmaceuticals Production Corporation	*370*
Warner-Lambert Export Limited	*457*
Irotec Laboratories Limited	*461*
Cascade Biochem Limited	*462*
MC-Building Chemicals Müller and Partn	*464*
G. Bruss GmbH Dichtungstechnik	*465*
Everlac Paints Limited	*468*
Warner-Lambert Export Limited	*471*
SmithKline Beecham (Manufacturing) Limited	*473*
Elisa Partnership	*476*
Acorn Environmental Limited	*477*
Schering-Plough (Avondale)	*488*
Swords Laboratories	*492*
Irish Fertilizer Industries Limited	*495*
Barclay Chemicals Manufacturing Limited	*522*
Loctite (Ireland) Limited	*523*
Syntheses Limited	*524*
Iropharm plc	*540*
Pfizer Pharmaceuticals Production Corporation	*542*
Novartis Ringaskiddy Limited	*545*
Eli Lilly S.A. Irish Branch	*546*
Roche Ireland Limited	*547*
Lawter International Luxembourg S.a.r.l.	*548*
Swords Laboratories t/a Bristol-Myers Squibb	*552*
Xerox (Europe) Limited	*553*
Reheis Ireland Limited	*574*

Company Name	Integrated Pollution Control Licence Register Number
Burgess Galvin and Company Limited	*575*
Xtratherm Limited	*583*
HP Chemie Pelzer Limited	*590*
Mallinckrodt Medical Imaging Ireland	*601*

Appendix 2

Copy of Cover Letter

53 St. Corban's Place,
Naas,
Co. Kildare.

March 2002

Dear Sir or Madam,

I am presently undertaking the distance learning Master of Science course in Environmental Protection through Sligo, Institute of Technology. My selected field of research is auditing mechanisms employed by companies licensed with an Integrated Pollution Control Licence by the Environmental Protection Agency.

As I am sure you are aware the field of auditing is critical in checking and correcting the environmental management system as specified in Clause 4.5.1 of the ISO 14001 standard. The purpose of my research is to identify any existing protocols that certified companies have for establishing audit programmes, auditor competence and audit reporting. In reviewing the current practices adopted in industry it is hoped that this may enlighten people as to the existing industry accepted standards.

I understand that you have a very busy schedule, however I would be greatly appreciative if you could allow a short period to impart your experiences with this topic by completing the questionnaire.

I would like to take this opportunity to advise you that all information submitted with the questionnaire will be handled in a sensitive and confidential manner. On receipt of your questionnaire the information will be addressed in conjunction with information received from a number of questionnaire recipients by means of a statistical analysis.

If you have any supporting information which you would like to include with the questionnaire that you feel is relevant to the subject matter, all attachments will be graciously received. Due to pressing submission deadlines I would appreciate it if you could forward the completed questionnaire by 30th April 2002.

If you have any queries concerning the above please do not hesitate to contact me at your convenience. I can be contacted during the day at 045-123456

Eagerly awaiting your response,

Yours sincerely,

Paul Kelly

Appendix 3

Environmental Auditing Questionnaire

Environmental Auditing Questionnaire

Section A – General Information

1. Company Name (optional):_____

2. Contact Name (optional):_____

3. Position (optional):_____

4. Contact Details (optional): Telephone_____
   Facsimile_____
   E-mail_____

5. Is your company indigenous (i.e. Irish owned) ?: Yes ☐ No ☐

6. Number of employees: <10 ☐
   10-50 ☐
   50-150 ☐
   150-250 ☐
   250+ ☐

7. Does your company have an environmental department ?: Yes ☐ No ☐

8. If yes, how many personnel are employed within this department ?:_____

Section B – Regulatory and Voluntary Controls

9. In accordance with the Environmental Protection Agency Act, 1992 and as detailed in your Integrated Pollution Control Licence, under which Class of Activity is your company licensed?

   _____

10. Under the requirements of your Integrated Pollution Control Licence your company is required to maintain an environmental management system. In the case of your company is this management system certified to an international standard ? Yes ☐ No ☐.

11. If no, please proceed to ***Section D-Integrated Pollution Control Licence Application.***

12. If yes, to which environmental management standard is your company certified ?:

    ISO 14001 ☐ EMAS ☐

13. Is your company certified to any quality management standard ?: Yes ☐ No ☐.

14. If yes, please specify details_____

15. Is your company certified to any health and safety management standard ?:
    Yes ☐ No ☐.

16. If yes, please specify details_____

Section C – Conducting Initial Environmental Review

17. When was your initial environmental review conducted ?:_____

18. Was this review conducted by in-house personnel primarily ?: Yes □ No □.

19. Was this review conducted with the help of external consultants ?: Yes □ No □.

20. If yes, in which of the following subject areas were consultants utilised ?

Advice only □ Verification only □ Auditing of site □ Monitoring only □
All/some of previous □

21. Was this review conducted by external consultants primarily ?: Yes □ No □.

22. How did you source a consultant for the purpose of conducting or assisting in the completion of the environmental review?:

Previous experience of consultancy on an environmental project	□
Previous experience of consultancy on a non-environmental project	□
Environmental magazines/advertising	□
Trade Exhibitions	□
Word of mouth	□

23. In selecting an appropriate consultancy to complete specified works on-site, which of the following issues were key selection criteria ? Please place in order of importance, 1 being the most important, 7 being least important.

Profile	□
Recommendation	□
Experience of consultants	□
Cost	□
Familiarity with consultants from previous work (not environmental) conducted on-site	□
Familiarity with consultants from previous work (environmental) conducted on-site	□

Other (please specify)

_____

24. Which of the following areas did you address in your baseline environmental review of your companies activities?

Water consumption	□	Odour	□
Energy consumption	□	Traffic/Transportation/Distribution	□
Raw material consumption	□	Radiation Sources	□
Emissions to atmosphere	□	Noise/vibration	□
Effluent/wastewater discharges	□	Visual impact	□
Dust particulates	□	Occupation exposure	□
Waste disposal	□	Waste handling on-site	□
Social impact	□	Material assets	□

Storage of hazardous materials ☐ Historical site contamination ☐
Risk of contaminated firewater risk generation ☐

25. In the case of aspects identified above, how many of these were actually quantified as opposed to being subjectively reviewed ?

Water consumption	☐	Odour	☐
Energy consumption	☐	Traffic/Transportation/Distribution	☐
Raw material consumption	☐	Radiation Sources	☐
Emissions to atmosphere	☐	Noise/vibration	☐
Effluent/wastewater discharges	☐	Visual impact	☐
Dust particulates	☐	Occupation exposure	☐
Waste disposal	☐	Waste handling on-site	☐
Social impact	☐	Material assets	☐
Storage of hazardous materials	☐	Historical site contamination	☐

Risk of contaminated firewater risk generation ☐

26. When undergoing your certification audit were any modifications requested to your initial environmental review ? Yes ☐ No ☐

27. If yes, please specify details

_____
_____
_____
_____.

Section D – Integrated Pollution Control Licence Application

28. When was your company granted its Integrated Pollution Control Licence ?_____

29. Was the application completed by in-house personnel primarily ?: Yes ☐ No ☐.

30. Was the application completed with the help of external consultants ?: Yes ☐ No ☐.

31. If yes, in which of the following subject areas were consultants utilised ?

Advice only ☐ Verification only ☐ Auditing of site ☐ Monitoring only ☐
All/some of previous ☐

32. Was the application completed by external consultants primarily ?: Yes ☐ No ☐.

33. How did you source a consultant for the purpose of conducting or assisting in the completion of the environmental review?:

Previous experience of consultancy on an environmental project	☐
Previous experience of consultancy on a non-environmental project	☐
Environmental magazines/advertising	☐
Trade Exhibitions	☐
Word of mouth	☐

34. In selecting an appropriate consultancy to complete the specified works on-site, which of the following issues were key selection criteria ? Please place in order of importance, 1 being the most important, 7 being least important.

Profile ☐
Recommendation ☐
Experience of consultants ☐
Cost ☐
Familiarity with consultants from previous work (not environmental) conducted on-site ☐
Familiarity with consultants from previous work (environmental) conducted on-site

Other (please specify) ☐

Section E – Auditing of Environmental Management and Control Systems

35. Does your company have a formalised auditing schedule to validate the environmental management system ?: Yes ☐ No ☐.

36. If yes, which of the following areas does the auditing schedule address ?:

Environmental Policy ☐
Environmental Aspects Register ☐
Environmental Legislation Register ☐
Environmental Management Programme ☐
Managerial/Supervisory control procedures
(e.g. corrective action, non-conformance, incident investigation, complaints) ☐
Primary control procedures
(e.g. waste handling, chemical handling, emergency response) ☐

37. Who conducts the auditing programme ?:

External consultants ☐ Internal environmental department ☐
Cross-section of staff from within company ☐
Other (please specify)_____ ☐

38. If the audit is conducted by in-house personnel, is it the company policy for staff from each functional area to be responsible for auditing within that area ?: Yes ☐ No ☐.

39. If no, is it the company policy for staff from separate functional areas to be responsible for auditing within individual areas, separate from that in which they normally work ?:

Yes □ No □.

40. What format does the audit take ?:

Review of associated documentation by auditor/audit team □

Completion of questionnaire designed to test subject matter □

Interview of personnel with responsibility for subject matter □

Other (please specify)_____ □

41. Which if any of the following tools are used to quantify/delineate audit observations ?

Checklists □ HAZOP/HAZAN □

Matrices □ Life Cycle Analysis □

Green Accounting □

Other risk assessment techniques □

(please specify_____)

Other environmental performance indicator □

(please specify_____)

42. In establishing the audit programme, rank the following influences in order of importance (1 being the most important, 8 being the least).

Management priorities □

Commercial intentions □

Environmental management system requirements □

Regulatory and contractual requirements □

Customer Requirements □

Potential risks to the organisation □

Views of interested parties □

Other (please specify)_____ □

43. Who is responsible for maintaining the environmental audit programme ?

Manager with overall environmental responsibility ☐

Individuals with responsibility for environmental auditing of individual areas ☐

Combination of both ☐

Other (please specify)_____ ☐

Section F – Competence of Auditors

44. How many personnel are involved in environmental auditing on your site ?_____

45. How many of these personnel have received post secondary education in a discipline that is relevant to environmental auditing on your site ?_____

46. What discipline do you see as being the most relevant to your environmental auditing programme ?

Engineering ☐

(Please specify civil, mechanical, chemical, etc.)_____

Science ☐

(Please specify Environmental, Chemistry, etc.)_____

Quality Control ☐

Business ☐

Health and Safety ☐

Marketing ☐

Other ☐ (Please specify)_____

47. Have any personnel in your facility involved in auditing undergone professional training in environmental auditing or environmental management systems ? Yes ☐ No ☐

48. If yes, please specify number and training course details in the following table;

Course Subject	Course Title	Training Centre/Company	Course Duration (days)	Number of Attendees
Environmental Auditing				
Environmental Management Systems				
Environmental Awareness				
Implementation of EMS				
Risk Assessment Training				
Other (please specify)				

49. Does any member of your auditing team maintain professional affiliation to an association for environmental auditors ? Yes □ No □

50. If yes please specify numbers and associations_____

_____

_____

51. Please rank the following characteristics in order if importance in your opinion of an auditor in your facility ? (1 for most important, 12 for least important).

Time management	☐	Ability to prioritise/focus significant issues	☐
Effective report writing	☐	Confidentiality	☐
Effective communication	☐	Experienced in similar industries	☐
Ethical	☐	Open mindedness	☐
Diplomatic	☐	Observant	☐
Tenacity	☐	Decisiveness	☐

52. Do you feel that every member of your environmental auditing team;

Has a good understanding of the requirement to audit ? Yes ☐ No ☐
Has received sufficient training to be an effective auditor ? Yes ☐ No ☐
Is aware of the benefits of auditing ? Yes ☐ No ☐
Understands the risk of poor auditing ? Yes ☐ No ☐
Feels that they are involved in the development of the auditing programme? Yes ☐ No ☐
Actively suggests modifications and improvements to the audit programme? Yes ☐ No ☐

53. How often do you review the competence of your environmental auditing team ?

Monthly	☐	Quarterly	☐
Biannually	☐	Annually	☐
No defined frequency	☐		

Other (please specify)_____

54. Are you aware of published standards for environmental management systems auditing ? Yes ☐ No ☐

55. If yes, please specify_____

Thank you for participating in this audit questionnaire – your assistance is very much appreciated

Please return the completed questionnaire in the S.A.E. by 30th April 2002

Appendix 4

Environmental Audit Protocol

1.0 INTRODUCTION

In this appendix the aim is to design a practical working tool, incorporating the information presented and discussed in the thesis that can be implemented practically in the field. To mitigate against a 'diluted' environmental template, this section presents a tool applicable to the chemical industry. However, the application of the template should not be considered as being limited to the chemical industry, as the thought processes in designing same are outlined such that the template can be modified to suit all applications.

The layout of this section is as follows;

- Preparing for the Environmental Audit,
- Method Statement for Conducting the Audit,
- Environmental Audit Template.

In preparing this guidance for conducting an environmental audit, in conjunction with previously referenced material, extracts and concepts are borrowed from the following sources;

Advice Notes on Current Practice (in the preparation of Environmental Impact Statements; Environmental Protection Agency, 1999,

Responsible Care; http://www.cia.org.uk/industry/care.htm,

BATNEEC Guidance Note for the Chemical Sector; Environmental Protection Agency 1996.

Regulation (EC) No. 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS)

Environmental Audit Protocol, Bord na Móna Environmental Consultancy Services, 1999.

1.1 Preparing for the Environmental Audit

1.1.1 Agreeing the Scope and Objectives of the Audit

In preparing for the environmental audit, senior management of the auditee should, facilitated by the environmental manager or other deemed responsible person, agree the scope and objectives of the audit.

(i) Scope

The scope of the audit can be the facility as a whole, an operational process or a waste treatment mechanism or other tangible subject matter which can be clearly defined. The scope should be agreed upon and documented. Issues such as confidentiality of the audit subject matter should also be assessed and agreed upon.

(ii) Objectives

The objective(s) of the audit should also be documented. Typical objectives may include compliance with a company policy, IPC licence, the environmental management system, or other operational control issue. Objectives should be meaningful, specific and achieveable.

(iii) Financial/Human Resources

Commitment of financial and human resources should be agreed, including issues such as personnel required, time required, external resources required (e.g. specialist consultants or contractors for say, environmental monitoring or consultancy).

(iv) Time Constraints

An achievable deadline should be agreed for the completion of the audit or audit programme.

1.1.2 Selecting the Environmental Audit Team

Choosing the participants in the audit team is a critical factor in achieving the successful completion of the audit. The composition of the audit team is a function influenced by numerous factors including audit objectives, individual ability of proposed members of the audit team and personal characteristics of team members.

(i) Audit Objectives

When selecting the audit team members, the scope and objectives of the audit or audit programme as agreed with senior management should be referenced. Questions that need to be asked when deciding if the audit objectives can be attained by proposed audit team members include;

- ❖ Are the objectives of the audit clearly understood?
- ❖ Is the scope of the audit clear?
- ❖ Are the requirements of the audit process clearly defined?
- ❖ Has the human resource required been identified (including skills, competency and time)?

(ii) Individual Ability of Proposed Audit Team members

Once the requirements of the audit and the audit team have been delineated, the next phase involves selecting team members who can deliver on the individual and combined facets of the audit.

The individual with responsibility for reporting on the findings of the audit process to senior management should have overall responsibility for selecting the audit team members.

Prior to commencing the selection process, the following questions should be taken into consideration;

- ❖ What are the issues that the audit needs to address (e.g. waste management, operation of wastewater treatment plant, atmospheric emissions, combination of same)?
- ❖ What is the expertise required to determine the answers required to attain the objective of the audit (e.g. operator experience, scientific knowledge, engineering capability, procedural familiarity)?
- ❖ What independence is required from the members of the auditing team (e.g. should the operator of the wastewater treatment plant be a member of the audit team)?
- ❖ Can all the expertise required be satisfied by in-house resources? (e.g. is specialist monitoring or engineering consultancy required ?).
- ❖ What time input is required from the proposed members of the audit team ?

(iii) Personal Characteristics/Abilities

When the 'proposed' candidates for the audit team have been short-listed, the individuals available for selection should be screened for personal traits including;

- ❖ Communication ability
- ❖ Ability to prioritise/focus on significant issues
- ❖ Observant
- ❖ Team player focus.

Once the scope and objective(s) of the audit or audit programme have been determined, the audit team members have been selected and are briefed on same, the team is ready to commence the audit.

1.1.3 Method Statement for Conducting the Audit

Prior to commencing the audit, a number of issues need to be agreed by the audit team; these are;

- ❖ Roles and responsibilities;
- ❖ Audit mechanism;

- ❖ Pre-Audit requirements; and
- ❖ Reporting mechanism.

(i) Roles and Responsibilities

Auditors individual roles and responsibilities should be clearly defined and understood by each auditor and the team as a whole.

(ii) Audit Mechanism

The format of the audit should also be agreed amongst the audit team. Decisions and scheduling of the following issues need to be determined prior to commencement of audit;

- ❖ Is the audit a desk-based review only?
- ❖ Will the audit require a tour of the audit subject matter?
- ❖ Will the audit require an interview of pertinent personnel?
- ❖ Is monitoring required that may require the operation of a specific piece of equipment ?

Any intrusive requirements of the audit, e.g. site tour, interviews, monitoring should be pre-arranged with the appropriate personnel to allow minimal interruption by the audit process.

(iii) Pre-audit Requirements

Each auditor should list what supporting information is required to provide a background to the audit subject matter. This information is likely to compose of some or all of the following; a process description, existing operational and control procedures, individuals responsibilities towards the audit subject matter, complaints register, correspondence with regulatory authorities, corrective action file, communication with environmental stakeholders (e.g. neighbours), accidents/emergencies register, historical monitoring data, maintenance data, results of previous audits.

Any equipment or apparatus required to assist the audit process should also be assessed (e.g. monitoring equipment, dictaphones, etc.).

(iv) Reporting Mechanism

The reporting mechanism on the findings of an audit is composed of three phases;

- Discussion of omissions, anomalies and findings between the audit team as an entity and the clarification of same with the individual(s) with responsibility for audit subject matter though the audit team leader,

- Presentation of draft report to individual(s) with responsibility for audit subject matter by the audit team leader, allowing scope of corrections and decisions concerning appropriate corrective action; and

- Presentation of final report and proposed corrective action to senior management.

A final comment worthy of mention is that, while the individual activities required above are comprehensive, any meetings or reports associated with successful completion of the audit process should be as brief and concise as possible.

1.2 Environmental Audit Template

1.2.1 Introduction

As stated previously, the application of the template should not be considered as being limited to the chemical industry as the principles in designing same are outlined such that the template can be modified to suit the targeted industry. It should also be noted that although the template is drafted considering the audit of the site as a whole entity, the template is flexible such that it can be applied to a smaller audit subject matter, e.g. process, abatement system, etc.

When implementing the protocol, it is stressed that although there is a formalised list of questions, the auditor should increase or decrease the priority on individual sections, depending on the objectives defined at the pre-audit phase. It should also be noted that auditors should apply their initiative if a topic which arises in the audit is deemed to require more attention than the template may be perceived to suggest.

1.2 General Information

This section of the template provides guidance on the audit subject matter (e.g. process). Auditors should obtain process flow information (e.g. schematics and descriptions) and determine the nature and quantity of raw materials used, intermediate products, environmental emission points and final products. Ancillary activities should also be identified and details obtained on same (e.g. cooling towers, abatement and treatment systems).

(i) Site Description

Auditors must assess the setting of the facility or operation being audited. A general site layout map should be obtained. The location of the site with respect to neighbours, sub-tenants on lands owned by the company, and designated environmental sites (e.g. Special Areas of Conservation, Natural Heritage Areas, etc.) should be determined.

(ii) Visual and Aesthetic Impact

One of the less well investigated areas of an environmental audit is that of visual and aesthetic impact of a site. The presentation and the setting of the site should be assessed, reviewing issues such as visibility, impact on material assets and adjacent land-use. Photomontages conceptualising the visual impact of the site or other visual prediction impact prediction mechanism should be reassessed to determine the accuracy. Efforts by the company in supporting the community (e.g. open days, contribution to local social events) should be investigated as much as the environmental impact on the locality.

(iii) Activity Licensing

This section of the template provides a prompt to the auditor on obtaining information concerning the direct environmental licences (e.g. Integrated Pollution Control or Trade Effluent Discharge Licence) or indirect environmental conditions (conditions associated with Planning Permission) that the company are subject to.

Determining the activities which attract this licence may assist in providing a focal point for assessing the environmental impact of the operation. Where possible, historical correspondence with the regulatory authority should be reviewed to assess previous difficulties experienced on-site concerning environmental issues.

(iv) Geology/Hydrogeology

An assessment of the vulnerability of the underlying subsurface to contamination should be identified. All information concerning potential pollutant pathways (e.g. springs, soakways, surface watercourses) and risk categories (e.g. vulnerability of quaternary and bedrock geology, aquifer resource classification) should be obtained.

(v) Soil and Groundwater Contamination

Risks of current and historical soil and groundwater contamination should be assessed. This risk assessment should include a review of any historical disposal of materials/wastewater on-site, storage of hazardous materials and an interpretation of soil or groundwater analyses conducted on site samples.

(vi) Emissions to Atmosphere

All emission points to atmosphere should be identified. Once identified, the activity(ies) from which the emissions to atmosphere are generated should be assessed for operational control. At a minimum, the potential sources of emissions to air as outlined in *Appendix 7* should be reviewed as deemed appropriate to the audit subject matter.

Potential contributors to air emissions include, but are not limited to the following;

- Volatile organics compounds (VOCs)/Organics
- Odours
- Organisms
- Halogens and compounds
- Phosphorous and compounds
- Sulphur and compounds
- Nitrogen and compounds
- Carbon oxides
- Particulates, metals, metalloids and compounds
- Acid gases

It should be noted that the previous list should not be considered as comprehensive for all sites. The Material Safety Data Sheets for all substances on-site should be reviewed to assess which substances may potentially be present in the emissions to air from the facility.

Information should be sought on baseline receiving environment quality and biodiversity (e.g. lichen survey, ambient air quality, etc.). This information should be compared with the existing quality of the receiving environment.

BATNEEC technologies employed for load minimization, recovery/recycling and treating should be compared to existing controls implemented on-site *see Appendix 6*. The operational performance and maintenance of these technologies should also be reviewed.

The licensing and monitoring of all identified emission points should be reviewed in tandem with historical compliance monitoring data. Percentage compliance with existing licence/permit limits or BATNEEC limits (*see Appendix 5*) should be determined. It is also recommended that an eco-index (pollutants emitted per unit raw material used/product sold) should be calculated to assess improvements or otherwise in reducing pollutants emitted on an annual basis.

Complaints or prosecutions received historically should be collated and the efficiency of corrective action programmes arising from same reviewed.

Any projected modifications to processes should be reviewed to determine any increased environmental impact predicted with same.

(vii) Noise Emissions

Any data available concerning noise monitoring on-site should be assessed. Occupational noise monitoring may present the key to elevated boundary noise levels.

The existence of data concerning the sound power level of machinery should be requested, in particular equipment in identified activities for high risk of noise generation.

Complaints or prosecutions received historically should be collated and the efficiency of corrective action programmes arising from same reviewed.

The licensing and monitoring of all identified noise monitoring points should be reviewed in tandem with historical compliance monitoring data. Percentage compliance with existing licence/permit limits or BATNEEC limits should be determined.

Any projected modifications to processes should be reviewed to determine any increased noise impact predicted with same.

(viii) Water and Energy Consumption

All sources of water (e.g. mains, wells, etc.) and energy (e.g. electricity, gas oil, etc.) should be identified.

The primary consumers of water and energy should be noted and the existence of any programmes to minimize consumption of same evaluated.

Concerning water quality, the frequency of monitoring and water quality should be reviewed to assess the existing quality and to determine if there has been a deterioration in same over time.

It is suggested that an eco-index (consumption of water and energy per unit raw material used/product sold) should be calculated to assess improvements or otherwise in natural resource consumption on an annual basis.

(ix) Emissions as Wastewater

All wastewater emission points should be identified. Once identified, the activity(ies) generate the emissions should be assessed for operational control. At a minimum, the potential sources of emissions as wastewater as outlined in *Appendix 7* should be reviewed as deemed appropriate to the audit subject matter.

Potential contributors to wastewater quality include but are not limited to the following;

- Mercury, Cadmium and compounds;
- Solvents;
- Organics;
- Heavy Metals;
- Salts, Cyanides and Sulfites;
- Inorganic acids and alkalis;
- Phosphates and Nitrates;
- Tributylin and compounds; and
- Tri-phenyl tin and compounds

It is stressed that the previous list should not be considered as comprehensive for all sites. The Material Safety Data Sheets for all substances on-site should be reviewed to assess which substances may potentially contaminate water on-site.

Information should be sought on baseline receiving environment quality and biodiversity (e.g. in floral and faunal quantity and diversity in receiving surface watercourses). This information should be compared with the existing quality of the receiving environment.

BATNEEC technologies employed for load minimization, recovery/recycling and treating should be compared to existing controls implemented on-site *see Appendix 6*. The operational performance and maintenance of these technologies should also be reviewed.

The integrity and location of all wastewater (foul, process or stormwater) conduits or pipework should be reviewed to determine the integrity and isolation of same. The provisions to promote general staff awareness regarding the location of same and what substances or liquids should or should not be permitted to enter drains and gulleys should be determined.

The licensing and monitoring of all identified discharge points should be reviewed in tandem with historical compliance monitoring data. Percentage compliance with existing licence/permit limits or BATNEEC limits (*see Appendix 5*) should be determined. It is also recommended that an eco-index (pollutants emitted per unit raw material used/product sold) should be calculated to assess improvements or otherwise in reducing pollutants emitted on an annual basis.

Complaints or prosecutions received historically should be collated and the efficiency of corrective action programmes arising from same reviewed.

Any projected modifications to processes should be reviewed to determine any increased environmental impact predicted with same.

(x) Chemical Management

This section of the template endeavours to assist the auditor in determining to what extent responsible care for chemicals is being conducted on-site.

Questions aim to assess if the company is aware if the storage and handling risks associated with the chemicals that are stored and used on-site. The storage facilities (including secondary containment) and procedures in place for safe and 'environmentally friendly' chemical management are also assessed.

(xi) Bulk Chemical and Drum Storage

The provisions to minimize spillage and explosion risk as a result of bulk chemical and drum storage should be reviewed in conjunction with the integrity assessments (e.g. BS8007:1987 construction standard) of the existing storage facilities.

(xii) Waste Management

All waste generation points should be identified. Once again, the identified activity from which the emissions are generated should be investigated and its operational performance and waste management procedures should be assessed. At a minimum, the potential sources of waste as outlined in *Appendix 7* should be reviewed as deemed appropriate to the audit subject matter.

Potential wastes which may be generated include, but are not limited to, the following;

- Catalysts;
- Molecular sieves;
- Activated Carbon;
- Filter aid, etc.;
- Organics;
- Halogen and compounds;
- Phosphorous and compounds;
- Biologically active materials;
- Organo-metallic compounds;
- Metal carbonyls;
- Metals and compounds;

- Oxidising agents;
- Metal sludges;
- Polymeric residues;
- Organic solvents;
- Asbestos;
- WWTP sludge;
- Waste engineering and maintenance oils;
- Waste batteries and fluorescent bulbs; and
- Packaging waste.

It is stressed that the previous list should not be considered as comprehensive for all sites. Waste should be assessed on an activity by activity basis and tracked from point of generation to final destination (off-site).

All company efforts employed for waste minimization, reuse, recovery/recycling and treating waste should be assessed as per the Waste Management hierarchy. The operational performance and maintenance of these technologies or practices should also be reviewed.

The provisions to promote general staff awareness regarding effective waste management should be determined.

The provision of storage facilities and handling procedures for on-site waste should be reviewed in conjunction with determining the management of the 'cradle to grave' hierarchy, (e.g. through the inspection and usage of appropriately permitted or licensed waste contractors)

As was the case with previous pollutants, it is recommended that an eco-index (pollutants emitted per unit raw material used/product sold) should be calculated to assess improvements or otherwise in reducing waste generated on an annual basis.

Complaints or prosecutions received historically should be collated and the efficiency of corrective action programmes arising from same reviewed.

Any projected modifications to processes should be reviewed to determine any increased environmental impact predicted with same.

(xiii) Indirect Environmental Aspects

In the previous sections, direction has been provided in determining the direct environmental impact of the sites activities on the immediate known receiving environment.

The audit should also appraise to what extent the auditee(s) has determined the remote or indirect environmental aspects of their operation. Indirect environmental aspects which should be assessed include;

- ❖ Impacts associated with manufacture and delivery of raw materials and final products;
- ❖ Waste generated from consumption or use of product by the consumer;
- ❖ Environmental performance of subcontractors;
- ❖ Environmental impact of developing new markets; and
- ❖ Administrative environmental impacts (policy and strategy decisions).

(xiv) Other

It is strongly recommended that where possible, audits should be supported by site tours to see 'in the field' what is occurring on-site. Office based audits risk becoming sterile paper based exercises only. Site tours also permit an inspection of general site housekeeping, chemical and waste storage facilities which can assist the auditor in determining to what extent ownership of environmental responsibilities has been disseminated amongst all staff on site.

Interviewing general employees can also provide invaluable information concerning environmental aspects which may have been overlooked or shown less attention compared to an office based review.

Overall, the audit should be as brief as possible, focusing on the identified objectives only. Information should be obtained in a non-confrontational and open manner. A good auditor should attract and promote open conversation concerning environmental issues of concern on site as opposed to a more adversarial approach.

Sheet Reference #1-		Page 1 of 1
AGREEMENT ON SCOPE AND OBJECTIVES OF ENVIRONMENTAL AUDIT (OR AUDIT PROGRAMME)		
Define the Audit Scope		
Outline the Audit Objectives	1.	
	2.	
	3.	
Resource Requirement	Human	
	Financial	
	Other	
Time Limitation		
Other Comment		
Circulation List of Report		
Confidentiality Details		
Document Retention Details		
Signed	Environmental Audit Manager (Date)	
	Senior Manager #1 (Date)	
	Senior Manager #2 (Date)	

ENVIRONMENTAL AUDIT TEAM SELECTION FORM

Define the Audit Scope			
Outline the Audit Objectives	1.		
	2.		
	3.		
Objective # 1			
Topics to be Addressed to Achieve Objective	A.		
	B.		
	C.		
Topic A			
Auditor Requirement	Yes	No	Details
Independence Required			
Management Experience			
Operator Experience			
Scientific Knowledge			
Engineering Experience			
Other			
Topic B			
Auditor Requirement	Yes	No	Details
Independence Required			
Management Experience			
Operator Experience			

Sheet Reference #2						Page 2 of 2
Scientific Knowledge						
Engineering Experience						
Other						
Topic C						
Auditor Requirement	Yes	No	Details			
Independence Required						
Management Experience						
Operator Experience						
Scientific Knowledge						
Engineering Experience						
Other						
Candidate Auditor	Personal Characteristics (1-5)					
Name	Communication		Ability to Prioritise	Observant	Team Member	**Total**
Topic A						
1.						
2.						
3.						
Topic B						
1.						
2.						
3.						
Topic C						
1.						
2.						
3.						
Proposed Audit Team						
1.						
2.						
3.						
Signed:				**Date:**		
	Environmental Audit Manager					

ENVIRONMENTAL AUDIT FORMAT

Environmental Audit Team	1.
	2.
	3.

Roles and Responsibilities	
1.	
2.	
3.	

Audit Mechanism			
Auditor # 1	Yes	No	Detail
Desk Based Review			
Process Tour			
Interview			
Monitoring			
Auditor # 2	Yes	No	Detail
Desk Based Review			
Process Tour			
Interview			
Monitoring			
Auditor # 3	Yes	No	Detail
Desk Based Review			
Process Tour			
Interview			
Monitoring			
Other Detail:			

Sheet Reference #3-			Page 2 of 2
Pre-audit Requirements			
Auditor # 1	Yes	No	Detail
Process Description			
Existing Operational Controls			
Other			
Auditor # 2			
Process Description			
Existing Operational Controls			
Other			
Auditor # 3			
Process Description			
Existing Operational Controls			
Other			

Time Deadline	
Signed:	
Auditor #1	
Auditor #2	
Auditor #3	
Environmental Audit Manager	
Date:	

Sheet Reference #4-

ENVIRONMENTAL AUDIT PROTOCOL

Audit Subject Matter:

Audit Location:

Auditor(s):

Date:

General Information

Process Address	
Contact Details	
Details of process, including raw material, intermediate products, final products.	
Details of operator involvement in the process	
Hours of operation and any scheduled shutdown	

Other Detail:

Site Description

Site Area	
Percentage of Site covered by Hardstanding Areas	
Is Site Plan available	
Are there any sub-tenants on the site	
What is the nature of the surrounding land use (residential, commercial, agricultural, etc.)	
Describe the topography	
Size and location of nearest residential communities	
Are there any designated sensitive areas in close proximity to the site (e.g. SAC, SPA, NHA)	

Other Detail:

Visual and Aesthetic Impact

Can the facility be seen from an adjacent public highway	
Has a photomontage been developed for the site to assess the visual impact, if any, of the site on views from outside the site ?	
Are there any items of archaeological importance within the confines or in the immediate proximity of the site ? (e.g. refer Hayes Compendium[Note 1])	
Have any complaints ever been received concerning visual impact of the site, or parts thereof ?	
What has the company done to be a 'better neighbour' in the locality?	
What management and operational control procedures are in place to ensure the effective tracking and mitigation of this aspect?	
Other Detail:	

[Note 1] National Archives.

Activity Licensing

What licences/permits are attached to the site?	
Are there any conditions of an environmental nature attached to these licences (e.g. IPC, Planning Permission, Atmospheric Emissions).	
What process activities attract these conditions?	
What regulatory authority enforces these licences/permits?	
What data, if any, is required to be submitted to the regulatory authority to demonstrate compliance with such licences or permits?	
What percentage compliance has been achieved with such licences/permits in the last three years?	
Has the facility been prosecuted for an environmental non-compliance or incident previously?	
When was the last site visit by such regulatory authorities?	
What non-compliances or observations were noted during such visits?	
What corrective actions were required or implemented as a result of comments received following such site visits	
Are any changes predicted with the site activities or process which may affect the validation of the licence or the permit?	
Other Detail:	

Geology/Hydrogeology

Describe the quaternary and bedrock geology, including aquifer resource classification and vulnerability classification.	
Where are the nearest surface watercourses (including field drains)	
Are there any boreholes, springs, wells or sump holes in existence on-site?	
Other Detail:	

Soil and Groundwater Contamination

Has there ever been an incident of soil or groundwater contamination on-site?	
Was there any remediation/site clean-up conducted historically (including Monitored Natural Attenuation, Pump and Treat, *In-situ* treatment, etc.)	
Has fill ever been brought to the site to alter site topography? Where was this fill sourced? Was analysis conducted on the fill to demonstrate the absence of contamination?	
Have any parts of the process been used historically for oil, chemical or waste storage?	
Has there, or is there any practice of on-site landfilling being conducted?	
Have soil or groundwater samples ever been taken on-site? What quality results were obtained?	
Has there ever been evidence of migration on-site of contaminants from external sources?	
What management and operational control procedures are in place to ensure the effective tracking and mitigation of this aspect?	
Other Detail:	

Emissions to Atmosphere

Detail all major and minor (forced or passive) emission points to atmosphere.	
What process activities require these emission points ?	
Are BATNEEC technologies in place on all emission points to minimise environmental impact (refer Appendix 6)	
What preventive maintenance is conducted on emission control devices? What frequency is this maintenance conducted on?	
Hours of operation and any scheduled shutdown	
Which, if any, of these emission points are subject to permits, licences, mass emissions or emission limit values?	
What monitoring is conducted on these emission points?	
What percentage compliance has been achieved with these mass emission or emission limit values ?	
If no emission limits are enforced on the emission points, what percentage compliance do the emissions have with the limit values as detailed in Appendix 6.	
Other Detail:	

Emissions to Atmosphere

Is/has ambient atmospheric monitoring been conducted?	
Have fugitive emissions been assessed and quantified ?	
Have there been any historical complaints concerning emissions to atmosphere from the facility?	
Have any complaints or comments been received concerning the quality of water or diversity of flora/fauna in adjacent watercourses?	
Are there any potential atmospheric emissions from sources off-site, which may impact on ambient air quality?	
Has the on-going impact of emissions to atmosphere on biodiversity been determined?	
Are there any projected modifications to atmospheric emission generating processes anticipated on-site?	
Other Detail:	

Noise Emissions	
Does the site have a requirement to conduct its activities within a noise limit during the day and night?	
Has boundary site noise ever been conducted?	
How frequently is noise monitoring conducted on site?	
Have the main noise contributors on site been identified?	
Has a noise reduction programme ever been determined for, or implemented on the site?	
Detail any noise abatement works or practices implemented on site	
Have any complaints ever been received concerning noise emissions from the facility?	
Are there any projected modifications to noise generating processes anticipated on site?	
What management and operational control procedures are in place to ensure the effective tracking and mitigation of this aspect?	
Other Detail:	

Water Consumption

What are the sources of water for site consumption?	
Is there any form of water pre-treatment prior to usage on-site?	
Has/is there any routine analysis performed on water that is supplied to the site?	
Have the main consumers of water been identified on the site?	
Has a programme been implemented to minimise water usage on site?	
What management and operational control procedures are in place to ensure the effective tracking and mitigation of this aspect?	
Other Detail:	

Energy Consumption

What are the sources of energy for site consumption?	
Have the main consumers of energy been identified on the site?	
Has an energy audit been conducted on site?	
Has a programme been implemented to minimise energy usage on site?	
What management and operational control procedures are in place to ensure the effective tracking and mitigation of this aspect?	

Other Detail:

Emissions as Wastewater	
	Page 12 of 19
Detail all wastewaters generated on-site (including process, sanitary and surface waters)?	
Do separate drainage systems exist for each type of wastewater	
Where are these wastewaters ultimately discharged to?	
Are BATNEEC technologies in place on all emission points to minimise environmental impact (refer Appendix A)	
What preventive maintenance is conducted on emission control devices? What is the frequency of this maintenance?	
Hours of operation and any scheduled shutdown	
Which, if any, of these emission points are subject to permits, licences, mass emissions or emission limit values?	
What monitoring is conducted on these emission points?	
What percentage compliance has been achieved with these mass emission or emission limit values?	
If no emission limits are enforced on the emission points, what percentage compliance do the emissions have with the limit values as detailed in Appendix A.	
What management and operational control procedures are in place to ensure the effective tracking and mitigation of this aspect?	
Other Detail:	

Emissions as Wastewater 	
What maintenance and inspection procedures are in place for ensuring integrity of wastewater tanks and pipelines?	
Have any complaints been received concerning the quality of wastewater discharged from the site?	
Have any complaints or comments been received concerning the quality of water or diversity of flora/fauna in adjacent watercourses?	
Has the on-going impact of wastewater discharges on biodiversity been determined?	
Are there any projected modifications to wastewater generating processes anticipated on site?	
What management and operational control procedures are in place to ensure the effective tracking and mitigation of this aspect?	
Other Detail:	

Chemical Management

Are inventory lists and material safety data sheets available for all materials used on site?	
What storage facilities are in use on the site for chemicals (including maintenance and fuel oils)?	
Have non-compatible chemicals and chemical wastes been clearly identified and stored separately?	
What procedures are in place for chemical handling and management on site?	
What training and facilities are in place for personnel managing and handling chemicals?	
Are there any projected alterations to the nature and quantity of chemical processes being used on site?	
Other Detail:	

Bulk Material Storage *Page 15 of 19*	
Identify all bulk storage facilities on site and their contents?	
What procedures are in place for bulk tank filling and distribution?	
Describe frequency of bulk delivery and times of same.	
Are bulk storage tanks fitted with high/low level alarms and are vent pumps protected against electrostatic hazards?	
What works and/or procedures are in place for minimisation of fugitive emissions during delivery of volatiles (e.g. floating tank roofs?)	
What secondary containment is in place for all bulk storage facilities on site?	
In the case of bunds, what procedure is in place for emptying rainwater?	
What maintenance and inspection procedures are in place for ensuring integrity of tanks, pipelines and secondary containment facilities?	
Other Detail:	

Drum Storage

Identify all drum storage facilities on site and their contents?	
What procedures are in place for drum delivery and distribution?	
Describe frequency of drum delivery and times of same.	
What secondary containment is in place for all drum storage facilities on site?	
In the case of bunds, what procedure is in place for emptying rainwater?	
What maintenance and inspection procedures are in place for ensuring integrity of drums and secondary containment facilities?	
Other Detail:	

Waste Management *Page 17 of 19*	
Does the facility have a formalised waste management plan? Does this waste management plan encompass the 'cradle to grave' philosophy?	
What procedures are in place for waste management?	
What regulatory body, if any, is involved with waste management issues on site?	
Have all hazardous/non-hazardous wastes been clearly identified?	
Where is waste stored on site?	
What secondary containment is provided for leachate containment or surface water protection?	
What maintenance and inspection procedures are in place for ensuring integrity of drums and secondary containment facilities?	
What external waste management contractors does the company use?	
How do these contractors treat or dispose of the waste?	
Have all waste hauliers and disposal contractors been licensed (e.g. Local Authority permits or Waste Licence from EPA)? Are copies of these permits/licences held on site? Are these licences in-date? Is there a procedure to check the status of the licence?	
Are or have wastes been treated on-site (e.g. treatment, on-site landfilling) presently or historically?	
Does the facility accept wastes on behalf of other parties? If yes, is this activity licensed?	

Waste Management	
Page 18 of 19	
What evidence is there in place to demonstrate efforts to achieve higher levels of the waste hierarchy on site (e.g. recovery and reuse as opposed to disposal)?	
Have any complaints or prosecutions been received concerning waste management on site or the removal and handling of the company's wastes off site?	
Describe site housekeeping on site?	
Other Detail:	

Indirect Environmental Aspects *Page 19 of 19*	
What environmental assessment has been conducted into product related environmental issues? -design -development -packaging -transportation -use and -waste recovery/disposal	
What environmental assessment has been conducted on issues such as; -capital investments -granting loans -insurance services -new markets -choice and composition of services (e.g. transport or catering trade) -administrative and planning decisions -product range compositions -environmental performance and practices of contractors, subcontractors and suppliers?	
Other Detail:	

Appendix 5

BATNEEC Emission Limit Values for the Chemical Sector (Environmental Protection Agency)

Introduction

The purpose of including these BATNEEC emission limit values, is to provide the auditor with a reference base to determine if emissions from the facility being audited are in comparison with what would be considered as adequately controlled using the best available technology not entailing excessive cost. The BATNEEC principle is an integral reference from the Environmental Protection Agency Act, 1992.

Emissions to Atmosphere

Emission Limit Values for Fertiliser Production		
Process	Source	Emission Limit Value (mg/m^3)
Ammonium Nitrate production	*Prill Towers* *-Particulate* *-Ammonia*	 *15* *10*
Ammonium Nitrate production	*Neutralisers/Reactors/Coolers/Driers* *-Particulate* *-Ammonia*	 *30* *50*
Ammonium Nitrate production	*Evaporators* *-Particulate* *-Ammonia*	 *15* *30*
Ammonium Phosphate Production	*-Particulate* *-Ammonia*	*15* *50*
Other Fertiliser production	*-Particulates* *-Sulphur Oxides (as SO_2)* *-Nitrogen Oxides (as NO_x)* *-Ammonia* *-Fluorides (as HF)*	*50* *200* *200* *50* *10*

Emission Limit Value for Sulphuric Acid Production	
Process	Minimum Conversion Rate (SO_2 to SO_3)
New process	*Steady State: 99.7%* *Start up (hourly ave. first 5 hours): 98%*

Emission Limit Values for Ammonia Production		
Source	Emission	Emission Limit Value (mg/m^3)
Steam Reforming Plants	*-Nitrogen oxides (NO_2 at 3% O_2)* *-Sulphur Dioxide (Natural Gas fuelled)* *-Carbon Monoxide* *-Diffuse Emissions* *-Nitrogen oxides (non-continuous emissions as NO_2)* *Purge Gas Scrubber*	*450* *2* *10* *1 t/a* *20 kg/h* *40 g NH_3/t NH_3 produced*

Emission Limit Values for Ammonia Production		
Source	Emission	Emission Limit Value (mg/m^3)
Partial Oxidation Plants- auxiliary boiler flue gas	*-Sulphur Dioxide* *-Nitrogen oxides (as NO_2)* *-Carbon Monoxide (hourly maximum)* *-Carbon Monoxide (daily average)* *-Particulates* *(active ingredient -hourly maximum)* *(active ingredient-daily average)*	*1700* *700* *175* *10* *50* *10*
Partial Oxidation Plants-steam superheater flue gas	*-Nitrogen oxides (as NO_2)* *-Sulphur Dioxide (Natural Gas fuelled)* *-Carbon Monoxide* *-Hydrogen Sulphide* *-Methanol*	*450* *2* *30* *0.3* *100*

Emission Limit Values for Specific Materials (not covered previously)		
Parameter	mg/m^3	Mass Flow Threshold for ELVs
Cadmium	*0.1*	*>1 g/hr*
Chlorides (as HCl)	*10*	*>0.3 kg/hr*
Iodides (as HI)	*5*	*>50 g/hr*
Carbon Disulphide	*5*	*>0.1 kg/hr*
Hydrogen Cyanide	*5*	*>0.1 kg/hr*
Mercaptans	*2*	*>0.1 kg/hr*
Amines (total)	*10*	*>0.1 kg/hr*
Trimethylamine	*2*	*>0.1 kg/hr*
Phenols & cresols and xylols	*10*	*>0.1 kg/hr*
1,2-Dichloroethane	*5*	*>0.1 kg/hr*
Dust-pesticide contaminated	*0.15*	*>1 g/hr*
Dust-pharmaceutical	*0.15*	*>1 g/hr*
Bromine	*10*	*>50 g/hr*
Chlorine	*10*	*>50 g/hr*
Iodine	*10*	*>50 g/hr*
Mercury	*0.1*	*>1 g/hr*
Total Heavy Metals	*0.5*	*> 5 g/hr*
Nitrogen oxides (as NO_2)	*300*	*> 3 kg/hr*
Sulphur oxides (as SO_2)	*300*	*> 3 kg/hr*
Particulates-general	*20*	*>0.5 kg/hr*
Ethylene dichloride (1,1 dichloroethylene)	*5*	*>0.1 kg/hr*
Acrylonitrile	*20*	*>0.1 kg/hr*
Toluene Di-isocyanate	*1*	*>0.1 kg/hr*
Ethyl acrylate	*1*	*Applicable to vents from bulk storage (> 20 tonnes)*
Isobutyl acrylate	*1*	
Methyl Acrylate	*5*	
n-Butyl Acrylate	*5*	
t-Butyl and higher acrylate	*20*	

Emission Limit Values for General Emissions to Air, excluding incinerators (not covered previously)			
Constituent Group or Parameter	mg/m^3	Mass Flow Threshold for ELV	Emission Limit Value (mg/m^3)
Carcinogenic Substances	*T.A. Luft I* *T.A. Luft II* *T.A. Luft III* *Substances (other than those above) with R45 designation*	*>0.5 g/hr* *>5.0 g/hr* *>25.0 g/hr* *>0.5 kg/hr*	*0.1* *1.0* *5.0* *5.0*
Inorganic Dust Particles	*T.A. Luft I* *T.A. Luft II* *T.A. Luft III*	*>1 g/hr* *>5 g/hr* *>25g/hr*	*0.2* *1.0* *5.0*
Vaporous or Gaseous Inorganic Substances	*T.A. Luft I* *T.A. Luft II* *T.A. Luft III* *T.A. Luft IV*	*>10 g/hr* *>50 g/hr* *>0.3 kg/hr* *>5.0 kg/hr*	*1* *5* *30* *500*
Organic Substances with Photochemical Ozone Potential – POCP	*U.K. AEA 1* *U.K. AEA 2*	*>0.5 kg/hr* *>2.0 kg/hr*	*20* *50*
Organic Substances	*T.A. Luft I* *T.A. Luft II* *T.A. Luft III*	*>0.1 kg/hr* *>2.0 kg/hr* *>3.0 kg/hr*	*20* *100* *150*
General Dusts		*<0.5 kg/hr* *>0.5 kg/hr*	*150* *20*
Pharmaceutical and Pesticide Dust-as active ingredient		*>1 g/hr*	*0.15*
Fugitive Emissions	*As per E.C. Solvent Directive*		

Note 1 Reference to the previous tables should be cross –referenced with the entire document- *Integrated Pollution Control Licensing, BATNEEC Guidance Note for the Chemical Sector,* Environmental Protection Agency, May 1996.

Discharges to Water

Emission Limit Values for Discharges to Water	
Constituent Group or Parameter	**Limit Value (Daily Average)**
pH	*6-9*
Number of Toxicity Units	*10*
Total Nitrogen (mg/l as N)	*>80% removal or 15 mg/l*
Total Phosphorous (mg/l as P)	*>80% removal or 2 mg/l*
Total Ammonia (mg/l as N)	*10*
Oils, Fats and Grease (mg/l)	*10*
Organohalogens (mg/l)	*0.1 (monthly mean)*
Phenols (mg/l)	*1.0*
Cyanide (mg/l as CN)	*0.2*
Mercury (mg/l)[Note 1]	*0.05*
Tin (mg/l)	*2.0*
Lead (mg/l)[Note 3]	*0.5*
Chromium (mg/l as Cr VI)	*0.1*
Chromium (mg/l as total Cr)[Note 3]	*0.5*
Cadmium (mg/l)[Note 2]	*0.05*
Zinc (mg/l)[Note 3]	*0.5*
Copper (mg/l)[Note 3]	*0.5*
Mineral Oil (mg/l) Interceptors	*20*
Mineral Oil (mg/l) Biological Treatment	*1.0*
EC. List I	*As per 76/464EC & amendments*
Benzene & Toluene & Xylene (mg/l combined)	*0.1 (monthly mean)*
Genetically Modified Organisms	*As per 90/219/EEC and SI 345 of 1994*
Parameter	**Minimum % Total Removal**
BOD	*91*
COD	*75*
Fish Tainting	*No tainting*

[1] Also compliance with Dir 82/176/EEC & 84/156/EEC, amendments and SI 55 of 1986
[2] Also compliance with Dir 83/513/EEC, amendments and SI 294 of 1985
[3] Where the sum of the loads of these metals is <200 g/day prior to treatment, the respective emission limit value may be increased four fold in justified cases.

Appendix 6

BATNEEC Control Technologies for the Chemical Sector

1.0 INTRODUCTION

In selecting the BATNEEC technology, the following hierarchy is adopted;

- Process design/redesign changes to eliminate emissions and wastes that might pose environmental problems
- Substitution of materials/solvents, etc. by environmentally less harmful ones
- Demonstration of waste minimisation by means of process control, inventory control and end-of-pipe technologies, etc.

1.1 Technologies for Load Minimisation

- Improved phase separation in the process
- Optimisation of vacuum condensation efficiency
- Additions of reagents to reactors via sluice valves
- Optimised separation of product and solvent in the filtration or centrifugation step prior to final drying
- Inventory Control
- Optimisation of water usage
- Countercurrent product rinsing
- Mother Liquor Treatment (recuperation, oxidation)
- Dry equipment cleaning and dry vacuum systems, where feasible
- Separation of cooling water, storm water and process effluents of different origin in order to permit appropriate treatment options.

1.2 Containment of Emissions

- Enclosure of materials (excluding bulk liquids), storage, handling, processing and transfer within a suitable building
- Minimisation of tank filling losses by, e.g. vapour return systems
- Secondary containment of relief valve or bursting disc discharges from reactors
- Low loss vacuum pumps, e.g. dry vacuum pumps, once through oil pumps, cryogenic solvent as pump seal liquid
- Covered basin in WWTP to prevent VOC losses
- Vent collection and ducting from tank farms to central abatement systems
- Closed transfer systems from reactors to centrifuges to filters and dryers
- Bunding of tanks
- Single controlled emission point for all large dedicated plants
- Minimisation of tank breathing losses by pressure vacuum valves, isolation and or tanks painted white
- Overground pipelines and transfer lines
- Floating roofs on bulk storage tanks
- Storage of delivered materials pending detailed analysis
- Check system to avoid mixing incompatible materials
- Bunding of all stored materials with separate bunding for incompatibles
- Overfilling protection on bulk storage tanks
- Prevention of rain ingress, wind entrainment, etc. for stored materials.

1.3 Technologies for Recovery and Recycling

- Waste air streams with relatively high solvent loadings, especially those after drying, distillation/condensation or vacuum filtration should be subject to an effective treatment, primarily aimed at recovery.
- Separate organic and aqueous phase drains from process buildings
- Interceptor tanks at each process building
- On-site solvent recovery plants
- Off-site solvent recovery
- Water condensors on reactor overheads
- Refrigerated condensers on reactor overheads
- Cryogenic condensation on reactor overheads
- Carbon adsorption/desorption on vapour streams containing organics
- Organic liquid absorption/desorption on vapour streams containing organics.
- Polymer adsorption/desorption on vapour streams containing organics
- Aqueous scrubbing with solvent recovery
- Optimisation of condensation capacity after distillation resulting in at least 95% efficiency for all solvents in multi-purpose plants and at least 99% for dedicated plants
- Reuse in another industry.

1.4 Technologies for Treating Air Emissions

- Biofilters as final air treatment (T1)
- Selective chemical reaction scrubbers, e.g. hypochlorite scrubbers for odour control of mercaptans, NaOH scrubbers for acid removal (T2)
- Aqueous scrubbing of soluble VOCs for liquid phase biodegradation in WWTP (T3)
- Cyclones for removal of fermentor aerosol (T4)
- Steam sterilisation of fermentor exhaust (T5)
- HEPA and bag filters (T6)
- Wet electrostatic precipitators (T7)
- Vapour incineration-thermal (T8)
- Vapour incineration-catalytic and regenerative (for non-chlorinated solvent streams) (T9)
- Flares (T10).

TABLE 1.1 SUMMARY TREATMENT TECHNOLOGIES FOR EMISSIONS TO AIR	
Emission Type	**Technologies**
VOCs/Organics	T2, T3, T8, T9, T10
Odours	T1, T2, T8, T9
Organisms	T5, T6
Halogens and compounds	T2
Sulphur and compounds	T2
Phosphorous and compounds	T2
Nitrogen and compounds	T2, T10
Carbon oxides	--
Particulates, metals, metalloids and compounds	T4, T6, T7
Acid gases	T2

1.5 Technologies for Treating Water Emissions

1.5.1 Pre-Treatment

- Air stripping of effluents for recovery or treatment (VOCs)
- Steam stripping of effluents for recovery or treatment (Organics)
- Steam or air stripping for removal of organohalogens and aromatic hydrocarbons prior to WWTP. (These streams should be treated as close to the source as possible and should not be transported in open sewer systems on-site. The air or steam used should be subject to recovery).
- Precipitation (Heavy Metals)
- Oxidation (Cyanides)

1.5.2 Primary Treatment

- pH correction/neutralisation (acids and alkalis)
- Coagulation/flocculation/precipitation (dissolved and colloidal solids)
- Sedimentation/filtration/floatation (solids removal)

1.5.3 Secondary Treatment

- Biofilters (organic treatment for BOD removal)
- Anaerobic treatment (organic treatment for BOD removal)
- Wet air oxidation (organic treatment for BOD removal)
- Activated Sludge/aeration lagoons (organic treatment for BOD removal)
- Extended aeration (organic treatment for BOD removal)
- Nitrification/denitrification (treatment of nitrogen compounds).

1.5.4 Tertiary Treatment

- Filtration, coagulation, precipitation (solids and phosphate removal)
- Ozonation/Oxidation (trace organics)
- Activated Carbon polishing (trace organics)
- Resin beds (dissolved solids)

1.5.5 Sludge Treatment

- Gravity thickening
- Dissolved air flotation
- Filtration
- Centrifugation
- Sludge digestion
- Drying.

1.6 Technologies for the Treatment and Disposal of Wastes

- Incineration
- Waste encapsulation
- Vitrification of waste
- Engineering landfill of wastes.

Appendix 7-

BATNEEC Sources and Emissions from the Chemical Sector

1.0 Sources of Emissions to Air from

1.1 Fugitive Emissions and Unscheduled Emissions

- Vapour losses during storage, filling and emptying of bulk solvent tanks and drums (including hose decoupling)
- Stripping of VOCs and odorous compounds from open tanks in wastewater treatment plants (WWTP) resulting in releases to air and or odour problems
- Venting of storage tank blanket gases
- Fugitive emissions of particulate matter from open storage, loading and unloading of solid materials
- Bursting disks and relief valve discharges
- Leakages from flanges, pumps, seals, valve glands, etc.
- Building losses (through door, window, etc.)

1.2 General Organic Chemical Manufacturing Plants

- VOC losses from wet product/cake handling/transportation (S1)
- Vapour losses from reactors, fermenters and in process holding tanks (S2)
- Vapour losses from open reactor manlids during loading (S2)
- Solid intermediates and products from handling, drying, milling and packing (S3)
- Solvent vapours from drying operations (S1)
- Building ventilation gases (m)
- Regeneration of catalysts, etc. (S4)
- VOC from cooling towers and ejector vents (m)
- Vapours from desolventiser exhausts (S1)
- Distillation vents (m)
- Material handling and storage (S5)
- Vacuum pump discharges (m)

1.3 Formulation Plants

- Solvent vapour losses from tablet coating (S1)
- Losses from material handling and processing (S5)
- Dust from milling and granulation (S3)

1.4 Organo-metallic Chemical Manufacturing Plants

- Process and blending operations (S6)
- Sump vents (m)
- General building extraction (m)
- Venting of blanket gases
- Distillation vents (m)

1.5 Inorganic Chemical Manufacturing Plants

- Absorption column releases (S7)
- Digestors (S9)
- Combustion gases releases (m)
- Reactor emissions (S8)
- Emissions from kilns (S8)
- Emissions from handling and storage of materials (S8)
- Emissions from dryers (S8)
- Releases from vaporising systems (S8)
- Emissions from dipping tanks and baths (m)
- Particulates from shot blasting (m)
- Hydrogenation off-gas (m)
- Building ventilation (m)
- Granulation and prilling plants (S10)

1.6 Chemical Storage Installations

- Filling (tank headspace and hose decoupling) (S11)

Summary of Sources and Emissions to Air	
Source Type	**Emission Type**
S1	Volatile Organic Compounds (VOCs)
S2	VOCs, Odours Organisms Halogens and compounds Sulphur and compounds Phosphorous and compounds Nitrogen and compounds Oxides of carbon Metals, metalloids and compounds Particulates (inc. active compounds) Acid gases
S3	VOC traces Halogens and compounds Metals, metalloids and compounds Particulates (inc. active compounds)
S4	VOCs Halogens and compounds Sulphur and compounds Phosphorous and compounds Nitrogen and compounds Metals, metalloids and compounds
S5	VOCs Halogens and compounds Particulates (inc. active ingredients)
S6	Organic compounds Metals, metalloids and compounds Halogens and compounds Particulates
S7	Sulphur and compounds Halogens and compounds Nitrogen and compounds Organics
S8	Sulphur and compounds Halogens and compounds Nitrogen and compounds Carbon oxides Organics Particulates Metals, metalloids and compounds
S9	Sulphur and compounds Halogens and compounds Nitrogen and compounds
S10	Sulphur and compounds Halogens and compounds Nitrogen and compounds Particulates Metals, metalloids and compounds
S11	Methyl acetate Acrylonitrile Toluene di-iso-cyanate Ammonia Hydrogen Fluoride

2.0 Sources of Emissions to Water from

2.1 Spills and Diffuse Sources

- Contaminated stormwaters
- Solvent tank leaks
- Pipework leaks
- Spillages
- Bund Drains
- Leakages from flanges, pumps, seals, valve glands, etc.

2.2 General Organic Manufacturing Plants

- Seal losses from liquid ring vacuum pumps
- Spent process liquors
- Wash waters
- Scrubber, purge, and abatement system liquors
- Aqueous phase from steam desorption of activated carbon
- Cooling tower blowdown
- Materials (including solvents, salts, etc.) in wastewater from extraction steps
- Dehydration water
- Laboratory effluent
- Condensate
- Boiler blowdown
- D.I. and R.O. reject and regeneration water

2.3 Formulation Plants

- Active ingredients in washwaters
- Contaminated stormwater

2.4 Organo-metallic Chemical Manufacturing Plants

- As per 2.2

2.5 Inorganic Chemical Manufacturing Plants

- Absorption column vent collection
- Spent reactor contents
- Effluent from gas purification systems
- Effluents from solids washing
- Evaporation blowdown
- Spent acids, alkalis, etc.
- Condensor effluent

2.6 Chemical Storage Installations

- Vessel cleaning
- Scrubber effluent

Summary of Releases to Waters	
Activity Type	**Parameter**
General Organic Chemical Manufacturing	Mercury, Cadmium and compounds Reaction products Solvents Organics Heavy Metals Ammonia Salts, Cyanides and Sulfites Inorganic acids and alkalis Phosphates and Nitrates
Formulation Plants	Solvents
Organo-metallic Chemical Manufacturing Plants	Mercury, Cadmium and compounds Metals Tributylin and compounds Tri-phenyl tin and compounds
Inorganic Chemical Manufacturing Plants	Mercury, Cadmium and compounds Metals Salts

3.0 Sources of Wastes from

3.1 General Organic Chemical Manufacturing Plants

- Sludges from WWTPs, abatement systems and settling ponds (W3 & W5)
- Still bottoms residue from solvent recovery plants (W3, W4 & W6)
- Reject active materials, e.g. chemicals, pharmaceuticals, pesticides, etc. (W3 & W4)
- Spent adsorbents (W1)
- Spent biomass in fermenter broths (W2)
- Solids reactor by-products and residues (W1, W3, W4 & W6)
- Shake down dusts from filters (W3 and W4)
- Plant or animal residues from extraction process (W2)
- Contaminated drums, filters, equipment, packaging and protective clothing (W1, W3, W4, W5 &W6)

3.2 Formulation Plants

- Active ingredients in dust collection systems (W2)
- Reject active materials, e.g. chemicals, pharmaceuticals, pesticides, etc. (W2)
- Contaminated drums, filters, equipment, packaging and protective clothing (W2)

3.3 Organo-metallic Chemical Manufacturing Plants

- Sludges from effluent treatment (W2 & W5)
- Slag from lead recovery furnaces (W7)
- Spent oil from tetra-ethyl lead absorbers (W7 & W8)
- Spent carbon from tetra-methyl lead absorbers (W7 & W8)
- Contaminated drums, packaging and protective clothing (W7 & W8)
- Used filters and filter aid (W7 & W8)

- Spent solvent (W7 & W8)

3.4 Inorganic Chemical Manufacturing Plants

- Spent adsorbents (W1)
- Non-recoverable materials and spent reactor solids (W9)
- Unreacted ore and residues from digestors (W9)
- Solids from treatment and neutralisation plants (W9)
- Solids from shot blast (W9)
- Dust from collection systems (W9)
- Redundant cell linings and carbon anodes (W9)
- Waste electrolytic solids (W9)
- Solids from emergency absorption of spillages (W9)
- Scrap diaphragms (W9 & W10)
- Spent membrane cells (W9)
- Drosses (non-recoverable)(W7)
- Off-spec material (non-reusable)(W9)

3.5 Chemical Storage Installations

- None

Summary of Other Releases	
Class	**Description of Waste**
W1	Catalysts Molecular sieves Activated Carbon Filter aid, etc.
W2	Organics Halogen and compounds Phosphorous and compounds Biologically active materials
W3	Organics Organo-metallic compounds Halogens and compounds Metal carbonyls Phosphorous and compounds Metals and compounds Biologically active materials
W4	Oxidising agents
W5	Metal sludges
W6	Polymeric residues
W7	Metals and compounds
W8	Organic solvents Halogen and compounds Organometallic compounds
W9	Halogens and compounds Organo-metallic compounds Metals and compounds
W10	Asbestos