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Implementing marine pollution policy: proposals for change

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IMPLEMENTING MARINE POLLUTION POLICY:
PROPOSALS FOR CHANGE

By

JONATHAN PETER RICHARDS

A thesis submitted to the University of Plymouth
in partial fulfilment for the degree of

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Institute of Marine Studies
Faculty of Science

In collaboration with
Greenpeace Environmental Trust

March 2001
This thesis is dedicated to Joshua Paris Richards
Abstract

This study aims to determine the factors that affect the implementation of marine pollution policy, especially with regard to regulation of the hazardous substances which contaminate the marine environment. The purpose is to identify weaknesses in the current regulatory regime and to propose improvements. The study also aims to develop a new strategic framework for the implementation of the recent international policy commitments, which call for the complete cessation of discharges of hazardous substances into the marine environment by the year 2020. Furthermore, the study seeks to provide evidence to support or challenge current theories relating to regulation and policy implementation.

Examination was made of the attitudes of environmental managers from the UK chemical industry and inspectors from the environmental agencies towards the regulatory system. These are the key personnel who operate at the regulatory interface where the policy outcome is determined. The methodology combined both qualitative and quantitative techniques. Structured interviews helped define the issues for subsequent investigation using a questionnaire survey which was sent to over 700 key personnel. Focus groups were then used to explain the survey findings and develop solutions to key regulatory problems.

Statistical analysis of the survey response data revealed similarities and significant differences between the views of industry and the regulator on the effectiveness of the current Integrated Pollution Control regime. The strength of the system was perceived as its practical and pragmatic approach, coupled with a convenient and familiar bureaucracy. The weaknesses identified related to the derivation and enforcement of standards. The Environmental Quality Standards system, which underpins the regime, was acknowledged to be flawed by both operators and regulators who agreed it should be improved by the expansion in the number of priority listed chemicals, the introduction of sediment Environmental Quality Standards and Direct Toxicity Assessment of effluents. Focus groups supported the expansion of the system, but recognised that it would create a regime that was both complex and impractical. The findings were used to construct a revised model of the existing regime. Multivariate analysis of the industry response data identified 3 cluster types and significant differences were revealed between their knowledge of policy developments, their implications and the need for changes to the current system of hazardous chemical control. Operators and regulators acknowledged the existence of the mutual interdependency which has created and maintained a tight policy network (community) at the regulatory interface. Further evidence to support the existence of this community and of regulatory capture, was provided by the study data.

Focus group discussions also identified the requirement for a more fundamental reappraisal of the regulatory system in order to deliver the OSPAR strategy. A new regulatory model, which incorporates process and product substitution, is proposed as a strategic framework to ensure that future policy commitments are implemented. This approach may lead to the opening up of the current tight policy network with resultant benefits for policy implementation and reduced regulatory capture. The new model could be applied by other countries within the OSPAR region and in other regions of the world, in order to improve environmental protection.
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<th>Description</th>
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<tbody>
<tr>
<td>ACF</td>
<td>Advocacy Coalition Framework</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>BAT</td>
<td>Best Available Technique</td>
</tr>
<tr>
<td>BATNEEC</td>
<td>Best Available Techniques Not Entailing Excessive Cost</td>
</tr>
<tr>
<td>BOD</td>
<td>Biological Oxygen Demand</td>
</tr>
<tr>
<td>BPEO</td>
<td>Best Practicable Environmental Option</td>
</tr>
<tr>
<td>BPM</td>
<td>Best Practicable Means</td>
</tr>
<tr>
<td>CEFIC</td>
<td>Council Europeen des federations de l’Industrie Chemique</td>
</tr>
<tr>
<td>CAC</td>
<td>Command-and-Control</td>
</tr>
<tr>
<td>CBA</td>
<td>Cost-Benefit Analysis</td>
</tr>
<tr>
<td>CIA</td>
<td>Chemical Industries Association</td>
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<tr>
<td>CIGN</td>
<td>Chief Inspector’s Guidance Notes</td>
</tr>
<tr>
<td>COPA</td>
<td>Control of Pollution Act</td>
</tr>
<tr>
<td>DETR</td>
<td>Department of Transport, Environment and the Regions</td>
</tr>
<tr>
<td>DoE</td>
<td>Department of the Environment</td>
</tr>
<tr>
<td>DTA</td>
<td>Direct Toxicity Assessment</td>
</tr>
<tr>
<td>EA</td>
<td>Environment Agency for England and Wales</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EEC</td>
<td>European Economic Community</td>
</tr>
<tr>
<td>EPA</td>
<td>Environment Protection Act 1990</td>
</tr>
<tr>
<td>EQS</td>
<td>Environmental Quality Standards</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>GESAMP</td>
<td>Group of Experts on the Scientific Aspects of Marine Pollution</td>
</tr>
<tr>
<td>GPA</td>
<td>Global Programme of Action</td>
</tr>
<tr>
<td>HMIP</td>
<td>Her Majesty’s Inspector of Pollution</td>
</tr>
<tr>
<td>HMIPI</td>
<td>Her Majesty’s Industrial Pollution Inspectorate</td>
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<tr>
<td>ICES</td>
<td>International Council for the Exploration of the Sea</td>
</tr>
<tr>
<td>INSC</td>
<td>International Conference on the Protection of the North Sea</td>
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<tr>
<td>IPC</td>
<td>Integrated Pollution Control</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>IPPC</td>
<td>Integrated Pollution Prevention and Control</td>
</tr>
<tr>
<td>MAC</td>
<td>Marginal Abatement Cost</td>
</tr>
<tr>
<td>MAFF</td>
<td>Ministry of Agriculture, Fisheries and Food</td>
</tr>
<tr>
<td>MBI</td>
<td>Market-Based Incentive</td>
</tr>
<tr>
<td>MDC</td>
<td>Marginal Damage Cost</td>
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<tr>
<td>MDL</td>
<td>Method Detection Limit</td>
</tr>
<tr>
<td>NRA</td>
<td>National Rivers Authority</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
</tr>
<tr>
<td>OPRA</td>
<td>Operator Pollution Risk Assessment</td>
</tr>
<tr>
<td>OSCOM</td>
<td>Oslo Commission</td>
</tr>
<tr>
<td>OSPAR</td>
<td>Combined Oslo and Paris Commissions</td>
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<tr>
<td>PARCOM</td>
<td>Paris Commission</td>
</tr>
<tr>
<td>PHS</td>
<td>Priority Hazardous Substance</td>
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<td>PNA</td>
<td>Policy Network Analysis</td>
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<tr>
<td>QSAR</td>
<td>Quantitative Structure Activity Relationship</td>
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<tr>
<td>RCEP</td>
<td>Royal Commission on Environmental Pollution</td>
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<tr>
<td>SEPA</td>
<td>Scottish Environment Protection Agency</td>
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<tr>
<td>SQV</td>
<td>Sediment Quality Value</td>
</tr>
<tr>
<td>UES</td>
<td>Uniform Emission Standards</td>
</tr>
<tr>
<td>UNCED</td>
<td>United Nations Conference on Environment and Development</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
</tr>
<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>VA</td>
<td>Voluntary Agreement</td>
</tr>
<tr>
<td>WET</td>
<td>Whole Effluent Toxicity</td>
</tr>
<tr>
<td>WIA</td>
<td>Water Industry Act</td>
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<tr>
<td>WRA</td>
<td>Water Resources Act</td>
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AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award.

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**External contacts:**


Signed........................................

Date..............15/11/01..............................
"In an age when man has forgotten his origins and is blind even to his most essential needs for survival, water along with other resources has become the victim of his indifference”.

Chapter 1. Introduction

1.1. Background

The current state of the marine environment (GESAMP, 1990; OSPAR, 2000a; Sindermann, 1996) demonstrates that international policies designed to protect the oceans have not achieved their primary objective. This is due to the failure of the policies to fully address the pertinent issues, an inability to set appropriate targets and the poor implementation of the specific and necessary measures. These deficiencies are clearly illustrated in the inadequate control of emissions of hazardous chemicals from industry which has resulted in widespread contamination of the marine environment, particularly in coastal zones. A new policy designed to achieve zero emissions of hazardous chemicals was agreed in 1998 (OSPAR, 1998) and this signals a new, more precautionary, approach to industrial pollution. However, past, less ambitious policies have been rendered ineffective by poor implementation and a number of previous studies have recognised the significance of the implementation phase in delivering environmental policy objectives (Jordan, 1993; Levitt, 1980; Smith, 1997). The success of the new policy is, therefore, likely to depend on the effective implementation of the policy through the regulatory process.

However, pollution regulation is situated within a broader policy context and this is illustrated in the simple conceptual model of the policy process depicted in Figure 1.1. The identification of issues leads to prioritisation and setting of objectives which are
subsequently operationalised through the development of standards and controls, together with the necessary implementing structures.

Figure 1.1. Schematic of the policy process for the control of pollution. (Adapted from Smith, 1997).

Although the essential scope of a policy is defined during its formation, the outcome and therefore the degree of success is determined through the implementation phase (Gouldson and Murphy, 1998). Implementation is usually interpreted to mean taking a statement of intent (policy) and translating it into specific activity. In practice this involves taking formal policy outputs, such as environmental legislation, and translating them into outcomes through the setting and enforcement of controls. However, perfect implementation, requiring policy makers to exert complete control over their implementing agencies, is acknowledged to be practically unattainable and so there is always some degree of implementation failure (Hogwood and Gunn, 1984). Weale (1992a, p43) remarked that; “Implementation failure is like original sin: it is everywhere and it seems ineradicable.” Several major factors affecting implementation were identified by Mitchell (1997) and can be used to explain unexpected outcomes. In a
comparison of national policies for the control of chemicals, Brickman et al (1985) observed that, as a result of the considerable discretionary power exercised by the administrators, the distinction between policy and implementation is relatively unimportant. They concluded that, “The British carry flexibility to the extreme, developing policy wherever possible through close, informal contacts among government officials and private groups. Flexibility characterises policy outcomes as well, with guidelines, recommendations and informal persuasion substituting as far as possible for statutory orders and prosecutions”. Such discretion, exercised by the implementing agencies operating at the regulatory interface (between themselves and the industrial operator) is a critical factor in determining the effectiveness of environmental policy in practice.

1.2. Aims and objectives

The aim of this study is to develop an improved management framework for the regulation of industrial pollution, based on the current regime, and to construct a new, strategic framework which is compatible with long-term policy objectives.

The main objectives of the study are:

1. To identify the factors that influence the setting of emission limits within industrial discharge licences.

2. To measure the attitudes of the regulators and industrial operators towards the current regulatory system.

3. To identify consensus on the faults and flaws in the current regulatory system, and propose appropriate solutions.
1.3. Chapter outlines

This section outlines the contents of the subsequent chapters. Chapter 2 examines the significance of industrial point source emissions of contaminants to the problem of marine pollution. Using literature and official documents, the implementation of past and present policy, through the regulatory process, is assessed by examining the development of policy, implementing legislation and the resultant detailed controls and measures. The regulatory system is critically examined for weaknesses and flaws, both in the science that underpins regulation and in the practical setting and enforcement of operational standards. A flow-chart, developed through this review, clarifies the regulatory process and highlights the critical decision points where the current system fails. These critical (or 'break') points provide the focus of the study and lead to the development of the specific objectives which are detailed at the end of Chapter 2.

Chapter 3 examines the literature on theories relating to regulation, bureaucracy, organisations and policy networks. It thus ties the subsequent empirical work into the existing theoretical literature. The chapter builds on the specific and critical review of the current IPC regulatory system outlined in Chapter 2. A number of regulatory strategies, including command-and-control, are considered, together with the theory of regulatory capture. The interaction between regulator and regulated is examined in terms of policy networks, game theory and advocacy coalition frameworks. The main hypotheses are developed jointly from these theoretical considerations and the critical review in Chapter 2.
Chapter 4 describes the methodology used to explore the perception and attitudes of key personnel, from industry and regulatory agencies, to the critical decision points and weaknesses identified in Chapter 2. The research design incorporates a combination of qualitative and quantitative methods for data collection and analysis in multi-phase investigation. The choice of specific research instruments used in data collection and the techniques used to sort and analyse both the qualitative and quantitative data are detailed in this chapter. The initial data collection phase consists of initial interviews with key stakeholders in the industrial pollution regulation. The results of this exploratory work are used, in the second phase, to develop a questionnaire survey that generates quantitative data, enabling generalisations to be made concerning the regulators and operators. The final, explanatory phase uses focus groups drawn from the operator, regulator and academic populations to explain the research findings and develop solutions. The results from the data collection and analysis are subsequently described in Chapter 5. The main contrasts are drawn between the regulators and operators and between clusters of like-minded industrial operators.

Chapter 6 relates the development (based on the current regime) of an improved system which arises out of the perceived flaws in the current regulatory system. The chapter also discusses the results in terms of the theoretical literature examined in Chapter 3, particularly those theories relating to regulation and bureaucracy. The concepts used in the improved model emerge largely from solutions suggested and supported by the respondents, particularly through the questionnaire survey and focus group discussions. This improved model is critically assessed for its ability to deliver practical
improvements to the protection of the marine environment and for its suitability as a framework for the implementation of the OSPAR strategy. This chapter demonstrates the general lack of strategic thinking by the operators and regulators and concludes that incremental improvements facilitated within the improved system will not deliver the long-term, strategic policy objectives required.

Chapter 7 uses the study findings to develop a new regulatory model for the implementation of the OSPAR strategy and explores the key decision-making areas essential for the successful policy implementation. A number of operational problems, such as priority substance selection and the need for wider stakeholder involvement in decision-making, are examined and solutions proposed. The policy target of zero emissions of hazardous chemicals is viewed by operators and regulators to be impractical, but they recognise that a fundamental re-think of current processes and products will be required in order to implement the strategy. Further evidence to support the existence of a tight policy community at the regulatory interface is presented.

Chapter 8 concludes that the improved model, based upon the familiar bureaucracy of the current regime, would not effectively protect human health or the marine environment from harm. The regime would become increasingly impractical, costly to manage and rendered ineffective by the inability to predict the environmental consequences of industrial discharges. It would be further undermined by a critical lack of data relating to the fate and effects of hazardous substances in the marine environment. Consequently, the implementation of the OSPAR strategy is identified as the best way forward, but it is
recognised that operational issues need to be addressed and the attitudes of both the
regulators and operators will need to be changed. Proposals are made concerning how the
implementation of the strategy could be realised in the UK using the new management
framework (developed in Chapter 7) which, it is argued, could also be applied to other
countries. It is maintained that policy inconsistencies between regions will need to be
addressed and some harmonisation through a global organisation, such as UNEP,
established. Finally, there is a brief discussion relating to suggested future work including
an international study to determine how the new approach may be applied to other
regions, including developing countries.
Chapter 2: Policy and regulation

In practice, the linear model of 'top-down' policy implementation, shown in Figure 1.1, is over-simplified because policy can effectively be made at various stages throughout the implementation process (Fineman, 1998; Smith, 1997) and consequently there is not always a clear distinction between policy and regulation. This chapter examines the various stages involved in the creation of marine pollution policy and its subsequent implementation through the regulatory framework and critically assesses the factors that influence regulatory control within the current system of industrial pollution management.

2.1. Issue identification and policy formation

2.1.1. Marine pollution

Although marine pollution continues to be an important political issue, there is little consensus on the definition of marine pollution, despite this being fundamental to the policy process. Probably the most widely accepted definition is that of the Group of Experts on the Scientific Aspects of Marine Pollution: “Pollution means the introduction by man, directly or indirectly, of substances and energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality of use of seawater and reduction of amenities.” (GESAMP, 1990). This identified the problem of marine pollution purely as a consequence of human activities and in terms of the results of those activities on the marine environment. This definition was also
adopted by a number of organisations concerned with the issue of pollution, including the United Nations Environment Programme (UNEP), the International Maritime Organisation (IMO) and the World Health Organisation (WHO). The GESAMP definition is insufficiently comprehensive because anthropogenic activities that can adversely affect the marine environment extend beyond the introduction of substances and energy. It also does not specifically define ‘harm’ nor ‘deleterious effects’, leaving these terms to be interpreted on a case by case basis. Bewers and Wells (1992) and Tomczack (1984) were particularly critical of the GESAMP definition because it was not sufficiently comprehensive. Despite the criticism, GESAMP has not chosen to adopt any revisions. A more succinct definition of pollution is offered by Spilhaus (1974) as “anything animate or inanimate that by its excess reduces the quality of living”. This definition, however is vague and open to interpretation and therefore does not provide a workable basis for regulation.

The common factor in these definitions is that it is not the mere presence of pollutants that constitutes pollution but their adverse effects. This is reinforced by the concept of contamination which recognises perturbation of environmental systems by anthropogenic activities but without the harmful effects of pollution. Contamination has been defined by the International Council on the Exploration of the Sea (ICES) thus: “Contamination is used to describe the situation which exists where either the concentration of a natural substance (e.g. a metal) is clearly above normal, or the concentration of a purely man-made substance (e.g. DDT) is readily detectable, but where no judgement is passed as to the existence of pollution (i.e. adverse effects)” (ICES, 1989).
The distinction between pollution and contamination is therefore seen as the ability to detect the substance and/or adverse environmental effects. The increasing sensitivity of modern chemical analysis makes it possible to detect very low concentrations of substances and therefore the apparent increasing contamination may be due more to the improvement in detection rather than significant changes to inputs of substances to the marine environment. The improvement in analytical techniques is also matched by the advance of scientific knowledge concerning the adverse environmental effects of contaminants. This may lead to the situation where what was previously considered to be harmless contamination may later be found to cause subtle harmful effects and therefore becomes re-defined as ‘pollution’. Thus, the distinction between contamination and pollution is defined pragmatically and is subject to continual re-appraisal. The boundary requires a definition of what constitutes an acceptable level of harm, which in turn involves social, economic and political judgements, as well as scientific considerations (Bewers, 1995). This accords with Hawkins’ (1984) view, that pollution is as much defined by social considerations as by scientific principles. There is no intrinsic difference between pollution and contamination but the significance of the identification of pollution is that an activity that is classified as polluting is likely to be subject to some form of regulation. The recognition of pollution is therefore a crucial first step in the regulatory process, but as the example of endocrine disruption illustrates (Carmichael, 1998), there is sometimes little consensus on whether ‘pollution’ is being caused and consequently appropriate regulatory measures are not implemented.
2.1.2. Industrial pollution and the marine environment

Globally, 80% of marine pollution stems from land-based sources and reaches the oceans via the atmosphere, direct discharges and through runoff (GESAMP, 1990). Windom (1992) identified seven major categories of contaminants which are considered to have real or perceived adverse effects on the marine environment: heavy metals, synthetic organic compounds, petroleum, sewage, litter, nutrients and anthropogenically mobilised sediment. According to Windom (1992) other contaminants, such as radionuclides are only of concern in specific coastal areas. The development of effective management strategies has been frustrated by a fundamental lack of understanding of the sources, fates and effects of synthetic organic compounds, in particular, which has resulted in an inability to predict the consequences of their discharge. This, coupled with increasing global production and usage trends, has led to the conclusion that synthetic organic compounds from land-based sources represent a significant future threat to the marine environment GESAMP (1990). Heavy metal contamination is important in some localised areas, such as industrialised estuaries.

Figure 2.1 illustrates the pathways which may be followed by anthropogenic inputs of contaminants to marine systems. Contaminants discharged to river or estuary are subject to a number of complex physical, chemical and biological processes which determine their transport and mixing and also change their chemical structure and activity. In the marine environment all of these processes may occur simultaneously and influence each other.
Figure 2.1. Schematic diagram showing sources, transport and sinks of anthropogenic contaminants in the marine environment transported through the estuarine mixing zone. Contaminants are discharged from factory (N) into river, to atmosphere and as solid waste. Large hollow arrows indicate material flow from sources. Large solid arrows indicate transfer of material to sediment (sink). Flux magnitudes are not shown. Flux across interface can be in both directions but the net fluxes are as shown. Contaminants in water column may be in dissolved (d) or particulate (p) form but are transferred to the sediment mainly as particulate material. Contaminants are subject to complex physico-chemical and biological processes which are not shown but discussed in the text. (Adapted from Chester, 1990).
Flocculation, adsorption, and biological uptake effectively remove contaminants from the water column and transfer them to the particulate phase which can then undergo sedimentation (Schwarzenbach et al., 1993). Contaminants are transported in both the dissolved and particulate form but as all water is eventually flushed out of an estuary, only the sediment acts as a sink for contaminants. The sediments themselves are subject to a number of physical, biological and chemical processes (such as tidal re-suspension, bioturbation and changing redox environments) which can result in the transport and recycling of deposited components back into the water column. and the exchange between the two is determined by the relative affinity of the contaminant for the solid or aqueous phase.

The transported material passes through the estuarine environment before reaching the coastal zone. Approximately 90% of the particulate material transported from rivers is trapped in the coastal zone and consequently, the vast majority of contaminants entering the marine environment from land-based sources are trapped and re-cycled in the near-shore (Chester, 1990; Windom, 1992). The most serious impact of contaminants from land-based sources is therefore in the coastal zones and consequently, marine pollution problems are largely coastal and not oceanic Sindermann (1996). The affected areas are mainly estuaries, coastal areas adjacent to estuaries, coastal areas adjacent to municipalities or large industrial complexes and to a lesser extent the continental shelf areas. This is significant because some 44% of the world’s population live within 150 km of the coast (Cohen et al., 1997). In the UK one third of the population lives within 10 km of the coast and approximately 40% of industry is located there.
In addition to the processes mentioned above, contaminants are subject to chemical, photochemical and biological transformation reactions that change their chemical nature. In the case of synthetic organic contaminants, chemical and photochemical processes yield other organic compounds, whereas biological transformations may lead to mineralisation (breakdown into stable inorganic species). Examples of chemical processes are redox reactions in metals which can result in significant changes to their bioavailability and toxicity. Chelation and complexation with inorganic and organic ligands, which stabilize the metals in the dissolved phase, can be significant for some contaminants. For example, approximately 90% of Cu in an estuary is complexed with humic acids (Turner et al., 1981). For organic compounds, hydrolysis, oxidation and reduction can alter structures and activities (Schwarzenbach et al., 1993). Photolysis can transform organic compounds such as substituted chlorobenzenes and ketones, whilst biological transformations, especially by microbial action, are important in the degradation of organic contaminants in the marine environment (Schwarzenbach et al., 1993; Scholz et al., 1987).

The persistence of many synthetic organic compounds coupled with their high fugacity from aqueous systems means they can reach the open sea as a result of atmospheric transport and deposited at the ocean surface. Aerial transport has resulted in global distribution of a number of synthetic organic compounds, including polychlorinated biphenyls (PCBs) and organochlorine pesticides, such as DDT and Lindane. These compounds are volatile and adsorb onto particles that are carried in wind-borne dust. Although their use has been restricted, they are still ubiquitous in the environment.
(Schwarzenbach et al., 1993). For example, there is growing concern that there is a net export of PCBs from industrialised nations to polar regions where significant accumulation of these compounds has been reported (Muir et al., 1988; Oehme, 1991). Some synthetic organic compounds can be detected everywhere from the bottom of the oceans to the arctic snow and in marine mammals and seabirds (where biological processes have led to their accumulation throughout marine food webs). This was not predicted when the compounds were originally licenced and illustrates how marine pollution can inadvertently result from the lack of knowledge and poor regulation of such persistent chemicals.

**Regulation of point sources in the UK**

Contaminants routinely enter the marine environment from industrial sources through licenced discharges. Monitoring has demonstrated that the major source of mercury, cadmium, arsenic and chromium to the UK marine environment was direct industrial discharge (NRA, 1995). In specific local areas, where industrial discharges are poorly controlled, heavy metals may constitute a significant threat to the marine environment Windom (1992). Bryan and Langston (1992) have shown that it is likely that, even in moderately contaminated estuaries, metals contribute to the stress to organisms. This is of concern, because despite tightening regulation, the concentrations of toxic metals in some UK estuaries remain well above background levels. A recent study found that hydrocarbons make a significant contribution to toxicity of UK estuarine and coastal waters, particularly in industrialised areas (Kirby et al., 1998). Of growing concern is the discovery of widespread effects on reproductive health of many marine organisms, which
has been attributed to the oestrogenic effects of industrial effluents (ENDS, 1998a; Harries et al., 1997). The continuing significance of industrial point sources to the total flux of contaminants to the marine environment has also been highlighted in a recent study of the water quality for Eastern UK rivers (Robson and Neal, 1997) which showed that regional variations in contaminant distributions could be attributed to industrial sources. They concluded that, long term, changes in point source inputs were likely to have more of an impact than changes in diffuse inputs on pollutant loads delivered to the marine environment. The removal of just one or two major point sources, such as a factory closure, can have a significant impact on water quality (NRA, 1993). This is illustrated by the effective elimination of pentachlorophenol from the Forth River catchment, through the use of an alternative chemical by one paper mill (Campbell and Ridgway, 1989) and, more generally, in the Mersey Estuary where a reduction in the input of a range of industrial pollutants was achieved through the adoption of cleaner technologies, improved effluent treatment and tighter regulation (NRA, 1995). Research by the Ministry of Agriculture, Fisheries and Food (MAFF), however, concluded that some of the more industrialised estuaries still contain waters and sediments which are acutely toxic to a range of bioassay organisms (Matthiessen et al., 1995).

As inputs decrease from point sources as a result of tighter regulation, the significance of the sediments as a source of contaminants will become more significant. Inputs of copper and lead into the Irish Sea from coastal sediments are similar to the sum of that from rivers and direct waste inputs (Williams et al., 1998). The input of copper from the contaminated sediments in the Humber estuary have led to the breach of statutory water
quality standards (Turner et al., 1998a). Lang et al. (1998) showed that coastal sediments were frequently highly contaminated with a number of toxic industrial chemicals and pesticides, even though some were not detected in the water column. This demonstrates that industrial pollution has not been adequately controlled in the past. The focus on measuring and controlling pollution in the aqueous phase, with little regard for the important role played by sediments, has resulted in the unforeseen chronic contamination of the estuarine and coastal environment. The regulation of point source pollution from industrial installations has therefore failed to prevent widespread contamination and this remains a key issue in the protection of the marine environment.

Ecosystem management

The present approach for controlling pollution using regulation and monitoring of chemical contaminants, rather than biomonitoring, may have underestimated pollution in the North sea (Turner et al., 1998a). Ecosystem management, based on biomonitoring, provides a new holistic approach to the protection of species and habitats (Grumbine, 1994). This approach is based on the conviction that an ecological network must be protected and restored where possible (Ferm, 1996). Data relating to ecosystems would be the most relevant as a basis for setting standards to protect the environment, but they are rarely available (RCEP, 1998). In the case of the North Sea, it is such a complex system that a thorough understanding of it as an ecosystem will probably never be attained. Furthermore, tests on ecosystems are time-consuming, labour-intensive, often imprecise and produce results which are relevant only to the particular ecosystem studied (RCEP, 1998). However, there are a range of tests which can be carried out at different
levels of biological complexity, from the biochemical, through the single organism, to population and community studies. Biochemical tests generally provide rapid results and provide a simple cause and effect explanation. The disadvantage is that biochemical tests cannot easily be extrapolated to community and ecosystem effects. However, a number of 'biomarker' tests have been used to predict the effect of pollutants on ecosystems but there is no one test that is a reliable indicator of environmental stress. Consequently, a suite of biomarkers may provide the most effective prediction of ecosystem disruption (Astley et al., 1999). Whilst there has been some success linking community structure to environmental variables (Clarke and Ainsworth, 1993) unambiguous cause-effect relationships remain difficult to establish.

2.1.3. Policy development

Contemporary public and political concern regarding the pollution of the marine environment by industrial sources can be traced back to incidents such as the discovery of the unexpected accumulation of PCBs in biological systems (Jensen, 1966) and the cases of "Minimata disease" caused by industrial discharges of methyl mercury entering the human food chain (Ambrose, 1998; Nriagu, 1988). In addition, the infamous case of the "Stella Maris" in 1971, which was unable to deliver its cargo of toxic waste to any port, focused attention on the related issue of the disposing of industrial waste at sea (OSCOM, 1984).

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These events established a connection between the anthropogenic inputs of causative agents, particularly industrial pollutants, and their subsequent harmful effects. It became
clear that, far from representing an infinite waste disposal sink, the oceans possessed a limited capacity to assimilate (or render harmless) waste, through the natural marine processes of dilution, dispersion and degradation. The development of marine pollution policy then focussed on attempts to quantify the extent to which the marine environment could cope with wastes and this became known as the ‘assimilative capacity’ (Stebbing, 1992). This concept underpinned the UK strategy of using the marine environment for the disposal of waste. Control of pollution was therefore reduced to the identification of harmful or hazardous substances, quantification of their properties and their subsequent control. However, the lack of data and understanding concerning the fates and effects of pollutants has undermined the effectiveness of this paradigm. More recently, an alternative approach, referred to as the Precautionary Principle (PP), has been established. The PP states that when an activity raises threats of harm to the environment or human health, precautionary measures should be taken, even in the absence of scientifically established cause and effect relationships. It thus represents a policy response to the recognition of scientific uncertainty in environmental management and implies an emphasis on waste prevention, rather than dilute and disperse. The PP also stresses the importance of avoiding, as opposed to predicting, harm. However, the vague definition of the principle means that it has been widely interpreted and there has been much debate over its practical application (Buhl-Mortensen, 1996; Gray, 1996; Gray and Bewers, 1996; Santillo et al., 1998).

Closely connected to the PP is the principle of sustainable development. There are many definitions of this concept, many of which appear to be contradictory (Turner et al.,
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Closely connected to the PP is the principle of sustainable development. There are many definitions of this concept, many of which appear to be contradictory (Turner et al.,
1994), but the most commonly used is that of the World Commission on Environment and Development (the Brundtland Commission): “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. (WCED, 1989, p43). Hawkins (2000) is very critical of the term sustainable development and believes the concept does not make any meaningful contribution to environmental management. The concept can be viewed on a continuum from weak to strong sustainability (Turner et al., 1994): Weak sustainability assumes that unlimited substitution between the different forms of capital (natural, human and economic) is possible via technological progress. Strong sustainability, on the other hand, assumes that natural capital (or critical components of environmental systems) cannot be substituted with other forms of capital. In the biodiverse coastal zone a strong sustainability strategy would necessitate a ‘zero net loss’ principle, or constraint on resource use affecting habitats, biodiversity and operation of natural processes (Turner et al., 1998b).

Whilst sustainable development, may be seen as vague and difficult to interpret, ‘industrial ecology’ is an attempt to operationalise the concept (Graedel and Allenby, 1995). Industrial ecology recognises that a sustainable environment will require close attention to industry-environment interactions, so that an industrial system is viewed, not in isolation from its surrounding systems, but in concert with them. The aim is to optimise the total materials cycle from virgin material to finished material, to component, to product, to obsolete product and to ultimate disposal. Factors to be optimised include resources, energy and capital.
Despite the growing recognition of the need for a precautionary approach, marine pollution policy has tended to evolve in response to crisis or failure rather than as result of a strategic vision (Gouldson and Murphy, 1998). Policy-making bodies have been involved with the development of marine pollution policy on a global, regional and national basis and they have produced a wide range of policy documents. Some of the more influential of the marine policy agreements are shown in Table 2.1 and discussed below.

**Table 2.1. Significant milestones in international marine pollution policy-making.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Forum</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>International Maritime Organisation</td>
<td>Regulate pollution from ships</td>
</tr>
<tr>
<td>1974</td>
<td>Oslo Convention</td>
<td>Prevent marine pollution from ships and aircraft</td>
</tr>
<tr>
<td>1978</td>
<td>Paris Convention</td>
<td>Prevent marine pollution from land-based sources</td>
</tr>
<tr>
<td>1987</td>
<td>2nd North Sea Conference (London)</td>
<td>Measures for the protection of the North Sea</td>
</tr>
<tr>
<td>1990</td>
<td>3rd North Sea Conference (The Hague)</td>
<td>Tighter controls on discharges of dangerous substances entering the sea via rivers and the atmosphere</td>
</tr>
<tr>
<td>1992</td>
<td>OSPARCOM</td>
<td>Combined Oslo and Paris Commissions</td>
</tr>
<tr>
<td>1992</td>
<td>UNCED Earth Summit</td>
<td>Agenda 21 for sustainable development</td>
</tr>
<tr>
<td>1995</td>
<td>4th North Sea Conference (Esbjerg)</td>
<td>Reduce discharges, emissions and losses of hazardous substances towards the target of their cessation within one generation</td>
</tr>
<tr>
<td>1995</td>
<td>UNCED Global Programme of Action</td>
<td>Assessment of impacts of land-based activities on the marine environment and development of national and regional programmes of action</td>
</tr>
<tr>
<td>1998</td>
<td>OSPAR Ministerial Meeting, Sintra</td>
<td>Cessation of discharges, emissions and losses of hazardous substances by the year 2020</td>
</tr>
</tbody>
</table>
International Maritime Organisation (IMO)

The IMO was established as a specialised agency within the UN by the Convention on the International Maritime Organisation which was adopted by the UN Maritime Conference in Geneva in 1948. It took ten years to bring the IMO Convention into force. The main work of the IMO at the initial stage was related to the regulation of pollution from ships, particularly oil pollution as well as ship's safety. The IMO became recognised as the competent organisation dealing with the marine environment (OU, 1991).


The first UN Conference on the Law of the Sea (UNCLOS I) met in Geneva in 1958. This and subsequent conferences produced the UN Convention on the Law of the Sea which came into force in 1994 and can be viewed as an 'umbrella' for conservation, pollution prevention and sets out a number of principles (whose technical details have been formulated elsewhere). The Convention has encouraged the development of other specialised agreements by providing a consistent framework (OU, 1991) and is closely connected to the development of marine environmental management over the last 50 years (Ducrotoy and Pullen, 1999).

United Nations Conference on Environment and Development (UNCED)

In addition to the IMO and UNCLOS (discussed above), UNCED is also involved in the global management of the marine environment. All three bodies issue guidance, provide a framework and facilitate the signature of agreements between contracting parties
(Ducrotoy and Elliot, 1997). The UNCED Rio Earth Summit in 1992 had a profound effect on the world-wide environmental agenda with such initiatives as Agenda 21; a comprehensive blueprint for the global actions to effect the transition to sustainable development which includes the protection of the oceans and the issue of environmentally sound management of toxic chemicals (Pullen, 1996). Agenda 21 led to a Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA), agreed in Washington in 1995. The GPA Co-ordination Office was established to develop and facilitate preparation of scientific assessments on the impacts of land-based activities on the marine environment and development of national and regional programmes of action. This may become more influential in the future by providing a framework for the global implementation of marine environmental protection measures (Ducrotoy and Pullen, 1999).

**International Conferences on the Protection of the North Sea (INSC)**

The International Conference on the Protection of the North Sea (INSC) applies to countries bordering the North Sea. The second INSC, held in London in 1987, agreed a comprehensive framework of measures for the protection of the North Sea, including a substantial reduction of the inputs of hazardous substances. The UK identified 23 priority substances in what became known as the ‘Red List’ and indicated that the INSC agreement would be applied to all UK marine waters. The Third INSC, held in the Hague in 1990, agreed a further package of measures including tighter controls on discharges of hazardous substances entering the sea via rivers and the atmosphere, and reduced discharges of nutrients. The UK also agreed that the dumping of sewage sludge should
cease by 1998, largely as a result of political pressure and to dispel the UK’s reputation as the ‘Dirty man of Europe’. The Hague Declaration added significantly to the framework for dealing with dangerous substances and agreed on a North Sea List of 36 dangerous substances for which 50% reductions in inputs via rivers and estuaries were required by 1995. For mercury, cadmium, lead and dioxins, target reductions of 70% or more by 1995, were set. The implementation of the agreement involved significant regulatory effort and investment, particularly in highly industrialised areas, such as the Mersey Basin (NRA, 1995). Although the targets were mostly achieved in the UK, estuaries and coastal waters continue to be polluted by toxic metals as a result of long-term contamination of sediments (e.g., Comber et al., 1995). This highlights the lack of scientific understanding and the inability to predict the consequences of a particular discharge. These targets represented a political response to environmental problems and were set on an arbitrary basis, rather than as part of a systematic approach to protecting the marine environment. This situation was effectively resolved at the Fourth INSC, held in Esbjerg in 1995, where an overall strategy to prevent pollution from hazardous substances was agreed. The Final Declaration contained a long term commitment to: “Continuously reducing discharges, emissions and losses of hazardous substances, thereby moving towards the target of their cessation within one generation (25 years)”. This represented an admission that the only method of preventing pollution was to prevent emissions of hazardous substances and provided the policy framework required to make a more systematic approach to stopping discharges.
Combined Oslo and Paris (OSPAR) Commissions

The Oslo and Paris (OSPAR) Commissions cover the north east Atlantic. The Oslo Commission was established to administer the Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft (the “Oslo Convention”). It was successful in bringing forward the global London Dumping Convention (LDC) targets in its region. Indeed, the LDC (now known as the London Convention) was highly influential in establishing the Oslo Convention. The Paris Commission was established to administer the Prevention of Marine Pollution from Land-Based sources, 1974 (the “Paris Convention”). The OSPAR Commission sets a framework for the control of inputs of substances and energy to the sea via the atmosphere and from land-based sources: rivers, pipelines direct discharges and offshore platforms. The Commission is involved inter alia in a review of a number of industrial sectors in order to establish the Best Available Techniques to avoid pollution from those sectors. In some sectors, such as the titanium dioxide and chlor-alkali industries, the Commission has been very influential in the monitoring and reduction of waste (OSPAR, 1992). The Commission developed the Black and Grey priority lists of hazardous substances for priority control and runs a Joint Monitoring Programme in which a number of contaminants are measured by Contracting Parties at regular intervals. Concentrations of these contaminants are assessed in fish, shellfish, seawater and sediments.

The 1998 Ministerial Meeting of the OSPAR Commission, in Sintra, committed to: “...make every endeavour to move towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020.” It was also agreed: “to
develop a dynamic selection and prioritisation mechanism, in order to tackle first the substances and groups of substances which cause most concern, and use it to up-date by 2000 the current OSPAR List of Chemicals for Priority Action." (OSPAR, 1998). Although the strategy has not yet officially been given legal status in national or EU legislation, the agreement is binding on the signatory states and there is a history of OSPAR agreements being implemented successfully. It could therefore have a significant impact on UK industry and major implications for the regulatory agencies. At the meeting in 2000, the Commission established a ‘dynamic mechanism for selecting and prioritising hazardous substances’ and thus finalised the first essential step in the implementation of the strategy (OSPAR, 2000b). However, this mechanism has only been able to add 12 hazardous substances to the OSPAR list in the 2 years since the strategy was agreed.

Royal Commission on Environmental Pollution (RCEP)

In the UK The Royal Commission on Environmental Policy (RCEP) was set up to advise the government. The Royal Commission on Environmental Pollution was established in 1970 and in 1972 published its Second and Third Reports, dealing with issues in industrial pollution and pollution in some British estuaries and coastal waters, respectively (RCEP, 1972a; RCEP, 1972b). These were highly influential in the development of government policy. In 1998 RCEP published its Twenty-first Report, Setting Environmental Standards (RCEP, 1998). One of the Commission’s main conclusions was that traditional ways of setting environmental standards no longer command public confidence.
Gaps and overlap

Effective policy-making is undermined by the lack of understanding concerning the marine environment and the inability to predict the consequences of a particular discharge. With the multiplicity of organisations, there is a danger of overlap and thus potential for duplication which can lead to confusion. An example of this is the identification of hazardous substances for priority action, where a number of international and national policy makers have compiled very similar lists (Ducrotoy and Elliot, 1997), which should now be consolidated. Significantly, INSC and OSPARCOM rarely adopt contradictory policy positions, but tend to reinforce each other, as in the long-term target of zero emissions of hazardous substances. Furthermore, both INSC and OSPARCOM allow countries to express concerns about pollution of a common resource and there is, consequently, a continuing role for both organisations. On a larger scale, the global nature of industrial pollution and the socio-economic implications associated with its regulation, means that there is a growing need for global agreements, such as UNCED, overseen and administered by a single central commission with influence and power. The zero emissions strategy agreed by OSPAR addresses the policy failures of the past and, provides a long term strategic vision. However, the strategy does not account for the other regions and there is some question as to whether the policy can be implemented unilaterally in the OSPAR region.

2.2. The development of a UK regulatory framework

The broad strategy established by the policy-makers is operationalised by the derivation of standards and principles which is achieved through the development of legislation.
Whilst the primary legislation varies little between Scotland and the rest of Great Britain, the different legal systems have resulted in the two areas developing separate regulatory bodies and instruments. The following discussion of the most significant legislative developments (Table 2.2), refers primarily to England and Wales, although most is also applicable to Scotland.

Table 2.2. Key legislative milestones in the UK.

<table>
<thead>
<tr>
<th>Year</th>
<th>Legislation</th>
<th>Primary function</th>
</tr>
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<tbody>
<tr>
<td>1863</td>
<td>Alkali Act</td>
<td>Control of noxious gases from chemical ind</td>
</tr>
<tr>
<td>1876</td>
<td>Rivers Pollution Protection Act</td>
<td>Control of sewage discharges</td>
</tr>
<tr>
<td>1937</td>
<td>Public Health (Drainage of Trade Premises) Act</td>
<td>Control of industrial discharges</td>
</tr>
<tr>
<td>1951</td>
<td>Rivers (Prevention of Pollution) Act</td>
<td>Introduced the consent system</td>
</tr>
<tr>
<td>1960</td>
<td>Clean Rivers (Estuaries and Tidal Waters) Act</td>
<td>Control extended to tidal waters</td>
</tr>
<tr>
<td>1961</td>
<td>Rivers (Prevention of Pollution) Act</td>
<td>Consent required for existing discharges</td>
</tr>
<tr>
<td>1974</td>
<td>Control of Pollution Act</td>
<td>Strengthening and widening of control powers</td>
</tr>
<tr>
<td>1987</td>
<td>Red List (of hazardous substances)</td>
<td>List for priority control</td>
</tr>
<tr>
<td>1989</td>
<td>Water Act</td>
<td>Strengthening of earlier provisions</td>
</tr>
<tr>
<td>1990</td>
<td>Environmental Protection Act</td>
<td>Introduced Integrated Pollution Control</td>
</tr>
<tr>
<td>1991</td>
<td>Water Resources Act</td>
<td>Consolidating legislation</td>
</tr>
<tr>
<td>1991</td>
<td>Water Industry Act</td>
<td>Enabled privatisation of water industry</td>
</tr>
<tr>
<td>1995</td>
<td>Environment Act</td>
<td>Created EA and SEPA</td>
</tr>
<tr>
<td>1999</td>
<td>Pollution Prevention and Control Act</td>
<td>Legislation to implement IPPC Directive</td>
</tr>
</tbody>
</table>

The development of legislation in the UK can be considered as an evolution of practice based on the problems encountered and, more recently, in response to the growing influence of the European Union. There are two main themes running through the development of the legislation; The development of the legislation itself and the development of an administrative organisation responsible for implementation and enforcement (Howarth, 1988). Legislation was designed to facilitate mandatory regulation and this command and control system continues to be the primary instrument
in pollution control. The following sections (2.2.1.- 2.2.7.) describe the development of water and industrial pollution legislation from the very early days of the industrial revolution through to the present day.

2.2.1. The beginnings of industrial pollution control

The Alkali Act, introduced in 1863, was the first piece of legislation to address the effects of pollution from industry and concerned the control of releases of noxious gases to atmosphere from the emerging chemical industry. The Act was enforced by the Alkali Inspectorate, the first industrial pollution inspectorate, and had some measure of success (Coley and Wilmot, 2000). During the same period, serious de-oxygenation of the Thames, caused by the profligate discharge of sewage into the river drew attention to water pollution and resulted in the first piece of legislation to control water quality; In 1876, The Rivers Pollution Protection Act was brought in to control the water quality and made it a criminal offence to pollute any British river. The Act imposed a duty to adopt ‘best practicable and available means’ to ‘render harmless’ sewage before being discharged (Howarth, 1988) and should have had a major influence on pollution. The legislation was based on the recommendations of the Rivers Pollution Commission, set up in 1868, but was drastically altered in the passage through parliament and, as a result, became virtually unenforceable (Hammerton, 1987). This was to set the pattern for the development of legislation: A robust and rigorous study by a group of experts subsequently watered down by parliament to appease vested interests. Specifically, the problem with the Act was that enforcement was the responsibility of the sanitary
authorities who were also the largest polluters and therefore in a weak position to prosecute.

Due to the expansion of the chemical industry, the Alkali Act 1863 was extended to cover other chemical processes and consolidated in the Alkali Etc. Works Regulation Act 1906 and enforced by Her Majesty’s Alkali and Clean Air Inspectorate.

In 1912, The Royal Commission on Sewage Disposal considered arguments for and against setting standards based on the quality of the receiving water and concluded that a ‘normal’ standard should be fixed (Howarth, 1988). They introduced the Biological Oxygen Demand (BOD) test (which remains one of the principal water quality tests) and combined this with suspended solids measurement to develop minimum water quality standards. The Commission also took the view that these standards should not be applied to the effluent but after mixing with the river water. This established the concept of the ‘mixing zone’ which also survives in current industrial pollution regulation. Taking into account typical dilution factors, the ‘Royal Commission Standard’ for sewage effluent arbitrarily specified a maximum of 30 mg/l suspended solids and 20 mg/l BOD, referred to as ‘30:20 effluent’. Although this standard was non-statutory, it was extensively applied to evaluate effluents and was one of the few numeric, specified standards for effluent quality. A distinctive feature of the development of UK water pollution legislation has been the reluctance to establish standards that are both numeric and statutory for water and effluent quality.
The Public Health (Drainage of Trade Premises) Act of 1937 directly addressed the problems of discharges from factory operations for the first time. The occupier of any trade premises was allowed to discharge 'trade effluent' into local authority sewers with the permission of the local authority who could either give unconditional consent or make it subject to limited conditions. However, discharges that had commenced before the Act came into force were exempt from the requirement to seek consent. This type of exemption for existing discharges is a common failing throughout the development of industrial pollution law and has undermined the effectiveness of the legislation. Another significant feature of this Act was the power given to the local authorities to take samples of trade effluent, although this was subject to complicated procedures, which until recently frustrated regulatory efforts to enforce conditions.

2.2.2. The introduction of the consent system

From a legal point of view, the 1876 Act formed the basis of all legal action concerned with the pollution of rivers until 1951, when preventative legislation relating to discharges to rivers was developed. The Rivers (Prevention of Pollution) Act 1951 was introduced with the aim of improving the 'wholesomeness' of the rivers and the coastal system. Wholesomeness was not defined in quantitative terms but is thought to refer to an ancient concept relating to the water being fit for cattle to drink (Howarth, 1988). The administrative responsibility was transferred to the newly created 34 river boards covering England and Wales with nine river purification boards for Scotland. These were independent and specifically charged with the duty of maintaining or restoring the wholesomeness of rivers and tidal waters. The 1951 Act introduced the discharge
consent, which was a simple device which provided a mechanism for controlling discharges by individually determined standards. The fixed standards introduced in the 1876 Act had proved to be unenforceable. The use of individual standards resulted in a site by site flexible approach, a feature which continues today.

The main weakness of the 1951 Act was that it applied to only new or altered discharges so that existing discharges were not covered. In addition, the Act covered non-tidal waters only and consequently a number of large industrial operators constructed factories in tidal waters (estuaries and coasts) outside the legislated areas. Financial difficulty and the lack of adequate powers to set a programme of improvements to rivers meant not much progress was made, but in the 1960s the boards were provided with the powers they needed to control all discharges. In 1960 the Clean Rivers (Estuaries and Tidal Waters) Act extended control to tidal waters and in 1961, the Rivers (Prevention of Pollution) Act, incorporated discharges that were allowed pre-1951 into the consent system.

The key successful feature of these Acts was the new concept of controlling discharges by means of the consent system which enabled the authorities, for the first time, to impose conditions on a discharge and gave them power to vary those conditions (Garbutt, 1995). The consent was therefore established as the practical means for delivering improvements in industrial environmental performance. These Acts led to improvements in the quality of inland waters, but the same could not be said of estuaries where there were many industrial discharges that, despite the legislation, were not controlled to any extent. For example, in the Mersey Estuary there were 200 industrial discharges to the
tidal waters, of which less than half required consents under existing legislation (Harper, 1984).

In 1963, the Water Resources Act redrew the boundaries to create 27 new River Authorities. In 1973, the Water Act created the 10 regional water authorities of England and Wales, which replaced the existing River Boards. The Water Authorities were responsible for sewage collection and treatment, water supply, pollution control, fisheries, land-drainage and flood-protection and recreation. In Scotland, the regulation of water quality was the responsibility of the River Purification Boards (RPB).

2.2.3. The growing European influence

Over the last 25 years European Union (EU) legislation has had an increasing impact on UK practice. In many areas of environmental management European legislation, usually in the form of a Directive, is now the dominant factor driving UK environmental policy, standards and legislation (Gillies, 1999). For a Directive to be fully implemented, Member States must introduce the relevant legislation and administrative procedures, including monitoring programmes and this must be formally communicated to the EC. There are over 400 separate pieces of existing legislation that in some way are concerned with environmental management (EA, 1998a). In some of the earlier Directives, the emphasis was more on environmental quality objectives related to specific uses of water, rather than directly addressing pollution control, e.g., 75/440/EEC (surface water for drinking), 76/160/EEC (bathing water), 78/659/EEC (water standards for freshwater fish), 79/923/EEC (shellfish waters), 80/778/EEC (drinking water). (See Table 2.3) Of
the later Directives, 91/271/EEC (urban waste water), which required specified standards of sewage treatment, had a major impact on the sewage treatment companies whilst 92/43/EEC (Habitats) is likely to lead to a review of discharge licences.

Table 2.3. Summary of European Directives relating to water quality and the control of aquatic and marine pollution.

<table>
<thead>
<tr>
<th>Year</th>
<th>Directive</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>76/160/EEC</td>
<td>Concerning the quality of bathing waters</td>
<td>EEC (1976a)</td>
</tr>
<tr>
<td>1976</td>
<td>76/464/EEC</td>
<td>On pollution caused by certain dangerous substances discharges into the aquatic environment of the Community.</td>
<td>EEC (1976b)</td>
</tr>
<tr>
<td>1978</td>
<td>78/659/EEC</td>
<td>On the quality of freshwaters needing protection or improvement in order to support fish life.</td>
<td>EEC (1978)</td>
</tr>
<tr>
<td>2000</td>
<td>2000/60/EC</td>
<td>Establishing a framework for Community action in the field of water policy.</td>
<td>EC (2000)</td>
</tr>
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</table>

The most important Directives relating directly to industrial pollution management are 76/464/EEC (Dangerous substances) and 96/61/EC (IPPC). These are discussed below.

The Dangerous Substances Directive

As a means of controlling pollution nearer its source, the ‘Council Directive of 4 May 1976 on pollution caused by certain substances discharged into the aquatic environment of the Community’, otherwise referred to as 76/464/EEC, was introduced. This Directive
was not, in itself, legally binding, but acted as a framework for the reduction and elimination of pollution of inland, coastal and territorial waters by dangerous substances. It was also intended to ensure consistency in implementing the International Conventions, such as OSPAR. According to Price (1980, p162), this Directive, “provoked us [the UK] into formulating a coherent system for controlling emissions by reference to their effects upon the receiving water and its required use”. The significance of the Directive for the UK was that it established quantitative, numerical statutory standards for effluent and water quality, something the UK authorities were historically reluctant to do, and therefore brought about a change in the regulatory approach.

The substances prescribed under 76/464/EEC were selected on the basis of their toxicity, persistence and tendency to bioaccumulate and were compiled into two lists; The Black List (List I comprising 18 substances) for which pollution must be eliminated and the Grey List (List II) for which pollution must be reduced. Legal regulation was achieved by means of ‘Daughter’ Directives, which specified standards for a particular substance. Two basic approaches can be taken to establish emission limits for industrial discharges within the European Community; a technology-based and a water quality-based approach (Crathorne et al., 1996, Johnston et al., 1996). Control parameters can be expressed in terms of Uniform Emission Standards (UES) or Environmental Quality Standards (EQS). UESs are based on fixed emission limits, irrespective of the size and number of plants, or the nature of the receiving waters and are fixed for particular industrial sectors by applying BAT. This approach therefore seeks to regulate at the point of discharge, whilst the EQS approach regulates chemical concentrations in the receiving environment. The
UES approach is applied by most of the European regulatory authorities whilst EQSs are applied by the UK authorities. This epitomises the British approach, which is to maximise the flexibility to determine the most effective means of achieving environmental standards. It was initially envisaged that standards would be issued for all List I substances soon after the adoption of 76/464/EEC but the process of assigning hazard ratings proved to be very slow. From the priority candidate list of 129 chemicals selected by the EC from an original group of 500, only 18 have been classified as EC List I chemicals under EC Directive 76/464/EEC (Edwards, 1992). This was despite the introduction of the ‘Standard Article’ Directive, 86/280/EEC which was introduced to accelerate the legislation, providing a standard set of clauses and an annexe. Where there was no Daughter Directive, the UK’s Water Research Centre drew up appropriate EQSs.

*Integrated Pollution Prevention and Control (IPPC)*

The European Directive 96/61 EC came into effect in October 1996. The purpose of the Directive is to “achieve integrated prevention and control of pollution arising from specified industrial installations, and to use the Best Available Techniques to prevent, or where that is not practicable, to reduce emissions into the air, water and land... in order to achieve a high level of protection of the environment taken as a whole.” (EC, 1996). This illustrates the key principles which are at the core of IPPC. The term ‘practicable’ introduces the subject of costs and implies that industry could refuse to ‘prevent’ pollution on the grounds that it would be too expensive. There is a lack of quantitative standards and explicit targets which will allow considerable flexibility to be exercised (Gouldson and Murphy, 1998). This is very much in the British tradition, and in fact,
IPPC was based upon the UK IPC regime (discussed later in section 2.2.5), although the definition of pollution has been widened to take into account vibration and noise. Whilst the Directive will have a major impact on industrial pollution regulation in some EU states over the next decade, it will be less significant for those UK industries already operating under IPC.

European legislation continues to be developed. The Water Framework Directive, agreed in October 2000, seeks for the first time to establish an integrated system of water management, taking into account the quantity as well as quality of water (Bloch, 1999). It is intended to absorb and replace existing Directives on the ecological quality of water, fish and shellfish protection, bathing water and drinking water. It also contains provisions for strengthening public participation in the regulatory process and this could increase the relative weighting given to environmental protection and reduce the importance of industry costs in decision-making. The Directive also incorporates language from the OSPAR strategy relating to hazardous substances but without making its implementation a legally binding requirement.

2.2.4. The UK response to Europe

The implementation of EEC Directives in the UK was intended to be facilitated by the strengthening of legislative powers through the introduction of the Control of Pollution Act (COPA) which became law in 1974. COPA consisted of four parts and established new controls over waste disposal (Part I) and strengthened powers to deal with water (Part II), air (Part III) and noise (Part IV) pollution, but still provided no precise
definition of water pollution. Part II extended and improved arrangements already established by previous water pollution legislation. The Act was therefore the culmination of an evolutionary process in the development of controls over 100 years and was essential for the control of coastal discharges in England and Wales. It ensured full geographical coverage for water pollution controls, applying these fully for the first time to coastal and underground waters and ending the distinctions between pollution control in tidal and non-tidal waters. Under COPA the Water Authorities had the responsibility of protecting inland and tidal waters from pollution. They were obliged to operate a consent system for regulating permitted discharges which included their own sewage effluents. Unfortunately the impact of COPA was seriously undermined by the Water Authorities when they carries out a large scale revision of consents. Many consents granted under the previous legislation were ‘translated’ to COPA consents, including numerous consents (which had been ‘deemed’ in the 1960s and detailed discharge limits on some chemical parameters, based on typical analysis of the effluent, but imposed no further restrictions). Consents granted under previous legislation were regarded as given under COPA. According to Hammerton (1987), there was evidence to suggest that some water authority consent conditions were relaxed so that many were varied, not to what a particular plant could deliver, but to a much lower standard, so that there was little possibility of the consent being breached. This illustrates that there was little rigorous application of science to the development of consents under COPA despite the impression given by the regulatory authorities. Howarth (1988) identified a major problem with discharge consents: There was no coverage of emissions of new substances,
not already specified in the consent and there would be difficulty in keeping up with the increasing rate of development and production of new chemicals.

A key feature of COPA was the new concept of public participation through the advertisement of consent applications and the introduction of public registers – a change from the secrecy that had been identified in the RCEP 2nd Report (RCEP, 1972a) as being unjustifiably maintained between the Alkali Inspectorate and operators. Parliament had recognised the weakness in the system whereby the Water Authorities policed their own discharges. The public were granted the right to obtain information concerning Water Authorities’ own discharges and could bring a private prosecution. The penalties for breach of consent were higher under COPA than for previous legislation and these were widely believed to improve enforcement (Levitt, 1980), but this was not the case (Hammerton, 1987).

Although the Act was passed in 1974, implementation of the principal sections of Part II did not commence until 1983 and the detailed legislation was not adopted until 1985, when the government was forced to do so by EC Directives. The delay in implementing COPA was caused by concern that the Act was going to lead to increased costs for water authorities and industry. The government ensured that the Act was written in such a way that provisions did not come into effect until activated by a Commencement Order. In the meantime, the investment needed to improve water quality was severely cut back. The UK fell behind on investment to improve sewage treatment and water quality and so failed to implement national legislation and international commitments.
During the 1980s, public concern and international pressures mounted. More political resources were put into tackling environmental issues and a number of new policy initiatives were developed (Osborn, 1997). Her Majesty’s Inspector of Industrial Pollution (HMIP) was formed in 1987 from the merger of the Industrial Air Pollution Inspectorate, the Hazardous Waste Inspectorate, the Radiochemical Inspectorate and the Water Pollution Inspectorate. In Scotland, separate bodies dealt with the water supply and sewage treatment and Her Majesty’s Industrial Pollution Inspectorate (HMIPI) performed the same regulatory functions as HMIP in England and Wales.

The 1989 Water Act strengthened and augmented the water pollution and control provisions of Part II of the Control of Pollution Act 1974. The 1989 Act also strengthened the provisions controlling the discharge of trade effluents into sewers, which are consented under the Public Health (Drainage of Trade Premises) Act 1937 and the Public Health Act 1961. The continuing problems of the Water Authorities policing their own consents resulted in the transfer of their regulatory role to the National Rivers Authority (NRA) who now had responsibility for water quality and ensuring that the UK was complying with EEC Directives. Regulations made under the 1989 Act and a subsequent direction issued by the DoE, imposed a duty on the NRA to ensure that discharge consents complied with EC obligations and in this way, the EQSs set in EC Directives were given legal status. Regulations made in 1989 (including prescribed substances and processes) also gave effect to a number of EC Directives, in particular 76/464/EEC, and enabled agreements made at North Sea Conferences to be implemented. The realisation that EEC Directives would require significant capital expenditure led to

2.2.5. Integrated Pollution Control – the current regime

Despite the future introduction of the IPPC regime, for the major industries, currently regulated under IPC, this remains the most important piece of legislation. The introduction of IPPC is unlikely to substantially alter the regulation experienced by the operators already regulated under IPC. Furthermore, the timetable for the introduction of the IPPC regime means that IPC will continue for some industries until 2007.

The case for an integrated reform of UK industrial pollution control, by simultaneously considering wastes to all media, was proposed by the RCEP in 1976 but the legislative framework was not introduced until the new Environmental Protection Act was passed in 1990. The Act provided a new framework for pollution control in the UK. The industrial processes with the most potential to produce significant harmful discharges of Red List substances became regulated under Integrated Pollution Control (IPC) (Castle and Harrison, 1996) by HMIP. The prescribed processes were authorised subject to the application of Best Available Technique Not Entailing Excessive Cost (BATNEEC). If a process discharged to more than one environmental medium, the Act insisted that the Best Practical Environmental Option (BPEO) is considered, whereby damage to the environment as a whole is minimised (DoE, 1991). The regime revolved around the
application-authorisation permitting procedure. Operators had to apply for an authorisation in order to legally operate their process. The regulatory agencies issued the authorisation and set the conditions (including standards) that the operators had to comply with. In the UK there are over 2200 sites and processes which are currently regulated under IPC (EA, 1998a; SEPA, 2000). The decisions concerning regulatory standards were deferred to HMIP in England and Wales and to HMIPI in Scotland (now subsumed by the Environment Agency and the Scottish Environment Protection Agency respectively).

Pearce and Brisson (1993) and Jordan (1993) believed that a more formal sector based systematic approach to standard setting was essential for IPC but this more formal approach was compromised by the need to accommodate the informal British tradition (O’Riordan and Weale, 1989). The practical problems encountered during the implementation of IPC, resulting from the tight timetable and HMIP’s lack of information and knowledge resources (HMIP, 1988), led to an increasing involvement of the operators in setting standards which were more to their liking (Smith, 1997). The use of the Chief Inspector’s Guidance Notes (CIGNs) initially envisaged as representing a prescriptive, top-down implementation became purely advisory and were later seen as the starting point for a negotiation of standards, where the site-specific circumstances of an operation would be taken into account. The original ‘arms length’ approach adopted by HMIP, which relied upon formal emission standards set centrally, therefore developed into one of close cooperation and consensus where site by site regulation was based on loose legal principles (O’Riordan and Weale, 1989). Often the information concerning
releases, provided by the operator in the application for authorisation, was incorporated into their authorisation thus effecting a status quo. In the absence of specified parameter limits for aqueous discharges in an application, the relevant limits set by the NRA under the Water Act 1989 were incorporated unchanged into the new authorisations. Therefore, whilst the concept of IPC was an improvement, the implementation resulted in limited changes in liquid effluent discharges.

Roles and responsibilities

The Environment Act (1995) established Environment Agencies and in 1996, the Environment Agency for England and Wales was created by bringing together all the functions of the NRA, HMIP and the waste regulatory functions of the Local Authorities, together with some parts of the DoE. The 1995 Environment Act also created the Scottish Environment Protection Agency (SEPA) from numerous separate organisations, including the RPBs, HMIP and waste regulation authorities.

Both the Environment Agency of England and Wales (EA) and the Scottish Environment Protection Agency (SEPA) are non-departmental public bodies and their management are given broad freedom to exercise their responsibilities within a clearly defined framework (EA, 1998a; SEPA, 2000). They were designed to create a ‘one stop shop’ for pollution control advice. The EA has approximately 10,000 employees organised into three tiers – head office, regions and areas. There are eight regions, each with three or four designated areas (26 in total). SEPA currently has approximately 700 employees and is organised into three regions with a head office. The head offices set policies and standards to ensure
a consistent national approach, whilst operational activities are carried out at the regional and area level. In both organisations the IPC regime is implemented by a total of approximately 150 IPC inspectors who are generally regarded by the managers of the chemical industry they regulate as peer experts and collaborators (Fineman and Clarke, 1996). The inspectors are key to delivering IPC and the success of the legislation was seen as "totally dependent" on effective enforcement using motivated staff (ENDS, 1988). However, the House of Commons Environment Committee (2000) identified low morale in the organisation and a consequent decrease in the Agency's effectiveness. The study also expressed concern about the Agency's ability to recruit personnel with sufficient experience and expertise necessary to regulate industry.

2.3. Setting standards in IPC

Although the setting of environmental standards is perceived as a scientific process, the science involved is often extremely complex and uncertain. It also involves value judgements about the level of harm or risk that is acceptable (Wallace, 1996). Measures taken to reduce and control environmental damage, such as the setting of standards, come at an economic cost. Unsurprisingly, industry has a history of resisting environmental regulation on the grounds of added costs and this creates a tension between environmental benefits and economic costs within the regulatory system. This tension is addressed by the IPC regime. The regulatory agencies exercise considerable discretion in setting the standards within a legislative framework, that includes the vague statutory principles BATNEEC and BPEO, which lie at the heart of IPC (DoE, 1991). The application and interpretation of these principles within an authorisation is critical in the
implementation of IPC. In addition to the application of the statutory principles, there are also a number of statutory water quality based standards which must be achieved. In practice, the negotiation of the authorisation conditions between the industrial operator and the regulator effectively determines the 'regulation' (Smith, 1997) and consequently has a significant impact on policy output.

2.3.1. Statutory principles

Although the regulatory agencies make the decision concerning the application of the principles, it is the responsibility of the operators to demonstrate, in their application for authorisation, that they have complied with BATNEEC and BPEO. These statutory principles both have their roots in the earlier principle of Best Practicable Means (BPM) which itself had evolved over 100 years, but which only legally applied to air releases from a small number of scheduled processes (Hawkins, 1984).

BPEO

The concept of BPEO emerged from the 5th report of the RCEP (RCEP, 1976), but it was not until 1988 that BPEO was actually defined in their 12th report (RCEP, 1988) as follows: “A BPEO is the outcome of a systematic consultative and decision-making procedure which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes for a given set of objectives, the option that provides the most benefit, or least damage to the environment as a whole, at an acceptable cost, in the long term as well as the short term” (RCEP, 1988).
In theory BPEO is the primary consideration of IPC and requires that the environmental implications of all the disposal options available for a prescribed substance are evaluated simultaneously. The resultant option which causes the least environmental damage should be adopted. However, there has been considerable difficulty in applying BPEO. Despite it being a central element of IPC it has been impossible to operationalise in a methodical way and there has been no consensus on the most appropriate way to interpret the term (ENDS, 1995). There were some attempts to express BPEO in terms of a quantitative index, but this was hampered by the lack of a comprehensive system of Environmental Quality Standards (EQSs) for air, water and land (Feates and Barrat, 1995). The calculation of the index was complicated and there was no consistency in the results. This situation produced a consensus between industry and the regulator that BPEO should be carried out in a relatively informal and pragmatic way (Gouldson and Murphy, 1998). The fundamental weakness of BPEO is that it focuses on existing processes and therefore assumes the existence of waste. BPEO is designed to select the best disposal method for a particular waste stream, rather than identify the best process or even the best way of fulfilling a particular need.

**BATNEEC**

According to IPC regulations, BATNEEC should be applied once the BPEO assessment has been completed. Whereas BPEO applies to the process of selecting an acceptable environmental management approach, BATNEEC is a device for abating a waste based on the state of technology and unsophisticated cost-benefit judgements (Weeks, 1994). BATNEEC first appeared in legislation in the context of emissions to air from industrial
operations in the EC Air Framework Directive of 1984 (EEC, 1984). The draft Directive required ‘state of the art’ technology but was amended following pressure from the UK. Originally, the ‘T’ in BATNEEC stood for technology, but in the 1990 Act the word ‘techniques’ was used to ensure that BATNEEC could be interpreted as widely as BPM. The 1990 Act also extended the application of BATNEEC to all media.

In BATNEEC, ‘best’ is interpreted as meaning the most effective in preventing, minimising and rendering harmless pollutant discharges, but it is not quantified and there are no fixed standards associated with it. According to Section 7(10) of the Environmental Protection Act, the term ‘Techniques’ includes “...(in addition to references to any technical means and technology) references to the number, qualifications, training and supervision of persons employed in the process and design, construction, layout and maintenance of the buildings, in which it is carried out”. Slater (1996) pointed out that there may be more than one set of techniques that achieve comparable effectiveness, i.e., there may be more than one set of best techniques in any one case. The term ‘available’ is taken to mean procurable by the operator of the process in question. The result is that BAT is an imprecise and flexible concept which is subject to interpretation.

The ‘NEEC’ element is taken in two contexts, depending on whether it is applied to new or existing processes. For new processes BAT should be applied but for existing processes the NEEC consideration is important and the regulator should set a timetable for plants to upgrade to BAT standards. However, Allot (1994) found that very few of the
necessary improvement programmes were actually specified. Thus NEEC can be used to justify the prolonged existence of an inadequate and polluting process, particularly during the last few years of its planned lifespan.

In their attempt to reconcile environmental benefits with economic costs, Allot (1994) pointed out that the balance HMIP was striking between environmental and economic factors was obscure and there was no evidence of a cost-benefit analysis of its proposed standard. Weeks (1994) concluded that there was currently no rigorous and effective method of applying the necessary cost-benefit analysis. O’Neill (1996) concluded that the concept that environmental options can be ranked in terms of monetary values is intrinsically flawed. In practice the cost of BAT appeared to be expressed relative to some indicator of individual company costs or profits and not relative to the environmental benefits. Pearce and Brisson (1993) criticised this aspect of NEEC because it resulted in the regulator having to make assessments of ‘fair’ rates of return and they were ill-equipped to make such judgements. The definition of ‘excessive cost’ is, like BAT, not a quantifiable measure and is dependent on subjective assessments. Despite the fact that there is a clear need for economic information, assessments of the economic impact of regulatory measures have been criticised as being ad hoc, implicit, narrow and non-systematic with the information provided through informal discussions between regulators and industry (Brickman et al., 1985).

In making a decision the recommendations of the Guidance Notes are modified by a number of factors including; current state of knowledge, financial implications and local
conditions (Simpson and Carless, 1997). An extract from a recent CIGN illustrates the approach: “Inspectors should not impose any release levels given in this Note as uniform release standards. They should, however, be taken into account when framing conditions in authorisations, together with any local effects and site-specific effects of releases (e.g. the release of mobile and persistent pollutants which might harm distant receptors), and other site-specific issues”. (HMIP, 1995).

The practical interpretation of BATNEEC is influenced by the process of negotiation between the regulator and the operator. This is in turn influenced by the background, experience and values of the individuals involved. Fineman (1998) found that some inspectors were stricter than others due to their personal style and the way they appraised the environmental consequences of the processes they regulated. Smith (1997) observed that although the regulator has the authority to enforce BATNEEC, it is dependent on the operators for information and for the financial and organisational resources that are needed to secure the necessary improvements. The regulator is therefore drawn into negotiating a compromise. The resource dependency can result in the interpretation of BATNEEC to be altered significantly to better suit the operators (Smith, 1997). This clearly reduces the imperative for environmental improvement. The process of negotiation also introduces inconsistencies into the process. However, the extent of the negotiation has been found to vary (Fineman, 1998): In some cases inspectors used the authority of the written BATNEEC standards from the Guidance Notes to impose standards on less knowledgeable operators. For more sophisticated operators, BATNEEC was negotiated and these companies were able to agree lower standards.
Gouldson and Murphy (1998) found that inspectors rarely became involved in detailed economic arguments because the negotiation led to both parties accepting BATNEEC without the need for detailed cost-benefit analysis, especially where there were obvious improvements to be made. Where technological solutions were required, inspectors suggested that end-of-pipe solutions were the first to be proposed by operators. This was due to short-term expediency and the consequent desire for a low cost quick fix, but Gouldson and Murphy (1998) also discovered that industry increasingly accepted that the application of cleaner technologies may be preferable, both economically and environmentally at least in the medium and long-term. However, a recent report commissioned by DETR (Ecotech, 1999) shows that end-of-pipe investments still dominate the capital spending, particularly by the chemical industry, and there is little evidence of a shift towards cleaner processes. This demonstrates that the application of BATNEEC and BPEO has not resulted in the adoption of new, less polluting production techniques.

2.3.2. Statutory standards

Within IPC there is a requirement for operators to “prevent, minimise and render harmless” their emissions. Weeks (1994) argued that the obligation to control emissions through the use of BAT did not necessarily result in the prevention of harm to the environment and this was especially the case when BAT was compromised by the use of NEEC. In the Netherlands Tonkes et al. (1999) demonstrated that effluents already remediated using BAT and BATNEEC exhibited toxic effects. Within the context of IPC, ‘harm’ is defined as “harm to the health of living organisms or other interference with the
ecological systems of which they form a part, and in the case of man, includes offence caused to any of his senses or harm to his property”. The Act does not define the nature of the effects which may be considered harmful or the level in the environment at which they may occur (Slater, 1996). Whilst it is relatively straightforward to set and monitor for chemical standards, biological standards present difficulties, due to the inadequate understanding of the ecological effects of pollution (Ducrotoy and Elliot, 1997). This has resulted in the adoption of a pragmatic approach which involves the use of ecotoxicological data to derive ‘safe’ environmental concentrations of hazardous substances, known as Environmental Quality Standards (EQSs) (Weeks, 1994). IPC requires that the authorised discharges must not cause any statutory EQSs to be exceeded and in this way emissions are “rendered harmless”. In addition to the application of the vague statutory principles of BATNEEC and BPEO, the regime is therefore underpinned by statutory standards. An EQS is defined as ‘the concentration of a substance which should not be exceeded in the receiving water to protect the use of the water’. These EQSs define maximum concentrations of substances at certain sampling points in the receiving waters. Gray (1995), criticised these EQS guidelines pointing out that they are often derived using questionable toxicity data and whilst useful, do not provide a logical scientific framework for the protection of the marine environment. This is an important issue because compliance with an EQS can have serious financial implications for industrial operators (Turner et al., 1998a).

The reliance on the EQS system to protect the environment and act as a safeguard within IPC, suffers from a number of flaws: The data used to derive the standards is often
incomplete and does not account for the relevant toxic effects, which are sometimes subtle and chronic. Furthermore, very few of the thousands of synthetic chemicals have an EQS and there is no recognition of the potential interactive effects between chemicals in a typical industrial effluent. The EQS system does not address physical accumulation, such as occurs in sediments, nor does it account for bioaccumulation in areas remote from the source, and consequently does not, for example, protect polar bears from PCB exposure (Norstrom et al., 1988).

Deriving an EQS

The derivation of an EQS is a three stage process (Zabel and Cole, 1999). Firstly the available data relating to a substance is collated and critically reviewed. From this exercise, the lowest reliable and relevant adverse effects concentrations are identified. Finally, safety factors, which attempt to account for the uncertainty in the process, are applied to these concentrations.

The degree of hazard is defined by establishing cause-effect relationships using toxicity testing and sets priorities for control. Risk assessment techniques are used to select compounds, usually based on toxicity, persistence and tendency to bioaccumulate (Agg and Zabel, 1990). It is assumed that there is a certain ‘safe’ concentration for each hazardous substance and this can be used to derive acceptable discharge levels for industry sectors and individual factories. One of the major weaknesses of this paradigm is that it relies heavily on finite and therefore inevitably incomplete lists of substances and there has been widespread criticism of the principle of risk assessment (Johnston et al., 52).
Alternative proposals for chemicals to be regulated on the basis of their intrinsic properties (hazard) have been made (Santillo et al., 1999). Due to the uncertain chronic biological effects of some chemicals, the Swedish Chemicals Policy Committee has recommended that chemicals should be phased out if they exhibit any two of the three properties mentioned above (ENDS, 1997a). This means that it would not be necessary for a substance to exhibit toxicity in order for it to be phased out. There are indications that a new EC chemicals strategy will be based on a more precautionary approach (ENDS, 1999a).

One of the key parameters used in the derivation of the EQS is toxicity. Toxicity tests on marine species currently include fish such as plaice (Pleuronectes platessa) and crustacea (Tisbe battagliai). These tests consist of acute toxicity, assessed using 24, 48, 72, and 96 hour LC-50 methods and chronic toxicity tests on fish to assess bioaccumulation, effects on reproduction and early life stages. EQS values are based on the lowest relevant and reliable adverse effect concentration (Zabel and Cole, 1999). Currently these procedures involve single chemical effects and do not take the combined, synergistic or antagonistic effects of mixtures into account. Other toxic mechanisms such as genotoxicity and endocrine disruption are also outside the current testing system. Furthermore, changing salinity regimes characteristic of estuaries, have been shown to have an effect on the toxicity of some chemicals, but this is not always taken into account (Hall and Anderson, 1995). Other physico-chemical data is compiled, including vapour pressure, solubility and stability in water, adsorption/desorption and the octanol-water partition coefficient (Byrne, 1988). When the available data is limited, Quantitative Structure Activity
Relationships (QSARs) may be used to predict the physico-chemical properties and toxicity of a substance (Zabel and Cole, 1999).

**Testing programmes**

Worldwide it is estimated that some 63,000 chemicals are in common use, approximately 3,000 account for 90% of the total production (Shane, 1994). Of the estimated 100,000 chemicals currently registered within the EU (Agg and Zabel, 1990), less than 10% have been tested for their toxicity and less than 1% of these have been tested for effects on aquatic or marine species. Although statutory EQS have been defined for the 18 List I substances, it is only recently that substances from the 'grey list' have been the subject of proposed EQSs. These proposed levels have already been criticised for not being sufficiently stringent (ENDS, 1997b). In the environment, marine and aquatic organisms can therefore be expected to be exposed to a 'cocktail' of pollutants, some of which will have been subject to limited individual testing, others for which there is no data and some whose presence in the water column is unknown. The Government, in its recent chemicals policy document (DETR, 2000) expressed concern about both the lack of adequate information on the hazards posed by most chemicals released to the environment in large quantities and the absence of even a 'basic assessment' of the risks they pose. Part of the Government's strategy is for industry to provide sufficient data to characterise the hazards of all chemicals in commerce (estimated at 20,000) by 2020. This coincides with the deadline for the target of zero emissions of hazardous substances set under the OSPAR strategy. In order to address this lack of data, the Chemicals Group of the Organisation for Economic Cooperation and Development (OECD) has adopted an
approach to test approximately 3000 ‘high production volume’ (HPV) chemicals (chemicals being produced in quantities of at least 1000 tonnes per annum in at least one OECD country) (Stevenson, 2000). Through the Chemical Industries’ Association (CIA), UK chemical companies are taking part in testing over 150 chemicals.

Using EQSs to set discharge limits

Once EQSs have been set, effluent discharge consents should be reviewed so that the EQS will be achieved after allowing for initial and acceptable dilution around the discharge point. This ‘mixing zone’ is defined by the regulator using a variety of hydrodynamic models and is therefore subject to inconsistencies. The mixing zone will vary depending on the particular model used. This is illustrated by Ragas and Leuven (1999) who compared several mixing models and revealed that the resultant permitted annual pollutant loads may vary by up to a factor of 3. They concluded that harmonisation of the derivation of water-quality based emission limits was necessary to prevent widely divergent pollutant loads under comparable environmental conditions.

Complex mixtures

It is generally the case that industrial effluents are complex, i.e. they contain many by-products that do not appear on the consent. There has been much debate about the effectiveness of the current regime particularly given the complexity of some industrial effluents (Johnston et al., 1991; Matthiessen et al., 1993) and Zabel and Cole (1999) believed that the toxicity of such mixtures is not well accounted for in the derivation of an EQS. A discharge licence does not specify all potentially hazardous chemicals present in an industrial effluent. For example, a complex chemical plant may be licenced to
discharge simple organic determinands and metals but their effluent is also likely to include many other unidentified compounds (Ducrutoy and Elliot, 1997). Analysis of effluents from a number of industrial sectors has highlighted the difficulty in identifying a significant proportion of synthetic organic compounds, even when the most sophisticated and sensitive analytical techniques are deployed. Indeed there are frequently many more chemicals present in the effluent than are legally allowed by the discharge licence (Johnston and Stringer, 1991; Nyholm, 1992). Law et al. (1991), found that complex mixtures of chemical contaminants, from industrial sources, occurred in offshore waters. Furthermore, of the chemicals isolated and tentatively identified in the Tees area, approximately 75% had no ecotoxicological data. Although the concentrations of the individual chemicals were not of particular concern, subsequent sensitive bioassay tests using oyster embryo (Crassostrea gigas) resulted in 100% mortality rates in some areas of the estuary (Matthiessen et al., 1993). Hendricks et al. (1994) found that a major proportion of the toxic compounds in the Rhine Delta could not be identified. Accurate prediction of the combined effect of these complex mixtures of industrial chemicals is poorly understood although some attempt to predict toxicity of mixtures using Quantitative Structure Activity Relationships (QSAR) methods has been made (Xu and Nirmalakhandan, 1998). For some structurally similar substances, combined EQSs (eg, total trichlorobenzenes or total atrazine and simazine) are sometimes recommended (Zabel and Cole, 1999).

In order to address this knowledge gap, a programme to demonstrate the role of Direct Toxicity Assessment (DTA) in controlling the environmental impact of effluents has
been initiated by the EA. The Agency regards DTA as a tool for priority action but does not intend to formally incorporate toxicity measures into consent conditions (ENDS, 1999b). There will need to be further work on the development of toxicity assessment techniques for liquid effluents discharged to the environment, before it can be widely applied to pollution management (Coombe et al., 1999). Experience in the USA, however has demonstrated that an effluent biomonitoring programme of some industrial point source discharges as part of the regulatory process can result in a marked reduction in the toxicity of those discharges (Fisher et al., 1998). Whole effluent toxicity testing (WET) has been developed for incorporation into the Dutch regulatory system for managing industrial pollution (Tonkes et al., 1999). Whilst DTA may help to address the issue of complex effluents, it still does not take a range of chronic and subtle toxic effects into account. It is also limited to a few species, which are unlikely to be universally representative different types of water body and geographical areas. If an effluent was found to be toxic, controls would still have to relate to the causes (ie, chemicals) responsible for the toxicity, so there remains a requirement to establish cause-effect relationships. Practically, therefore, DTA can only used as a crude screening technique for acute toxicity of effluents.

2.3.3. Wider participation

The opportunities for wider stakeholder involvement in the setting of IPC authorisation conditions is achieved by the requirement to refer applications to a number of statutory consultees and publish details of applications for licences in local press. Public access to information is an important part of this involvement and public registers of emissions
were first established under COPA and they were very effective in improving compliance. Smith (1997) believed that IPC brought ‘unprecedented transparency’ to pollution regulation. This is arguable, given the fact that the negotiations between regulators and operators are held in private and that information can be withheld on commercial sensitivity grounds. This ‘transparency’ has not facilitated wider public involvement. Taylor (1997) was critical of the information held in the public registers: “...all of the documents are highly technical and use jargon that would probably be unfathomable to anyone without experience of industrial processing or pollution matters”. She concluded that public registers alone were not providing the avenue for public involvement in pollution control. However, the publication of information concerning toxic releases has made an effective contribution to the tightening of regulatory standards in the USA (Fisher et al., 1998). The publication of the ‘top polluters’ list in the UK highlighted by Friends of the Earth was criticised by the Chemical Industries Association (CIB, 1999), but followed in the tradition of the “Filthy 50” (Greenpeace, 1992), a listing of the 50 industrial plants licenced to discharge the largest amounts of hazardous chemicals into the aquatic and marine environments.

The RCEP was critical of the traditional methods for setting environmental standards (RCEP, 1998). In particular they identified a “trend toward the development of more inclusive processes, less dominated by technocratic practice, which ask those affected by risk to participate in the selection of risk management options capable of meeting multiple social goals.” The role of quantification in risk characterisation was questioned, especially the ability to accurately estimate risk given data inadequacies and difficulties
with extrapolation. A greater social participation in the conduct, interpretation and use of risk assessment and management analyses was recommended. The technical analysis and command-and-control regulation was deemed to have failed to deal satisfactorily with environmental problems and not taken valued social objectives fully into account. The influence of wider involvement of stakeholders in the setting of environmental standards has been recommended by the RCEP (RCEP, 1998). As part of the Government’s Chemicals Strategy (DETR, 2000), a stakeholder forum will be assembled from the chemical industry, scientists, trade associations, environmental groups, consumer groups and trade unions. The forum will ‘fast-track’ the risk assessment process for chemicals identified for priority action and will agree risk reduction measures with the chemical industry. For chemicals likely to cause serious or irreversible damage the strategy may include plans for the withdrawal of that chemical. This bold and sensible approach is an excellent example of the precautionary principle being applied in practice.

2.4. Enforcement of standards in IPC

2.4.1. Compliance with standards

Once the standards are set, they need to be enforced. The practical problem of strict enforcement was quickly recognised by the regulator who conceded that, “For various reasons, absolute limits came to be regarded in practice as not really applying as strictly as they were stated in consents. The notion that compliance for ‘most of the time’ was acceptable became widespread.” (NRA, 1990). The regulators are often faced with a choice between negotiating compliance and enforcing standards. In order to preserve the working relationship and maintain the possibility of compliance, the regulator will
typically bargain with the operator to the detriment of the strict implementation of the intended legislation (Weale, 1992b). The assumption that this cooperative, flexible style, characteristic of British regulators (Brickman et al., 1985; Fineman, 1998), represents the best approach is also supported by a study of the Danish regulatory agency which found that over-legalistic enforcement styles were not effective (May and Winter, 1999). But there is not universal consensus. Harrison (1995) compared the levels of compliance in the pulp and paper industry in Canada, where there is a cooperative style, with the USA, where there is an adversarial and inflexible approach, and found that compliance was lower in Canada. Therefore, whilst it is necessary to get tough up to a point, the threat of coercion can be counter productive and the regulators have to strike a balance.

Inspection visits are an integral part of the IPC compliance procedure. These are made by the inspectors, and the Agency sets targets, but there have been problems with the low inspection rates. The Agencies own figures (EA, 1998a) indicate there was a 7% drop in inspections compared to the previous year. This was significantly below the the inspection rate achieved by HMIP and represented only 58% of the ‘policy requirement’. This is important because this inspection activity has been shown to increase compliance in North America (Dasgupta et al., 2000; Laplante and Rilstone, 1996; Nadeau, 1997). In order to prioritise their activities, the EA has developed a risk-based regulation system called ‘Operator Pollution Risk Assessment’ (OPRA), which attempts to quantify the risk of pollution from a particular operator by assessing both the intrinsic hazard of the process and the way it is managed (EA, 1997). These ratings however are not available to the public, nor does the EA publish any data on compliance with authorisations, so the
public cannot assess the overall performance of industry and consequently their involvement in regulation is inhibited.

Part of the measurement of compliance is the monitoring of effluent streams and the environmental quality. The legally binding authorisation conditions should facilitate stricter enforcement but this requires a monitoring regime capable of ensuring compliance and detecting breaches. The admissibility of subsequent sample analysis in legal proceedings however was, until recently, subject to compliance with the ‘tri-partite’ sampling procedure, criticised as hampering the efforts of the regulator to prove non-compliance (ENDS, 1997c). Much of the routine monitoring is carried out by the operators as part of their authorisation conditions, with the regulators carrying out check monitoring. However, the EA does not publish any overview of the results of its check monitoring, so it is not easily available to the public.

The issue of compliance with environmental legislation was highlighted recently by Friends of the Earth in their report into the pollution from ICI’s Runcorn site (Peak Associates, 1998), which followed a number of high profile incidents (ENDS, 1998b); The report strongly criticised the Environment Agency for failing to control pollution from the factory and questioned whether their authorisation represented BATNEEC particularly given what they see as the lack of enforcement of the Improvement Programmes, an issue previously identified by Allott (1994).
2.4.2. Sanctions

It is important that the regulator is willing to impose sanctions, where appropriate, something which has been criticised as lacking (e.g. ENDS, 1997d). Before the formation of the EA, the NRA prosecuted enthusiastically but HMIP tended to follow traditional reliance on industry compliance, persuasion, enforcement notices and giving due warning of prosecution. HMIP regarded prosecution as the last resort and failure (Simpson and Carless, 1997). According to Fineman (1998), IPC inspectors are uncomfortable with enforcement and prosecution because it represents a failure of their preferred collaborative style of regulation and preserving an amicable dialogue with the operators is seen as important. The process of prosecution is also risky and time-consuming and failure was seen to damage credibility. The magistrates' court can be used in clear cut cases to impose fine of up to a maximum of £20,000, but they are not well suited to dealing with the highly technical issues that can arise. There are provisions for invoking the High Court, where unlimited fines can be imposed, but their lengthy procedures act as a disincentive because, even simple cases, if disputed, can take a long time to resolve. Consequently there have been suggestions that a specialist court dealing with environmental offences should be established (Carnwath, 1992). The legal system in Scotland discourages the regulators further from initiating proceedings (ENDS, 1997e). The number of prosecutions for breach of discharge limits or for pollution incidents brought by the environment agencies remains low. In the year 1998/99, the EA took 9 prosecutions under IPC, but in Scotland there has only ever been one prosecution under IPC since SEPA's establishment in 1996 (ENDS, 2000a). This highlights an inconsistency between the enforcement of IPC by the two Agencies and demonstrates
that SEPA has a major problem concerning the use of sanctions. Even when successfully prosecuted, the level of fines imposed is often too low to act as an effective deterrent, although this has recently been changing (ENDS, 1998b). In 1999 the average fine for prosecuted businesses (including those regulated under regimes other than IPC) in England and Wales was £6800 (EA, 2000a), although for IPC prosecutions the fines were only a little higher, with the average per case of £15,883 in the period 1998/99. The Agency Chairman commented, “The fines are still derisory compared to the state of corporate finance. It is still not enough. It is not a deterrent.” (EA, 2000b). The corresponding figure for all businesses in Scotland was even lower at £2220 (ENDS, 2000a). The House of Commons Environment Committee (2000) supported the EA’s campaign for stiffer fines and recommended they should be sufficient to offset the financial benefits gained by the offenders. The government’s Sentencing Advisory Panel issued new sentencing guidelines which urged the courts to take full account of companies’ ability to pay when setting fines and to impose fines which have a real economic impact on large firms. It is too early to judge whether these recommendations will result in higher financial penalties. The EA’s policy concerning prosecution states that “It aims to punish wrongdoing, to avoid a recurrence and to act as a deterrent to others” (EA, 1998b). Because the fines are generally low, and are of little significance to large companies it is difficult to see how the EA policy can achieve its objectives. However, the main incentive to comply with their consent or authorisation conditions may be the avoidance of negative publicity associated with prosecution, rather than fines (Mehta and Hawkins, 1998; Fineman and Clarke, 1996). The threat of mandatory regulation, even with ineffective sanctions, appears to be industry’s main driver for
environmental performance (Bayliss et al., 1998; Cairncross, 1991; Fineman and Clarke, 1996; Petts et al., 1999).

2.5. Conclusions and objectives

The continued contamination of coastal waters and sediments by hazardous substances demonstrates the failure of previous control policies, caused by poor design and implementation deficiencies. A new strategy designed to achieve the cessation of discharges, emissions and losses of hazardous substances to the marine environment, has been adopted by OSPAR and addresses many of the deficiencies of previous policies. It recognises that definition of 'safe' environmental concentrations for many of the growing number of synthetic organic chemicals is critically undermined by the limitations in contemporary understanding, both of their biological effects and of complex marine processes. The strategy integrates the precautionary principle into the policy process and echoes and reinforces the INSC agreement. Although the strategy has not yet been given legal status in national or EU legislation, history demonstrates that OSPAR has been successful in influencing government policy and legislation. Whilst the policy has been designed by OSPAR, its success will be determined during the implementation stage and currently, it is most likely that the strategy would be implemented largely within the existing framework of IPC. Therefore, by understanding the IPC process, a judgement can be made as to whether the current regime can effectively deliver the strategy.

The IPC regime represents the culmination of development of industrial pollution control which has taken place over the last 100 years. Although legislative instruments and
statutory principles have become more complex, the underlying principle of regulation has remained unaltered. This principle involves the identification and subsequent control of source emissions through a license which ensures that 'safe' environmental concentrations of listed chemicals are not exceeded. Indeed despite the introduction of successively elaborate legislation, the consents, originally written for the 1951 Act, have been translated into subsequent legislation, so that the basic form of the license to discharge to controlled waters, now incorporated into the IPC authorisation, has not substantially changed in nearly 50 years. A recurrent theme throughout this development has been the reluctance to set legislative quantitative and binding standards for water and effluent quality. Instead, vague definitions and concepts, such as 'wholesomeness', 'best practicable means' and 'excessive cost' were designed to suit the informal British tradition (O'Riordan and Weale, 1992; Brickman et al., 1985). These imprecise standards are open to interpretation and have created a flexible and pragmatic approach to regulation which has led to compromise on environmental protection. Although IPC has moved regulation from end-of-pipe to process management, industry has remained very influential in the operation of the regime. IPC is not designed to achieve the absolute quantitative standards required for the implementation of the OSPAR strategy, nor is it capable of delivering the clean production and product substitution likely to be required.

2.5.1. Weaknesses of the IPC regime

The implementation of the IPC regime involves several complex scientific, technical, economic and political judgements and is underpinned by some statutory EQSs. Figure 2.2 has been developed, as part of the present study and does not exist elsewhere.
Figure 2.2. Existing IPC regulatory process indicating 'break' points ① - ⑪ which are described in Table 2.4.
Figure 2.2 shows the relationship between the statutory standards and principles and highlights the key decision points that comprise the process of setting and enforcing standards within the current IPC regime. The weaknesses in the current system and their positions in the IPC regulatory process are indicated in Figure 2.2 as ‘break points’ and are summarised in Table 2.4.

**Table 2.4. Summary of recognised issues with IPC regulatory process with some example references.**

<table>
<thead>
<tr>
<th>Break Point</th>
<th>Process</th>
<th>Problem</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Alternative regulatory regime</td>
<td>Leads to lower priority and fragmented system.</td>
<td>ENDS (1997b)</td>
</tr>
</tbody>
</table>
In addition to the many weaknesses in the practical definition and enforcement of environmental standards within IPC, there are widely perceived flaws in the EQS system which underpins the regime. Standards within IPC are largely defined through negotiation where the ambiguity of legislation offers the inspector (and the operator) flexibility to reach a compromise (Hawkins, 1984; Lowe et al., 1997; Porter and Van der Linde, 1995). Consequently, the setting of environmental standards has been, in practice, deferred to the inspectors (Smith, 1997) who, through their actions and beliefs, have effectively defined policy and consequently the extent of environmental protection (Fineman, 1998).

The attitudes of the inspectors and their industrial counterparts at this regulatory interface will therefore be highly influential on the success of new policies and initiatives. Despite the crucial importance of this interface to the delivery of environmental policy, there have been few empirical studies of how the regulator and the regulated actually perceive the practical derivation and enforcement of the standards that are fundamental to the IPC regime.

2.5.2. Aims and objectives of PhD

This review has shown that there are many gaps of a fundamental nature in the derivation and enforcement of environmental standards and emission limits. The purpose of this study is to explore the regulatory interface and use the findings to develop better management models for the achievement of current and future policy objectives. In order
to accomplish this, the perceptions of inspectors and their industrial counterparts of these weaknesses will be explored and solutions to the problems will be sought.

The aims of the study are:

1. To develop an improved management framework for the regulation of industrial pollution, based on the current IPC regulatory process.
2. To develop a new, strategic framework which will facilitate the implementation of the OSPAR strategy in the UK and which could be applied to other countries.

In order to realise the above aims, a number of objectives need to be achieved, namely:

1. Determine the factors that influence the setting of emission limits within IPC authorisations, especially the relative importance of science, technology and economics and how they are reconciled through the application of BATNEEC.
2. Investigate the enforcement of authorisation conditions, by examining attitudes towards monitoring, compliance and sanctions and studying the influence of the power balance between the regulators and operators.
3. Identify consensus on the faults and flaws in the current system and discover any consensus on solutions.
4. Investigate attitudes towards the implementation of the OSPAR strategy and assess the implications for future regulation.
Chapter 3. Theoretical considerations

The purpose of this chapter is to provide the theoretical underpinning for the empirical study described later in the thesis and to establish the main hypotheses. The chapter builds on the specific and critical review of the current IPC regulatory system, outlined in Chapter 2, and provides an explanation of theories relating to regulation, bureaucracy, organisations and the way they interact in the context of the implementation of industrial pollution policy.

3.1. Regulation

According to Francis (1993, p6), 'Regulation is best understood as a mid-point between prohibition and the complete absence of state involvement'. The state intervenes to constrain private activity in order to promote the public interest, thereby correcting what is called 'market failure'. Traditionally, market failure is viewed in economic terms as the result of the absence of competition and is characterised by higher prices and fewer goods than would occur in a competitive market. Market failure is therefore seen as restricting choice and regulation intervenes to correct the situation. One example of this concept is the failure to incorporate environmental costs into the economic accounting system. These environmental costs (or 'externalities') mean that the true cost of produced goods and services is not reflected in the price of the product and this results in the over-exploitation of resources. Despite attempts to assign monetary value to environmental goods and services (Constanza et al., 1997), there remains a difficulty in internalising environmental costs and benefits and this explains why environmental regulation is
necessary. This form of regulation has become the most rapidly expanding component of
social regulation and has been implemented to protect against such things as air and water
pollution or contaminated food. Environmental regulation sets, at a minimum, a measure
of constraint on economic activity and consequently has to reconcile the competing
drivers of economy and environment. This is frequently carried out using cost-benefit
analysis (CBA) where costs and benefits are defined according to the satisfaction of
wants or preferences (Turner et al., 1994). From a theoretical perspective, in order to
define what environmental economists refer to as the most ‘efficient’ level of pollution,
otherwise known as the social optimum (or Pareto optimum), information is required
regarding the Marginal Abatement Costs (MAC) and the Marginal Damage Costs
(MDC). Figure 3.1 illustrates the case. The intersection of the two curves represents the
social optimum of the lowest overall cost.

![Figure 3.1. Schematic plot of pollution intensity versus cost/benefit. The intersection of the MAC and MDC curves corresponds to the Pareto optimum.](image)

One of the key problems in environmental regulation, however, is that these costs, particularly environmental costs and benefits, are frequently unknown. This has led to widespread criticism of the CBA framework; O’Neill (1996) argues against the very concept of placing a monetary ‘value’ on the environment. Nevertheless, irrespective of how they are established, once environmental quality targets are set, regulation is usually required to achieve them and a number of different instruments and approaches can be used.

3.2. Regulatory strategies.

The role of pollution regulation is to limit releases to levels usually defined by a public body which is invested with government authority to ensure that industrial operators control their process emissions. Regulation, therefore is the process comprising the influences and decisions by which pollution controls are set (Smith, 1997). There has been much debate concerning the regulatory strategies, but the main types are command and control (CAC), voluntary agreements (VA) and market-based incentives (MBI). These are summarised in Table 3.1. Environmental economists have criticised the CAC approach as being ‘inefficient’, in that it disregards differences in marginal abatement costs, promotes end-of-pipe technologies and provides no dynamic incentive to move beyond the legally bindings standards (Lubbe-Wolff, 2001). The supposed greater efficiency of economic instruments, such as taxes, tradable pollution permits and subsidies, results from the greater freedom afforded to the individual within a given framework compared with a CAC approach.
Table 3.1. Summary of the main regulatory approaches.

<table>
<thead>
<tr>
<th>Regulatory Approach</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Examples</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command-and-Control</td>
<td>• Certain outcome</td>
<td>• Inefficient</td>
<td>Hazardous chemical regulation</td>
<td>Hawkins (2000)</td>
</tr>
<tr>
<td></td>
<td>• Predictable outcome</td>
<td>• Requires enforcement</td>
<td></td>
<td>Turner et al. (1994)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No dynamic incentive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market-based Incentives</td>
<td>• Efficient</td>
<td>• Unpredictable outcome</td>
<td>Pesticide tax</td>
<td>Turner et al. (1994)</td>
</tr>
<tr>
<td></td>
<td>• Provides dynamic incentive</td>
<td>• Political opposition</td>
<td>Water pollution</td>
<td>Pearce and Turner (1990)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Regulated opposition</td>
<td>charges</td>
<td>Burrows (1979)</td>
</tr>
<tr>
<td>Voluntary Agreements</td>
<td>• Based on consensus</td>
<td>• Compromised</td>
<td>'Responsible Care' programme</td>
<td>Hawkins (2000)</td>
</tr>
<tr>
<td></td>
<td>• Cheap for government</td>
<td>• Often not 'voluntary'</td>
<td>Environmental Management Systems</td>
<td></td>
</tr>
</tbody>
</table>

According to Hawkins, (2000), it is likely that CAC regimes will be preferred in those cases where the impacts of non-compliance are especially serious, such as minimising exposure to radioactive or hazardous substances and consequently, for the control of emissions of hazardous substances, a CAC, or mandatory, form of regulation is usually necessary. Gouldson and Murphy (1998, p41) define mandatory regulation as: “A system of direct control over market organisations and activities, operated by government and its representatives, which has a legal basis and is operationalised through a range of implementing structures and procedures”. Given the uncertainty regarding environmental harm from pollution by hazardous substances (discussed in detail in Chapter 2), the use of regulatory standards may represent the best approach and regulatory control, even a ban, is likely to be preferred to a policy which seeks to discourage use through a prohibitive tax (Hawkins, 2000). In cases where the aim is to totally prevent a discharge or emission, regulation may be more efficient, dependable and politically acceptable than
the use of economic instruments (Turner et al., 1994) because, with standards, the outcome is more certain, whereas with MBIs, the outcomes are less predictable (Turner et al., 1998b). Indeed, in some cases, instruments such as ill-conceived environmental tax reforms, could even lead to a deterioration in environmental quality. For this study, the control of hazardous substances is the focus and so the theories of MBIs are not considered directly, although it is recognised that they may be used to complement a CAC regime (Burrows, 1979; Hawkins, 2000; Pearce and Turner, 1990; Turner et al., 1998b).

There has been growing interest in the use of voluntary agreements (VAs) as an alternative to the CAC approach to pollution control (Segerson and Micelli, 1998). The VA approach can reduce the conflict between the regulators and the regulated industry, and can meet environmental targets more quickly (Baggot, 1986). Often though the incentive for a 'voluntary' programme is the threat of a harsher outcome, such as legislation, if the VA is not made (Goodwin, 1986). The success of most so-called voluntary agreements (Arora and Cason, 1995) is therefore dependent on the background threat from the regulator and the bargaining power of the industrial operator. In cases where there is no serious threat and the operators have strong bargaining power, there may be no improvement in environmental quality (Segerson and Micelli, 1998). This indicates that VAs are not really appropriate for the control of hazardous substances.

In addition to the certainty it provides, most administrators favour the CAC approach because it enables them to set a clear, definite target; less information is required to
introduce regulations and it generally receives political and administrative support (Young, 1992). This is particularly valid for uniform environmental standards, frequently promulgated by environmental regulatory agencies (Jones and Scotchmer, 1990) because, in this case, there is no need to know the operator’s abatement costs. Industrial operators favour the CAC approach because it provides the potential benefit of regulatory capture (discussed in section 3.3.1). This capture can lead to less stringent regulation and this is the main disadvantage of the CAC approach. The other problem is that it provides no incentive for innovation or improvement beyond the prescribed targets. This is especially true of technology-based standards, such as BATNEEC, which are often subject to vague guidelines (on acceptable risks and excessive costs) and are inherently biased against technological innovation. This is of concern because the impact of regulation on the pace of technological advance in pollution control has been described as the single most important criterion on which to judge environmental policies (Milliman and Prince, 1988).

The use of standards to protect the environment is a key part of environmental regulation and the success of a regulatory system depends on how enforceable and achievable those standards are (McEldowney and McEldowney, 2001). Although standards appear to offer objective and verifiable criteria, many lack precision and an over-reliance on standards can lead to complacency (McEldowney and McEldowney, 2001). Nevertheless, according to the RCEP (1998, p5), ‘Standards are a crucial element in the environmental policy process, and in what has been called “the legal, epistemological and cultural matrix in which environmental politics is conducted”’.
A CAC approach to regulation also requires standards to be enforced and this ultimately requires the threat and use of sanctions. Hood (1986) pointed out that an inflexible enforcement response by a regulator is very rare and the norm is for persuasion, bluff, threats and negotiation to achieve compliance. Indeed, according to Kipnis et al. (1980), the use of sanctions within and between organisations is a last resort. They must be applied carefully because failure to follow through any threat can lead to the loss of credibility. Effective when used in moderation, repeated and excessive use of sanctions will lead to resentment.

In the case of non-compliance, the appropriate response may depend on the nature of the violation (Hood, 1986): For example, where non-compliance is a result of incompetence, a ‘soft’ enforcement response, such as providing information and guidance may be most successful, but where evasion results from opportunism, a ‘hard’ response, such as detection and punishment is more effective. This is because opportunistic non-compliance arises from the potential violator weighing-up the advantage of non-compliance against the expected cost (taking into account the probability of detection and conviction). If the expected cost is less than the cost of compliance then there is an incentive to violate (Burrows, 1979).

3.3. Regulatory Agencies

Bernstein (1955) suggested that regulatory agencies go through a ‘life-cycle’: from ‘generation’, into ‘youth’ when expectations are high and political support is strong, onto ‘maturity before ‘old age’ when they decline and perform inadequately. In order to
successfully implement policy, the agency must have the will, competence, skill and resources to perform implementation (Milliman and Prince, 1988). The agency must also avoid being dominated or captured by the firms they regulate.

3.3.1. Capture of regulatory agencies

Wilson (1980) argued that ‘Regulatory agencies are likely to be captured by the interests they are supposed to regulate. To suggest that matters are any different from this is to mark oneself as hopelessly naïve or even disingenuous’. Capture means the tendency for the regulator and operator to seek co-operation and consensus. Once captured, the regulator sympathises with the operators and regulates to protect the interests of the operators. Regulatory capture tends to occur during the administration of regulations by a mature regulator. Bernstein (1955) suggested that vague regulatory statutes encouraged industrial control of regulatory agencies and even that vague statutory language was the primary cause of agency capture by industry. He argued that the vaguer the laws the agency administered, the less likely that the agency would be independent of the industry it was supposed to regulate. Lowri (1969) pointed out that one of the implications of capture theory was the more a government attempted to do, the more its various parts would fall under the control of specific, self-seeking groups. To overcome this problem, he suggested that legislative devices, such as clear standards and court review of agency decisions should be developed.
3.3.2. Bureaucracy and regulatory agencies

Weber (1947) identified rational-legal authority as the dominant mode of action in a modern industrial society. It is viewed as rational because the means are specifically designed to achieve particular ends and legal because it is exercised through a system of rules and procedures. Its characteristic system of administration is bureaucracy. According to Beetham (1987), a bureaucracy is an administrative hierarchy financed by grant, rather than by the sale of its product on the market. Weber identified that the strength of bureaucracy lies in its standardisation. Critical to the success of the bureaucratic organisation are the formal rules and set down procedures. In a classic bureaucracy the most important rules are: (a) There should be limited scope for subjective interpretation (Hood, 1986) and; (b) The administration is carried out by rigid bureaucrats (Merton, 1940). Thus the implementation of regulations would be an exercise in administering rules. This represents a ‘top-down’ model of implementation, where it is assumed that the policy and regulations formulated by government are translated into instructions to be carried out by administrators at the ‘bottom’ of the implementation chain (Pressman and Wildavsky, 1973). Successful implementation in this model is the achievement of the desired policy outcome, but this infers a mechanistic relationship between policy objectives, instruments and policy outcomes which is often difficult to establish (Knill and Lenschow, 2000).

Allinson (1984) described a continuum of bureaucratic behaviour, with the two extremes being ‘bureaupathic’ (strict conformity to rules) and ‘bureatic’ (violation of rules). Between the dysfunctional extremes lie functional behaviour patterns characterised by a
sensible interpretation of rules, a proper use of discretion and a willingness to treat each individual case on its merits. In some bureaucracies there can be a tendency for the adherence to rules, originally conceived as a means, to become an end in itself resulting in the displacement of goals, so that an instrumental value becomes a terminal value (Merton, 1940). In Weber’s classic model of bureaucracy, rule conformity is seen as an expression of an individual’s desire for the security afforded by adherence to rules, regulations and standard operating procedures.

More sophisticated workers operate in professional bureaucracies, where the principle of central control is modified and staff are allowed a greater degree of autonomy (Buchanan and Huczynski, 1997). According to Lipsky (1980) ‘street level bureaucrats’ have the capacity to make decisions as a result of the complex nature of the task and the requirement to interact with other people which calls for the use of discretion and the need to exercise judgement. Regulatory agents can thus infuse the regulatory encounter with their ‘personal attitudes, professional anxieties and political concerns’ (Fineman, 2000, p63). This is characteristic of the ‘bottom-up’ approach to implementation, where the implementers have the flexibility and autonomy to adjust policy in the light of local requirements (Knill and Lenschow, 2000). Success is judged by the extent to which the perceived outcomes correspond to the preferences of the actors involved. In the ‘bottom-up approach, policy objectives are not defined as benchmarks to be achieved and it is expected that they may undergo modification during the process of implementation. Outcomes are influenced by the regulated firms and it is therefore important to understand their characteristics and the way they respond to regulation.
3.4. Regulated firms (operators)

Whereas a bureaucracy operates outside the market, a firm is defined as a hierarchy that operates within the market and is subject to its incentives and sanctions (Beetham, 1987). However, business corporations in the real world are likely to share some of the characteristics of firms and bureaucracies.

Environmental management has emerged as an essential function in many industrial sectors. The mandate for this function has recently evolved from ensuring compliance with regulations to acting as a ‘change agent’ (creating awareness of environmental concerns) which requires increased integration across a broad range of corporate functions (Fryxell and Vryza, 1999).

Theory predicts that when faced by threatening new conditions, managers and organisations attempt to preserve the status quo (King, 2000) although, even in the absence of external factors, there is often a mild pressure towards change (March and Simon, 1993). In response to regulation, operators may choose short-term solutions that are acceptable to regulators. However, this reduces incentives to engage in pollution prevention and other system-wide changes (Ashford, 1993; Staw, 1981). There are two broad perspectives on how operators respond to environmental regulation:

Punctuated equilibrium: Punctuated change results from external events such as environmental regulation (Tushman and Romanelli, 1985). The formation of a ‘buffer’ (eg waste treatment) is often chosen as a tactic which facilitates short-term compliance
without making fundamental changes and therefore reduces the need for change. Intervention is required because internal forces in the company operate to maintain the status quo in spite of clear dysfunctional consequences. It has been argued that environmental regulation should be draconian in order to shock industry into fundamental change (Porter and Van der Linde, 1995). Such a shock may serve to trigger innovation, provided the level of stress experienced by the organisation does not exceed the optimum (March and Simon, 1993). Innovation, in common with other organisational activities, can be increased by the imposition of deadlines and improved clarity of goals (March and Simon, 1993). However, even in the absence of fundamental change, mindsets and perceptions can be altered and therefore, a defensive short-term response does not necessarily preclude a more integrated and complete response (King, 2000).

**Autogenesis**: Gradual changes may result from incremental low level changes. This theory suggests that change occurs in a more undirected manner through repeated iteration of elements within the organisation. Change need not occur soon after the environmental disturbance, nor need it occur in a sudden manner. Environmental regulation may alter deep structure in the organisation and over time this will show as actors in the organisation change their skills and alter their values. A process of gradual change in mindsets can occur at the industry level and this may cause entire industrial sectors to progress through stages of response to environmental regulation (Hoffman, 1997).
Environmental management has become an important element of a firm’s competitive strategy. Using models based on game theory it has been shown that, in order to avoid an increase in costs, firms tend to relocate in reaction to unilateral tightening of environmental regulation. In addition, the loss of competitiveness for a producer unable to relocate may result in it being forced out of business.

Game theory is concerned with the actions of decision-makers who are conscious that their actions affect each other. In an attempt to maximise their payoffs, the players devise plans (or strategies) that pick actions depending on the information that they possess at a particular moment (Rasmussen, 2001). It is beyond the scope of this study to describe the mathematical underpinnings of the theory which is amply treated elsewhere (Kuhn, 1997; Rasmussen, 2001; Romp, 1997). The application of the theory to environmental regulation is of relevance (Folmer et al., 1998) and can be used to model interactions between firms and between firms and regulators (see section 3.5).

Markusen et al. (1995) and Rauscher (1997) considered a company whose location choice is dependent on pollution tax rates set by two countries in a non-cooperative game scenario. A ‘race to the bottom’ was the outcome, unless governments have a second instrument, such as a subsidy, to influence the firm’s choice. However, these location models disregard the firm’s option to install clean production technology as a selling argument. If some consumers have a preference for goods produced in an environmentally friendly process then a firm may introduce clean technology because it gains a monopolistic profit by differentiating its product from those produced in a
polluting way (Kuhn, 1998). The producers of a homogenous product (Motta and Thisse, 1994) lose competitiveness if the firm cannot evade the cost increase associated with tighter regulation by re-locating. However, the producer of a differentiated green product may avoid the loss of competitiveness without having to relocate, provided there are consumers willing to pay for a green product. This is a necessary condition for non-relocation which is, in turn, a necessary condition for the sustainability of unilateral regulation (Kuhn, 1998) and consequently, there may be a potential for unilateral environmental policies. Government intervention can provide an incentive for the producer or consumer of a green product and thus provide the ‘carrot’ to complement the ‘stick’ of tightening CAC regulation.

3.5. The interaction between regulator and regulated

Two analytical frameworks have been used to explain the development and implementation of pollution policy. Policy network analysis (PNA) and advocacy coalition framework (ACF) have both been widely used as analytical tools. Both approaches focus on inter-organisational relationships within policy sectors and can be used to analyse and explain stability and change in the context of industrial pollution policy (Smith, 1997; 2000).

3.5.1. Policy Networks

Policy networks are a recent development in the analysis of public policy (Hogwood, 1995) and provide an analytical tool for interpreting and explaining interactions of the actors seeking to influence decisions over the policy process. The complexity of policy
issues, such as industrial pollution, frequently produces an interdependence between the main policy actors in terms of their respective resources, such as knowledge, finance, legal authority and organisational capacity. According to Weale (1992b), the problem with all environmental regulation is that the knowledge of the regulatory agencies lags behind technological innovation. These asymmetries of information are a pervasive feature of the regulatory process. Not only does this create mutual interdependence of the policy network actors but, because the operators possess useful private information (in the game theory sense), it also affects the bargaining and negotiation which is the regulatory process. Policy networks theory is thus based on the supposition that this resource interdependency brings actors together into policy networks (Rhodes, 1998) and these constrain and influence the policy process. The information asymmetry creates the potential for the use of information as power because organisations need to construct the appearance of a rigorous decision-making process in order to support a course of action and create the appearance of bureaucratic rationality (Cohen and Bradford, 1989). This power is the basis for influencing and bargaining through the negotiation and exchange of benefits. There is growing evidence that industrial pollution control is defined through negotiation, especially where the ambiguity of the legislation provides scope for interpretation (Fineman, 1998; Hawkins, 1984; Porter and van der Linde, 1995; Smith, 1997). The influencer relies on a trade that involves making concessions in exchange for getting what they want (Buchanan and Huczynski, 1997). However, such bargaining creates obligations in the future that the influencer must honour.
According to Bressers and O’Toole (1994), policy networks can be classified according to their level of integration: When highly integrated they are known as policy communities and typically exclude groups which challenge their views and this helps to maintain stability and preserve the status quo; When loosely integrated, they are referred to as issue networks. In policy communities, the resource interdependencies tend to be based upon exchange and therefore interaction involves negotiation and bargaining. Membership of networks and the relationship between the actors are of critical importance in determining the policy outcome especially where a very tight network exists (Smith, 1997). Network structure (degree of cohesion) during policy formation can influence the pattern of implementation (Bressers and O’Toole, 1994). However, Jordan and Greenaway (1998) have demonstrated that closed policy communities can open following pressure from new entrants such as the environmental lobby, with impact on policy outcomes. Policy communities are more likely to change in reaction to exogenous influences which disrupt their inherent conservatism and lead to major policy changes (Rhodes and Marsh, 1992). However, such exogenous influence is exerted outside the policy community and therefore, whilst policy network theory can explain stability, it may not be the most appropriate tool for the analysis of major change (Smith, 2000).

3.5.2. Advocacy Coalition Framework (ACF)

Whereas policy network analysis stresses the role of resources in inter-organisational relationships, ACF emphasises belief systems and policy-oriented learning (Sabatier, 1998). An ACF is defined as: “The group of people and/or organisations interacting regularly over periods of a decade or more to influence policy formulation and
implementation within a given policy area/domain.” (Sabatier, 1998, p111). Each coalition is bound together by shared policy core beliefs of their members. Core beliefs represent the coalition’s basic normative goals for the policy area, their perception of causal mechanisms and strategies for achieving their goals. An actor’s policy core beliefs are important because these help bind the coalition together. For example, Smith (1997) found that industry and regulators are united in their policy core belief that pollution is an engineering problem to be solved by the regulator working in partnership with industry. Policy core beliefs can change but members will resist information suggesting their basic beliefs may be invalid or unattainable (Hann, 1995). The change of policy core beliefs is known as policy-oriented learning and this can occur within and between coalitions (Sabbatier, 1998). Central to this learning model is the concept that policy actors can adjust to changing circumstances and knowledge gained through experience. Learning can be categorised into three types (Fiorino, 2001): Technical learning, which consists of a search for new policy instruments (such as economic instruments) takes place in the context of fixed policy objectives and tends to lead to ‘more of the same’ types of solutions; Conceptual learning is the process of re-defining policy goals and developing new strategies, such as sustainable development; Social learning emphasises the relationships between the policy actors and the quality of the dialogue. It builds on technical and conceptual learning but requires a different implementation style in which government, industry and other stakeholders share responsibility for achieving policy goals.
3.6. Conclusion and main hypotheses

Despite the theoretical ‘efficiency’ of market-based regulatory strategies, the certainty and predictability of a CAC approach appears to be the most pragmatic option for the control of hazardous chemicals emissions, especially when a total ban is required. However, there are a number of disadvantages associated with the CAC approach in addition to the supposed inefficiency: (a) It cannot respond quickly to new information; (b) There is a need to enforce the standards set; (c) There is no dynamic incentive for the operator to improve environmental performance particularly where technically-based standards, such as BATNEEC, are prescribed. The CAC approach is therefore inherently biased against innovation; (d) A CAC regime often leads to regulatory capture and the subsequent compromise of regulatory standards. This is exacerbated by the vague nature of the statutory principles, so that regulation, including the enforcement and use of sanctions, is essentially a negotiation and bargaining process. In a regime where these vague statutes exist, the implementation involves the use of discretion by the implementing agency and can no longer be done according to the Weberian model of strict top-down implementation. Instead, ‘street-level’ bureaucrats shape policy in a ‘bottom-up’ process. The negotiation and bargaining is a complex process that is characterised by an informational asymmetry which places the regulator at a disadvantage, creates a mutual interdependence between the main policy actors and thus establishes a policy community which will tend to resist change. Private information, held by the operators, but required by the regulator to create an appearance of bureaucratic rationality is used in the bargaining and exchange of benefits which can be modelled using game theory. The core policy beliefs of the main policy actors are also
important to the potential for policy change and key to this is the extent of policy-oriented learning. Previous work has shown that operators and regulators share the basic technical view of regulation and therefore have not progressed to conceptual or social learning.

The aims and objectives detailed at the end of Chapter 2 relate to the practical derivation and enforcement of standards within the context of the IPC regime. The main hypotheses of this study, resulting from the review in Chapter 2 and the theoretical considerations in this chapter are:

1. The current regulatory regime is incapable of responding to the ever-increasing number of hazardous chemicals and the increasing new knowledge concerning their environmental effects.

2. The current regulatory regime (dominated by a tight policy community which defines technically-based standards through a process of negotiation and bargaining) is incompatible with the implementation of the OSPAR strategy.

Through studying the attitudes and beliefs of the main policy actors, the empirical work will seek to produce data to confirm or reject these hypotheses. The data will also provide evidence to support or challenge the theories reviewed in this chapter and in doing so will add a new level of explanation and thereby contribute to the existing theoretical literature on topics such as bureaucracy, organisations, regulation and policy networks theory.
Chapter 4. Methods

The model of the IPC regulatory process, described in Figure 2.2, identifies a number of critical weaknesses, or 'break points', which shape policy outcomes and can therefore undermine environmental protection. Consequently, the study focussed on improving understanding of these 'break points' and the methodology was designed to explore the perceptions and attitudes of those involved in the key decision areas to these weaknesses.

The purpose of this chapter is to describe and explain the methodological approach and the selection of instruments and techniques used in the gathering of data and its subsequent analysis, which is described and analysed in the remainder of the thesis.

The study of perceptions and attitudes to develop theories and explanations requires a social scientific approach (Gill and Johnson, 1997). Social scientific explanations, however, are rarely based on universal laws, characteristic of other branches of science, because few meaningful universal generalisations can be made (Hempel, 1966). Due to the lack of understanding of the processes operating at the regulatory interface, explanations could not therefore be deduced but required empirical observation. Consequently, the study was designed to produce probabilistic rather than deductive explanations by adopting an empirical, as opposed to a conceptual, approach.

4.1. The research design

A combination of both qualitative and quantitative research methods is essential to counteract the deficiencies of the individual methods (Bryman, 1995). Such combinations
also facilitate the ‘triangulation’ of method through the utilisation of more than one research instrument to measure the main variables (Denzin, 1970) and thus enhance the validity of the findings by mutual confirmation. Jick (1983, p139) pointed out that, “It is probable that the triangulation approach is embedded in many doctoral theses”. Although Blaikie (1991) and Fielding and Fielding (1986) challenge the view that triangulation strategies necessarily reduce bias and improve validity, it has become accepted that such methodological combinations can improve the quality of research (Bryman, 1995; Hakim, 2000; Miles and Huberman, 1994, Neuman, 2000). Despite his criticism of some triangulation methodologies, Blaikie (1991) acknowledged the sequential use of different methodologies to provide a basis for the development of subsequent stages of the research process. In a well designed research process each method can be strengthened by the intrinsic qualities of the other.

Qualitative and quantitative research methods can be used at various stages during a study. According to Miles and Huberman (1994, p1), qualitative data, “…are the source of well-grounded, rich descriptions and explanations of processes in identifiable local contexts…”. Qualitative research can thereby act as a precursor to the formulation of problems and the development of instruments for subsequent quantitative research. Qualitative research can also act as a source of hypotheses and ideas which are subsequently tested by quantitative methods in a larger or more complex study (Hakim, 2000). Qualitative data may also greatly assist in the analysis and understanding of quantitative data which provide the basis for in-depth discussions. Because of its unstructured and exploratory nature, qualitative research blends easily with other types of
The great strength of qualitative research is the validity of the data obtained, but the main weakness is that it is unrepresentative. Quantitative research methods are designed to be more representative and are more efficient in elucidating structure. The combination of statistical analysis from quantitative studies with deep, credible understanding of complex, real world contexts from qualitative study creates a 'powerful mix' (Miles and Huberman, 1994, p42). The combination of these two approaches can therefore provide a complete account of the research subject. The mixing of the styles can occur in several different ways (Tashakkori and Teddlie, 1998) and the two approaches may be used either in parallel or more commonly, sequentially. Both qualitative (Fineman, 2000; Smith, 1997) and mixed methodologies (Petts et al., 1999) have been used in recent studies of the regulatory interface.

This study utilised such a hybrid methodology and involved three main phases (Neuman, 2000):

- **Exploratory phase**: Qualitative research to formulate and focus the questions for future study and develop quantitative instrumentation.
- **Descriptive phase**: aimed to provide a detailed picture of the subject.
- **Explanatory phase**: Qualitative study was designed to build on the exploratory and descriptive stages and to deepen the test findings by identifying the reasons for the study findings. (Hakim, 2000; Miles and Huberman, 1994).

Exploratory interviews, questionnaires and focus groups comprised the three main research instruments in the multi-stage research process (See Figure 4.1).
Figure 4.1. Flow-diagram outlining the research process. The three main stages of the research are indicated (①,②,③). Adapted from Oppenheim (1992).
The three stages of the research were conducted in distinct phases between April 1998 and May 2000 (see Table 4.1).

**Table 4.1. Summary of the research schedule for the three main stages.**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Research instrument</th>
<th>Date conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Structured interviews</td>
<td>March – April 1998</td>
</tr>
<tr>
<td>2</td>
<td>Postal questionnaire</td>
<td>February – March 1999</td>
</tr>
<tr>
<td>3</td>
<td>Focus groups</td>
<td>March – May 2000</td>
</tr>
</tbody>
</table>

Prior to the exploratory interviews, the current regulatory process was reviewed through informal discussions with industrial operators, regulators and environmental groups, supplemented by examination of official documents at the environmental agencies' public registers. This helped to operationalise the aims of the study. It was decided to study the IPC regime due to the fact that processes regulated under IPC use or produce potentially harmful substances in significant amounts and therefore have the greatest potential to cause pollution. A number of themes, encompassing a broad range of regulatory topics, were developed to form the basis of the initial investigation: (1) The application process for an authorisation; (2) The derivation of individual parameter limits in an authorisation; (3) The effectiveness of national policy and legislation in providing environmental improvements; (4) The impact of the organisational and structural changes within the regulatory bodies on the regulatory process; (5) The influence of international policy-makers; (6) The role of science in the regulatory process; (7) The effectiveness of current monitoring schemes; (8) The importance of economics and employment in regulatory decision-making.
Two geographical areas were selected for the initial phase of the study: The industrialised estuaries of the Mersey in England and the Forth in Scotland are both populated with a wide range of large industrial operators regulated under IPC and therefore provide plentiful opportunities for data collection. It was envisaged that data from these two estuaries would also enable a comparison to be made between the different regulatory regimes pertaining to England and Scotland, particularly regarding the relative effectiveness of the EA and SEPA.

Theoretical, or purposive, sampling strategy was used throughout the study (Mason, 1996). This involved the setting of initial sampling quotas and their subsequent review in the light of data analysis at each stage. Analysis, theory and sampling activities were thus treated interactively to select units which were designed to enable meaningful comparisons in relation to the research objectives.

4.2. Exploratory interviews

Interviewing is the most widely used method in qualitative research (Mason, 1996). Exploratory interviews were used in the initial stage of the research to generate empirical data for underpinning the subsequent research and analysis (Oppenheim, 1992). The methodology for this stage of the research was designed to identify areas of conflict and uncertainty within the existing regulatory framework rather than establish consensus.

Fowler (1993) argued that personal interview procedures are probably the most effective method for enlisting co-operation for most populations, as well as the fact that longer
interviews can be done in person. Burgess (1984, p102) calls them, “Conversations with a purpose”. The narratives that are produced are constructed in situ (Holstein and Gubrium, 1995). Personal contact with the respondent means that rapport and confidence building are possible and the interviewer is able to answer any questions that the respondent might have and probe for adequate answers. In this respect, unanswered questions are generally avoided (Moser and Kalton, 1971). Oppenheim (1992) points out that the open ended questions which are possible in personal interviews are important in allowing the respondents to say what they think and to do so with greater richness and spontaneity. In addition, personal interviews prevent misunderstandings and maintain control over the sequence in which the questions are answered.

However, interviews are subject to response errors in the form of response bias and response variance. A successful interview is also dependent on cognition by the respondent of what is required of him and the motivation to give accurate answers (Moser and Kalton, 1971). Interviewer bias may also be introduced by the fact that the interviewer, at least in part, determines the form that the interview takes. It has been argued that, “There is, in the report of an informal interview, more of the interviewer than on the standard survey questionnaire, which is another way of saying that the process is often not so reliable.” (Moser and Kalton, 1971, p299).

4.2.1. Interview design

To overcome some of the limitations associated with the method, which could lead to response errors, a number of measures were taken to reduce their impact. The questions
included in the interview were worded carefully to avoid any misunderstanding or ambiguity. The format of the question order was designed to follow a logical path. Any misunderstandings were clarified to the respondent. The interviews were carried out at the respondents place of work to allow for a relaxed atmosphere. Prior to the interview, the interviewee was sent a brief outline of the project aims together with an indication of the scope of the interview. This was reiterated at the start of the interview. The structure of the interview was based around themes and was designed to explore the various aspects of factors influencing the implementation of pollution policy legislation through the regulatory process. Each theme was introduced, in predetermined sequence, by a brief statement and followed by a very general open question designed to allow the respondent to talk freely and at length. A number of prompting questions were formulated (see Appendix I), based on the themes described above, and used as necessary during the interview to ensure that questions were fully answered. This control of the interview was maintained to minimise interview inconsistencies. The interviews were tape-recorded, following prior consent, and subsequently transcribed to provide a precise account of the discussions.

4.2.2. The sample

With respect to sample selection, quota selection (Miles and Huberman, 1994) was used for the key groups operating at the 'sharp end' of policy implementation, who were identified as regulators, industrial operators and environmental groups. Expert scientists from government and academic institutions were considered to be comparatively remote from the regulatory interface and were therefore not included in the initial stage of the
research. Through discussions with EA and SEPA personnel and from information obtained from the Public Registers concerning authorisations, industrial operators with significant emissions to the aqueous environment were selected for study. Structured interviews were conducted with environmental managers from these companies, together with IPC Inspectors relevant to the area of study. In addition, industrial pollution campaigners from two prominent international environmental groups were interviewed (see Table 4.2). The field work was conducted during the period April to August 1998 and a total of ten structured interviews, using established methods (Oppenheim, 1992), were completed. The interviews focused on the derivation and management of the parameter limits for releases to controlled waters, including monitoring and enforcement of authorisation conditions. The duration of the interview varied from between one to three hours, very much dependent on the response of the interviewee.

Table 4.2. Details of interview respondents and their roles within the organisations. Process Schedule References for operators are given in brackets.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Location</th>
<th>Main activity</th>
<th>Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Agency</td>
<td>N. West</td>
<td>Regulator</td>
<td>IPC Inspector</td>
</tr>
<tr>
<td>S.E.P.A.</td>
<td>E. Region</td>
<td>Regulator</td>
<td>IPC Specialist</td>
</tr>
<tr>
<td>S.E.P.A.</td>
<td>E. Region</td>
<td>Regulator</td>
<td>Environment Protection Officer</td>
</tr>
<tr>
<td>Greenpeace</td>
<td>London</td>
<td>Environmental campaigner</td>
<td>Toxics Campaigner</td>
</tr>
<tr>
<td>Friends of the Earth</td>
<td>London</td>
<td>Environmental campaigner</td>
<td>Industrial Pollution Campaigner</td>
</tr>
<tr>
<td>ICI C&amp; P</td>
<td>Mersey</td>
<td>Chlorine manufacture (4.4.)</td>
<td>Site Environment manager</td>
</tr>
<tr>
<td>Associated Octel</td>
<td>Mersey</td>
<td>Chlorine manufacture (4.4.)</td>
<td>Environment Manager</td>
</tr>
<tr>
<td>Shell UK</td>
<td>Mersey</td>
<td>Petroleum refining (4.1)</td>
<td>Environment Officer</td>
</tr>
<tr>
<td>Alcan Chemicals</td>
<td>Forth</td>
<td>Alumina production (2.2)</td>
<td>Environment Manager</td>
</tr>
<tr>
<td>Lothian Chemicals</td>
<td>Forth</td>
<td>Solvent recovery (5.2)</td>
<td>Works Manager</td>
</tr>
</tbody>
</table>
4.2.3. Analysis of Data

After transcribing the interviews, the data obtained were processed using ‘Framework’ analysis (Ritchie and Spencer, 1994). This involved systematically coding, grouping and summarising descriptions and providing a coherent organising thematic framework to encapsulate and explain (Holstein and Gubrium, 1995). There were several key stages:

- Familiarisation: An overview of the data was achieved through immersion in the data: listening to tapes, reading transcripts and listing recurrent themes and key issues.
- Identification of a thematic framework: A thematic frame was developed within which the material could be sorted.
- Indexing: The thematic framework was systematically applied to the data.
- Charting: Charts were constructed by ‘lifting’ data from the original transcripts and rearranged according to the appropriate thematic reference.

The results of the ‘Framework’ analysis were used as the basis for the design of the main research instrument, the questionnaire survey.

4.3. Questionnaire

The use of questionnaires as research instruments has a number of advantages compared with interviewing (see Bourque and Fielder, 1995; Moser and Kalton, 1971; Neuman, 2000; Oppenheim, 1992): Quantitative data can be derived from questionnaire surveys enabling statistical tests to be applied, which subsequently allow generalisations and inferences to be made concerning the target population. The standard format of a
questionnaire avoids any bias that might be introduced by the interviewer during personal interviews and therefore helps to reduce errors.

4.3.1. Questionnaire design

The 5 page questionnaire was designed in accordance with established methods (see Bourque and Fielder, 1995; Moser and Kalton, 1971; Neuman, 2000; Oppenheim, 1992) and divided into 7 main sections each dealing with a different theme (see Appendix II). These themes were; (1) UK industrial Policy, (2) Environmental Quality Standards, (3) Hazardous chemicals and risk assessment, (4) BATNEEC and the economics of pollution control, (5) Monitoring and compliance, (6) The chemical industry, and (7) The future. Of the total of 58 attitudinal questions, 42 used a 5-point Likert scale to measure responses (Moser and Kalton, 1971). The five response categories were ‘Strongly disagree’; ‘Disagree’; ‘Neither agree nor disagree’; ‘Agree’ and ‘Strongly agree’. Likert scales are useful for multiple-item measures and are more likely to capture the totality of a broad concept than a single question and it can help make finer distinctions between respondents (Bryman and Cramer, 1999). The remaining 16 questions were based on a ranking or dichotomous scale. A final section consisting of 6 questions related to personal and organisational details of the respondent.

4.3.2. The sample

The sample representing the regulatory interface was defined as all chemical industry Environmental Managers and the Environment Agency Inspectors responsible for their regulation (see Table 4.3). A list of Agency IPC Inspectors and chemical process
operators in the UK was obtained from the EA and SEPA. These operators were contacted, by telephone, to obtain the identity of their Environmental Manager so that the survey could be targeted to named individuals.

Table 4.3. Details of the sample for the postal survey.

<table>
<thead>
<tr>
<th>Category</th>
<th>England/Wales</th>
<th>Scotland</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petrochemical processes</td>
<td>25</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>The manufacture and use of organic chemicals</td>
<td>260</td>
<td>19</td>
<td>279</td>
</tr>
<tr>
<td>Acid processes</td>
<td>42</td>
<td>4</td>
<td>46</td>
</tr>
<tr>
<td>Processes involving halogens</td>
<td>57</td>
<td>6</td>
<td>63</td>
</tr>
<tr>
<td>Inorganic chemical processes</td>
<td>155</td>
<td>5</td>
<td>160</td>
</tr>
<tr>
<td>Chemical fertiliser production</td>
<td>12</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Pesticide production</td>
<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Pharmaceutical production</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Sub-total operators</td>
<td>562</td>
<td>41</td>
<td>603</td>
</tr>
<tr>
<td>Regulators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment Agencies (EA/SEPA)</td>
<td>102</td>
<td>12</td>
<td>114</td>
</tr>
<tr>
<td>Total sample</td>
<td>664</td>
<td>53</td>
<td>717</td>
</tr>
</tbody>
</table>

As the total sample consisted of over 700 personnel and the methodological approach required a large data set for the successful use of statistical analysis, a postal survey method was selected as the most appropriate research instrument (Oppenheim, 1992).

4.3.3. Postal survey

The advantages and disadvantages of postal surveys are well documented in the literature (see for example, Frankfort-Nachmias and Nachmias, 1982; Moser and Kalton, 1971; Neuman, 2000; Oppenheim, 1992). The limitations of this type of survey are: There is no opportunity to clarify the meaning of a particular question; There is limited opportunity to probe responses further; The response rates can be low. These limitations were reduced
(Neuman, 2000) by ensuring the questionnaire was appropriate for the methodology and rigorous by pre-testing of the questionnaire carried out using well-informed professionals and by piloting to 24 environment managers, IPC Inspectors and representatives of environmental groups. It was proposed to target the survey to named individuals in order to increase the response rate.

The main survey was despatched in February 1999 to all IPC Inspectors and environmental managers of chemical processes with IPC authorisations. The useable response rate after one reminder was 41.1% (see Table 4.4) which was considered to be sufficient to meet the research objectives. This response rate for this type of survey is seen as very favourable. Recently in a survey of over 700 environmental directors of industrial companies in the USA, Fryxell and Vryza (1999) achieved a response rate of 32%. They observed that this was satisfactory considering that environmental issues are sensitive matters for most companies.

Table 4.4. Details of response rate to postal survey.

<table>
<thead>
<tr>
<th>Respondent type</th>
<th>Despatched</th>
<th>Returned</th>
<th>% Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPC Inspectors</td>
<td>114</td>
<td>41</td>
<td>36.0</td>
</tr>
<tr>
<td>Operators</td>
<td>603</td>
<td>254</td>
<td>42.1</td>
</tr>
<tr>
<td>Total</td>
<td>717</td>
<td>295</td>
<td>41.1</td>
</tr>
</tbody>
</table>

The Pattern of respondents was examined to identify any non-response bias. The return rate was higher from the Scottish sample, with 56.6% returning completed questionnaires compared with 39.8% from England & Wales. A higher proportion of operators (42.1%) responded to the survey than regulators (36.0%). Within the operator sector, multi-
national companies were more likely to return questionnaires (49.8%) compared to the smaller operations (36.5%). There was no bias among the different process type categories. No other response bias was identified.

A total of four questionnaires were returned unanswered by the Team Leader at Huntingdon who explained that, "As a matter of internal policy we are unable to comment on Government Policy etc.". A similar response was received from the Team Leader at the EA office in Bangor who stated, "The Agency considers it inappropriate to comment on our own effectiveness as a major regulator....". One individual inspector explained that, "I do not consider it appropriate as a Pollution Inspector responsible for enforcing pollution regulations to complete such questionnaires even in confidence". The letters received from the operators who returned questionnaires unanswered gave pressures of work as the reason for not completing the survey.

4.3.4. Analysis of data

There appears to be a trend toward the more liberal treatment of multiple-item scales (such as Likert) although there are no strict rules which allow the analyst to specify when a variable is definitely ordinal and when it is interval (Bryman and Cramer, 1999). It is now common practice to treat multiple item measures as though they were interval scales. Labovitz (1970) argued that almost all ordinal variables can and should be treated as interval variables as the amount of error that can occur is minimal, especially in relation to the considerable advantages of the application of a wide range of statistical techniques.
Recently, multiple item responses were successfully analysed using regression techniques by Fryxell and Vryza (1999).

**Coding the data**

The response options to each question were all given scores — numbers which referred to the responses. For example the Likert scale responses which ranged from ‘strongly disagree’ to ‘strongly agree’ were coded 1-5 (see Table 4.5). Other variables were assigned codes relating to their response categories and were recorded in a coding copy of the questionnaire. Subsequently all responses obtained from the survey were assigned the appropriate code by reference to the coding copy to create numerical data.

<table>
<thead>
<tr>
<th><strong>Response</strong></th>
<th><strong>Score</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>1</td>
</tr>
<tr>
<td>Disagree</td>
<td>2</td>
</tr>
<tr>
<td>Neither agree nor disagree</td>
<td>3</td>
</tr>
<tr>
<td>Agree</td>
<td>4</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>5</td>
</tr>
</tbody>
</table>

The numerical data was entered into an SPSS® data file and all subsequent analysis was carried out using this software (Foster, 1998; Kinnear and Gray, 1999; McCormack and Hill, 1997). In order to check the data for errors, frequencies were generated and missing data and anomalies were identified and then corrected by referring back to the original questionnaire responses.
Descriptive statistics

Descriptive statistics were calculated for the Likert scale variable responses, with mean scores derived from the 5 point scale. Standard deviation was calculated for all the of valid responses \( n \) for each variable. These calculations were performed both for the whole sample and separately for the regulator data and operator data. Operator and agency sub-sample means were compared using one way analysis of variance (ANOVA) to identify any significant differences between the respective attitudes of the two groups. Differences between the groups were indicated by the test statistic and categorised in order of increasing significance: at the 5% level \( (p<0.05) \), at the 1% level \( (p<0.01) \) and at the 0.1% level \( (p<0.001) \). These levels of significance are conventional and arbitrary (De Vaus, 1996). It was considered that \( p<0.01 \) should be used as the minimum level, but it was thought that this could lead to type II errors and significant differences could remain undetected.

Crosstabulations

For the categorical variables, crosstabulations were carried out using chi-square test for significant differences at the \( P<0.05 \) level.

Factor analysis

Factor analysis is a generic name applied to a number of multivariate statistical methods which address the problem of analysing the structure of interrelationships (correlations) among a large number of variables by defining a set of common underlying dimensions, or factors (Child, 1990; Hair et al., 1998; Malhotra, 1996; Stevens, 1996; Tabachnick and
Fiddell, 1989). These factors provide direct insight into the interrelationships among variables and can provide empirical support for addressing conceptual issues. In this study, the technique was used as an exploratory tool to reduce a number of regulatory attitudes to a more focused set of dimensions which could also be used for subsequent analysis. The first stage in factor analysis is to summarise the information contained in a number of original variables into a smaller set with a minimum loss of information. This was achieved by applying principal components analysis, as a data reduction technique, to the operators' attitude scores (Likert scale) relating to the use of science in regulation. This procedure was not carried out for regulator data due to the relatively small number of respondents in the regulator sample (Child, 1990; Hair et al., 1998). A correlation matrix was computed for all these variables and any showing no substantial correlation (< ± 0.3) (Child, 1990; Hair et al., 1998) were removed at this stage. As the minimum requirement for factor analysis is that the ratio of responses (cases) to variables should be at least 5:1 (Child, 1990; Hair et al., 1998; Malhotra, 1996; Tabachnick and Fiddell, 1989) no multivariate analysis was performed using the regulator responses. Factor extraction was computed from the correlation matrix. Three criteria for identifying the number of factors were applied; Latent root, percentage of variance explained and Scree test (Child, 1990; Hair et al., 1998; Malhotra, 1996; Stevens, 1996; Tabachnick and Fiddell, 1989). Diagnostic tests were used to validate the model before factor rotation was performed, using a varimax method to give clearer separation of the factors (Hair et al., 1998; Tabachnick and Fiddell, 1989). The resulting principal component factor loading scores of the underlying dimensions were then interpreted and named. The factor scores were saved for subsequent cluster analysis.
Cluster analysis

Cluster analysis describes a group of multivariate techniques whose primary aim is to group objects on the characteristics they possess (Hair et al., 1998; Stevens, 1996). The technique is frequently used as a classification tool and is concerned with the identification of discrete categories. It is a purely empirical method of classification and there is often no single best solution to a clustering problem (Punj and Stewart, 1983). The purpose of cluster analysis in this investigation was to identify distinct operator types which could be used to explain and predict regulatory behaviour. Cluster analysis was used to develop classifications of operators based on their attitudes to science in regulation. These classifications (or clusters) were then subsequently profiled using variables that were not part of the factor and cluster analysis.

The approach used in this study combined hierarchic and non-hierarchic methods, as recommended by Harrigan (1985), Hartigan (1975), Punj and Stewart (1983). A hierarchic technique, using Ward’s minimum clustering algorithm with squared Euclidean distance measure of interobject similarity, was used to determine the initial cluster solution. Then, K-means non-hierarchical method was used to cluster the results with the cluster centroids from the hierarchical results as the initial seed points. In this way, the advantages of the hierarchical method to identify the number of clusters were combined with the ability of K-means to ‘fine tune’ the results. The cluster solutions were assigned to each case and saved for subsequent profiling analysis.
In the survey a considerable amount of detailed information was collected on variables which were not used in the factor and cluster analysis. This data was used to develop profiles of group members by examining differences between other variables. These profiled clusters were then named according to their apparent characteristics. Intercluster differences attributable to each factor or variable were tested using F ratio comparisons of variances among the mean of criterion variables from a one way ANOVA analysis and Tukey’s Honestly Significantly Different (HSD) Test adjusted for unequal size. Due to the qualitative nature of some of the variables, chi-square tests of independence were used in preference to ANOVA.

4.4. Focus Groups

Focus groups can be used alone or with other qualitative or quantitative methods to bring an improved depth of understanding (Mason, 1996). According to Wolff et al. (1993) the use of focus groups to illustrate and confirm conclusions from survey analysis represents the most reliable objective of multi-method design and can capture the in-depth contextual details that are not identified in quantitative surveys. Wolff et al. (1993, p124) also suggested that, “The qualitative method adds a degree of contextual nuance that it is impossible to extract from the cold parsimony of a statistical analysis”. The format is more active than in-depth interviews and focus groups can bring out spontaneous reactions and ideas through the interaction between the participants. Groups create their own structure and meaning and groups can bring the researcher closer to the ‘truth’ by the addition of embellishing interpretive data (Frey and Fontana, 1993). Focus groups provide the opportunity to elicit a range of opinions or attitudes at another level.
Although they produce less information than an individual interview, focus groups produce data that are often richer and fuller than the data available from an individual interview. They yield additional information as the group achieves consensus or disagreement on reality (Hakim, 2000). A focus group consists of a discussion of approximately 90 to 120 minutes, led by the moderator and involves 4 to 10 persons. Some researchers prefer to use small groups because they feel they can generate more in-depth information (Greenbaum, 1998).

4.4.1. Focus group design

The focus groups were designed, in accordance with established methods (Greenbaum, 1998; Knodel, 1993; Morgan, 1998), to explain some of the survey findings and identify new regulatory models. Prior to the focus group the participants were sent a summary of the questionnaire findings, together with details of the themes that would form the basis of the discussion. The discussion covered four main themes: (1) Environmental Quality Standards, (2) BATNEEC, (3) OSPAR 2020, (4) Future regulatory options. The discussions were prompted by stating the survey responses to key questions relating to the above themes. Group participants were asked to give their opinions and explain the survey results. Additional prompting questions were used as appropriate. The sessions were conducted by the author. This was considered likely to enhance the accuracy of the subsequent analysis by reducing the distance between the analyst and the subject being studied (Knodel, 1993). The discussions, which lasted between 1 and 2 hours, were tape-recorded and subsequently transcribed.
4.4.2. The sample

A total of four focus groups, a typical number in areas of specific research (Hakim, 2000), were carried out involving a total of 16 participants (see Table 4.6). Environmental Managers from the chemicals industry in England and Scotland were involved, together with IPC Inspectors from the Environment Agency and Environmental Scientists from the University of Plymouth. Unfortunately it was not possible to assemble a group of IPC Inspectors from SEPA.

Table 4.6. Details of focus group composition.

<table>
<thead>
<tr>
<th>Type</th>
<th>Participants</th>
<th>Location</th>
<th>Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulator</td>
<td>6</td>
<td>Bridgewater</td>
<td>IPC Inspectors</td>
</tr>
<tr>
<td>Operator</td>
<td>4</td>
<td>Hull</td>
<td>Environment Managers</td>
</tr>
<tr>
<td>Operator</td>
<td>3</td>
<td>Edinburgh</td>
<td>Environment Managers</td>
</tr>
<tr>
<td>Academic</td>
<td>3</td>
<td>Plymouth</td>
<td>Environmental Scientists</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.4.3. Analysis of data

Focus group analysis uses many qualitative strategies and approaches (Kreuger, 1997). After transcribing the focus group discussions, the data obtained were processed using framework analysis (Ritchie and Spencer, 1994). In a similar method to the analysis of the exploratory interviews, charts were constructed by ‘lifting’ data from the original transcripts and rearranged according to the appropriate thematic reference (Hammersley and Atkinson, 1995).
Chapter 5. Results

The results are presented in accordance with the three stages of the research process, starting with the exploratory interviews, followed by the questionnaire survey and finally the focus groups.

5.1. Exploratory Interviews

The thematic considerations below draw extensively on quoted responses from the operators and regulators. These quotes are used throughout the text to illustrate the perceptions held by the two parties. The views expressed are those of a targeted group of key personnel involved in the delivery of environmental regulation and although no assumptions can be made as to whether these views represent a general consensus, they may be considered typical.

5.1.1. Setting of authorisation conditions

It is a requirement that the regulators must consider and then reconcile the environment, technology and economics in the derivation of authorisation conditions, in order to achieve a balance between the needs of industry and protection of the environment (EA, 1998a). One of the aims of this study was to determine the relative significance of these factors in the setting of parameter limits within authorisations. The thematic analysis shown in Table 5.1 are constructed using quoted responses from the interviews concerning the importance of environment, technology and economics as well as external influences on the setting of discharge licence conditions.
<table>
<thead>
<tr>
<th>Respondent</th>
<th>Environment</th>
<th>Technology</th>
<th>Economics</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA</td>
<td>&quot;...we've got well stipulated EQSs...providing an assessment of risk to the environment...we are using those EQSs and where we think that those EQSs don't address all of the issues then we're carrying out additional studies.&quot;</td>
<td>&quot;...approaches from companies basically saying: 'We're installing an additional piece of abatement plant to reduce emissions'.&quot;</td>
<td>&quot;...financial data is something that we would have access to. Whether we're in a position to interpret it in the correct way...whether we have the data to quantify environmental benefit...It's basically a case of me pushing until companies squeal...&quot;</td>
<td>&quot;...public comments...tend to be very short on technical or reasoned objection...There have been consultees who've asked us to take into account certain conditions and those have been taken into account in the formulation of the conditions.&quot;</td>
</tr>
<tr>
<td>SEPA 1</td>
<td>&quot;You look at the environmental criticality to see where you must meet the EQS...limits can be fairly well dictated within the legislation, either in EQSs, Guidance Notes...they're fairly set.&quot;</td>
<td>&quot;...there's one company who are building an ETP...not quite state of the art...we would want to monitor the progress of the ETP...and then we'll decide to reduce emissions in the discharge consent.&quot;</td>
<td>&quot;...they've got to prove that not spending the money or spending the money will make a difference...In the main you find they are very open...You've got to balance cost and performance.&quot;</td>
<td>&quot;In the main they (consultees) might suggest one or two bits and pieces which would go into the authorisation and we'd look at them on merit and under the Act...&quot;</td>
</tr>
<tr>
<td>SEPA 2</td>
<td>&quot;...the use of EQSs is helpful...you don't have to worry about the impact...provided the concentration isn't above that, we're alright. So all you have to look at is your dispersion modelling.&quot;</td>
<td>&quot;Obviously limits would be changed...once they'd put the new plant in then you would impose the new standards.&quot;</td>
<td>&quot;...what excessive cost is must take into account the environmental benefits...Part of it comes down to our professional judgement...you certainly have to rely on their openness and honesty.&quot;</td>
<td>&quot;...if the public were well educated they could make our life very difficult...the likes of Greenpeace and FoE are much better at targeting responses...&quot;</td>
</tr>
<tr>
<td>ICI</td>
<td>&quot;You have to render harmless, ultimately whether it's a prescribed or non-prescribed substance...we would not put stuff out and carry on putting stuff out that was damaging...We meet the EQS levels.&quot;</td>
<td>&quot;BAT can be described...as techniques and as technology changes it gives the Inspector...the ability to drive change...we made changes to the process...we were able to argue successfully for the Agency to increase the concentration limits.&quot;</td>
<td>&quot;&quot;BATNEEC is very much dependent on the local situation...it is up to you, the applicant, to say what that is...to make your case...we've spent, over the last 3 years, £60m on capital investment for environmental improvements.&quot;</td>
<td>&quot;You don't get improvements by direct action by the pressure groups or by media.&quot;</td>
</tr>
<tr>
<td>Shell</td>
<td>&quot;Our aqueous consents are really quite basic.&quot;</td>
<td>&quot;...they knew what targets we were capable of meeting so they didn't put unrealistic authorisation limits on us.&quot;</td>
<td>&quot;They've got to take the legislative aspects into account, but there's no point in putting targets on industry which they just can't meet.&quot;</td>
<td>&quot;The only feedback we got was from local residents; some of it was favourable, some of it was unfavourable and some of it was sitting in between.&quot;</td>
</tr>
<tr>
<td>Respondent</td>
<td>Environment</td>
<td>Technology</td>
<td>Economics</td>
<td>External</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
<td>------------</td>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>Octel</td>
<td>&quot;...they didn't expect existing processes to suffer too much under this first raft of applications ...in the main it was 'start from where you are now'.&quot; &quot;...if you're actually causing harm they won't authorise you.&quot;</td>
<td>&quot;If you say you can do the new limits, that's what they put in the authorisation ...if we could get it to work the EA could then promote its use, so we were actually setting BATNEEC/BPEO standards.&quot;</td>
<td>&quot;We know that under certain circumstances there's a return on some of the investment and we know for some others there's no return, but we realise that those 'no return' ones probably need doing.&quot;</td>
<td>&quot;There weren't any contentious issues.&quot;</td>
</tr>
<tr>
<td>Alcan</td>
<td>&quot;Taking the EQS, the dilution factor and other industry into account, limits were set.&quot; &quot;...The North Sea Conference did come into it with the 50% mass emission reduction.&quot;</td>
<td>&quot;What's BATNEEC? - SEPA never gave a satisfactory answer.&quot; &quot;...We feel, ourselves, that we are keeping up with technology.&quot;</td>
<td>&quot;...you can use a number of technologies, but it's very expensive and I doubt at the moment whether it's going to be economic.&quot;</td>
<td>&quot;There was no response from the public and as far as I'm aware the consultees had no influence on the authorisation.&quot; &quot;...By issuing so many statements full of errors their (Greenpeace) credibility has been damaged.&quot;</td>
</tr>
<tr>
<td>Lothian</td>
<td>&quot;You're granted a consent to discharge based on what they put forward ...So for all that we're being allowed to discharge there it's not having a significant effect.&quot;</td>
<td>&quot;It is a batch process and I think this is probably why they've allowed the higher consent because recycling you're handling all sorts of material ...I think we need to invest more in treatment on this site.&quot;</td>
<td>&quot;What is 'not entailing excessive cost'?...we were an existing company and they couldn't have levelled unnecessary financial burden which could have radically affected the operation.&quot;</td>
<td>&quot;I'm not in favour of pressure groups sitting down on a personal level. They should be directed through government and the government should tackle these issues.&quot;</td>
</tr>
<tr>
<td>FoE</td>
<td>&quot;...the vast majority of chemicals have no toxicity tests and have no environmental fate data ...the whole issue of non-prescribed substances is totally non-precautionary ...Does the EA ask DETR to prescribe more chemicals or not?&quot;</td>
<td>&quot;...most of them in an existing plant such as ICI or Albright and Wilson are set on what the plant is currently achieving ...Industry has a lot of interest in making money out of its older products from its older plants.&quot;</td>
<td>&quot;...in the case of new plants, it's clearer how BATNEEC is applied ...but existing plants tend to claim that everything's too expensive anyway ...I think they rely a lot on industry because it's very difficult to second guess a large company.&quot;</td>
<td>&quot;In policy-making we obviously contribute to consultations, we generate interest around certain issues, we try to counter the effects of industry lobbying which is always very substantial to minimise regulation.&quot;</td>
</tr>
<tr>
<td>Greenpeace</td>
<td>&quot;That whole concept that a body has the capacity to take up, absorb and de-toxify things that are inherently persistent or toxic ...is just ridiculous ...the balance is completely in favour of industry.&quot;</td>
<td>&quot;Is there such a thing as BAT in the production of PVC?...It assumes it's alright to operate that process, it doesn't take into account the broader questions...&quot;</td>
<td>&quot;...BATNEEC had meant that environmental standards were lower because they'd gone for the cheapest option ...our focus has been on the chemical industry...it's very, very secretive there...&quot;</td>
<td>&quot;I think that the Albright and Wilson consent changed and it was partly driven by our campaign but it's difficult to say that it was us that did it.&quot;</td>
</tr>
</tbody>
</table>
When questioned about the influence of environmental protection in the derivation of parameter limits, regulators and large companies identified the importance of EQSs. The meeting of an EQS is seen as a key criterion in the approval of a discharge, and also as a useful tool. In essence, an EQS combined with some simple dispersion modelling will then make the determination of limits relatively straightforward and the regulator can assume that the discharge has been 'rendered harmless' as required by the legislation. One regulator explained:

"The use of EQSs is very helpful, you don't have to worry about the impact; provided the concentration isn't above that, we're alright."

A key part of the legislation is the requirement to use BATNEEC which attempts to reconcile the technological and economic factors. All the industrial operators questioned believed that it was up to them to define BATNEEC; according to one company representative:

"BATNEEC is very much dependent on the local situation, it's up to you, the applicant, to say what that is, to make your case."

The onus is therefore seen to be very much on the operator, rather than the regulator to define BATNEEC. Indeed, in one case where the operator was installing novel pollution abatement technology it was said that, if it proved successful, the EA would then promote its use. In effect, the operator was setting BATNEEC (or BAT) standards for the industry as a whole. The subsequent alteration of the parameter limits in the authorisation would be based on the actual performance of the equipment after a 'proving period'. In making a judgement on what constitutes BATNEEC, the regulator was perceived to be at a disadvantage in the
assessment of the financial element. Regulators indicated they depended on their relationship with the operators. Both the operators and regulators were well aware of interdependency and its resultant classic negotiation scenario. The regulators explained that, in the early days of IPC, this was not necessarily a problem because unacceptable emissions were easy to identify and companies readily agreed to spend in order to provide significant environmental benefits. However, according to one regulator, further improvements may be more difficult to justify:

"The position we're getting into now, is that we've done all these [obvious improvements] and now there needs to be a much more detailed and objective consideration of what does entail excessive cost...it's basically a case of me pushing until companies squeal."

The operators and regulators expressed the view that there is no point in the regulator putting targets on industry which they just cannot meet or imposing a financial burden which could radically affect the operation. The regulators pointed out that it was not within their remit to consider the issue of jobs, nor impacts on the local economy during their decision-making. These were considered to be political matters and operators could use the appeals procedure, provided for under the legislation, if they felt they had been unfairly treated.

Part of the aim of the Environmental Protection Act was to facilitate wider involvement of the public and interested parties in pollution regulation, something which is addressed by the requirement to seek responses during the application period. Operators and regulators observed that there appeared to have been insignificant input from the public and therefore had no effect on the final authorisation. The regulators and the operators attributed this mainly to the lack of technical or reasoned objection by the public and one Inspector said:
"...if the public were well educated they could make our lives very difficult."

The responses from the statutory consultees, such as The Ministry of Agriculture, Fisheries and Food (MAFF) and English Nature, were also seen by the regulators to have little influence on the authorisation conditions, but, according to one regulator, for different reasons:

"MAFF...have a small team working on IPC applications and a lot of their responses were fairly generic, saying if the company complied with Guidance Notes relevant for the particular process then they wouldn’t have any objections."

There is no requirement to seek similar consultation during the statutory review process which one regulator thought was a possible weakness in the legislation.

In addition to the factors that influence parameter limits within an authorisation, new policy initiatives are seen by both operators and regulators to have had a direct effect on authorised discharge limits. The link between the policy making forums of the INSC and PARCOM and the imposition of tighter discharge controls was identified, in this case by an operator:

"The NSC did come into it with the 50% mass emission reduction by 1995 compared with the base of 1985. That was part of the original consents.... That really started to drive things."

It was clear from these interviews that another significant influence in derivation of the authorisation conditions was historical. Many of the consent conditions issued under previous legislation were simply written into the new authorisations as one operator explained:
"...they didn't expect existing processes to suffer too much under this first raft of applications, because they had been controlling the existing operations for a number of years and it would be very strange to suddenly go 'Stop!' ...in the main it was, 'Start from where you are now'."

This authorisation of the status quo was not perceived as a problem by the regulators because they believed prior controls had been effective in controlling aqueous emissions. One of the regulators expressed this view concisely:

“One would have expected the previous regulatory regime to have put controls in place which were sufficient to prevent harm. I think that COPA did that and did it well.”

5.1.2. Enforcement of authorisation conditions

There are two main issues regarding enforcement: The regulatory assessment of compliance with legally binding conditions and the subsequent response of the regulator to cases of non-compliance. Compliance with authorisation conditions is essential if the system is to work effectively. This is another area where the regulators operate under guidance and the decision to take any action is subject to the Inspector’s professional judgement, although within SEPA this involves a wider discussion with a licencing team. Responses are summarised in Table 5.2. The introduction of the IPC legislation created immediate problems of non-compliance for one operator:

“The NRA’s method...was to set limits which they expected you to meet 95% of the time. Legislation changed overnight; the agency took those limits and wrote them into our authorisation. We now have to meet those limits 100% of the time.”

This change resulted in a sudden and dramatic increase in the number of reported non-compliances by this operator.
### Table 5.2. Thematic chart for enforcement of consent and authorisation conditions.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Compliance</th>
<th>Sanctions</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA</td>
<td>&quot;...a limit that's been exceeded by only a few percent? I've certainly not taken any enforcement action over any of those and I'd be surprised that anyone else in the Agency has.&quot;</td>
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<tr>
<td></td>
<td>&quot;...we would use the improvement programme within every authorisation to address that gap between the current position and the standards that are in the Chief Inspector's Guidance Notes.&quot;</td>
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<tr>
<td></td>
<td>&quot;We have an enforcement and prosecution policy...prosecution for very serious breaches of authorisation conditions, where there's been very major environmental impact...It's left up to the professionalism of the people implementing it...&quot;</td>
<td></td>
</tr>
<tr>
<td>SEPA 1</td>
<td>&quot;We will look at the circumstances of the breaking of an authorisation...we tend to take a rather pragmatic approach...what is the impact of this break?...you can have 'no impact' to 'serious impact'...You do give industry the benefit of the doubt.&quot;</td>
<td></td>
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<tr>
<td></td>
<td>&quot;...at one end you'd take no action...if there is an instantaneous and definitive environmental impact, a fish kill or dead sea-gulls...something must be done...you'd be wrong not to take a case to the Procurator Fiscal.&quot;</td>
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<tr>
<td>SEPA 2</td>
<td>&quot;...the majority of breaches of consent conditions have no effect - they are not set at a level where if you go over them you're suddenly going to get harm... The use of simple consent numbers sounds great but they're open to all sorts of legal argument&quot;</td>
<td></td>
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<tr>
<td></td>
<td>&quot;...you might set a target limit and time-scale to improve.&quot;</td>
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<tr>
<td>ICI</td>
<td>&quot;Every time we have a failure, we have to report it to the Agency and it goes in the public record...There are so many trivial ones: Say we have a pH limit of 5-10. Does it really affect the environment if we are for 10 mins 10.6?..&quot;</td>
<td></td>
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<tr>
<td></td>
<td>&quot;The NRA's method of driving improvement was to set limits which they expected you to meet 95% of the time and drive you towards meeting them 100% of the time. Our target is zero non-compliances...&quot;</td>
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</tr>
<tr>
<td></td>
<td>&quot;...most of the regulatory non-compliances are, say like doing 32 mph in a 30 mph zone. Occasionally you're going to get a 70 mph in a 30 mph zone and that's where we're prosecuted.&quot;</td>
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</tr>
<tr>
<td>Shell</td>
<td>&quot;I think in general that big industry cannot afford to get caught, shall we say, misleading the EA with respect to emissions.&quot;</td>
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<tr>
<td></td>
<td>&quot;We have regular meetings with the EA so we can get an understanding of what they're looking for.&quot;</td>
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<tr>
<td></td>
<td>&quot;We're confused on the EA's enforcement and prosecution policy. Generally we would not expect to be prosecuted for what we regard as a minor offence i.e. a breach in water quality or air emission standards as compared to what's set in the authorisation.&quot;</td>
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</tr>
<tr>
<td>Octel</td>
<td>&quot;We did have an incident that was very visible...that was last June and they haven't decided yet what they're going to do.&quot;</td>
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<tr>
<td></td>
<td>&quot;...where there's been an issue, that's been dealt with.&quot;...&quot;Although we've had an indication of where they wanted us to go, there hasn't been a specific 'You will reduce by...&quot;...&quot;If there is a problem they will change an authorisation at any time.&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;If as an industry we say 'Sorry we're not going to do anything until you issue an Enforcement Notice' then you get an Enforcement Notice.&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;...they don't have the obligations but they have the power.&quot;</td>
<td></td>
</tr>
<tr>
<td>Alcan</td>
<td>&quot;I would say that our plant has the best environmental record of all Alcan's alumina plants.&quot;</td>
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</tr>
<tr>
<td></td>
<td>&quot;Whenever we install a piece of environmental equipment we always put it in with a lighter specification than current legislation.&quot;</td>
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<tr>
<td></td>
<td>&quot;In some cases SEPA have taken a formal sample but they don't prosecute if the result is up to 150% of the limit.&quot;</td>
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</tbody>
</table>
Regulators and operators generally expressed the view that a small exceedence of the authorisation parameter limits should not and does not warrant sanctions and that the environmental impact of any non-compliance must be taken into account, as this example, given by one of the operators, illustrates:

"Say we have a pH limit of 5-10; does it really affect the environment if we are, for 10 minutes, 10.6? Most of the regulatory non-compliances are, say, like doing 32 mph in a 30 mph zone. Occasionally you’re going to get a 70 mph in a 30 mph zone and that’s when we’re prosecuted."

Both the operators and the regulators perceive these breaches of consent limits as ‘trivial’ and as one regulator explained:

"The majority of breaches have no effect - they are not set at a level where if you go over them, you’re suddenly going to cause harm."
In the case of a highly visible incident, which has an instantaneous and definitive impact, such as a fish kill, the regulators believe that they have no choice but to take enforcement action.

The type of sanctions that are exercised can include prosecution with consequent fines. The decision to prosecute an operator is taken as a last resort and very rarely happens as a result of a simple exceedence of authorisation limits, as one operator confirmed:

“Generally we would not expect to be prosecuted for what we regard as a minor offence, ie. a breach in water quality or air emission standards as compared to what’s set in the authorisation.”

There are legal aspects to the sampling and sample evidence which complicate the issue and have to be taken into account by the regulator when deciding on appropriate enforcement action. Summing up the difficulty, one regulator explained:

“The use of consent numbers sounds great, but they’re open to all sorts of legal argument.”

5.1.3. Monitoring

Monitoring serves both to police authorisation conditions, and assess environmental impacts. A summary of the responses to the questioning in this subject is given in Table 5.3. It was accepted by all parties that, due to practical and resource limitations, it was impossible to monitor everything all of the time and therefore an unauthorised emission may go undetected. This was recognised by the regulators, one of whom admitted:

“If someone does spill a 45 gallon oil drum down the drain, the chances are that no monitoring programme will ever pick that up.”
### Table 5.3. Thematic chart for monitoring.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Scope</th>
<th>Scheme</th>
<th>Feedback</th>
<th>Biomonitoring</th>
<th>Self-monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA</td>
<td></td>
<td></td>
<td>&quot;I think it works very well...it's very effective and has led to environmental improvements.&quot;</td>
<td>&quot;Fairly recently Me/HCH was detected in the water body and traced back to a particular operator with the result that the authorisation was changed.&quot;</td>
<td>&quot;...you can see from the public register that companies are reporting their non-compliances...We now have a large amount of high quality data from these companies.&quot;</td>
</tr>
<tr>
<td>SEPA 1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>SEPA 2</td>
<td>&quot;...probably there isn't enough real work being done in the environment at large to fully ascertain whether there's a problem&quot;</td>
<td>&quot;How often do you actually have to monitor to ensure that you haven't missed something?... If someone does spill a 45 gallon oil drum down the drain the chances are that no monitoring programme will ever pick that up.&quot;</td>
<td>&quot;...if someone says 'we've seen an oily slick, or something on the river'...that would be investigated.&quot;</td>
<td>&quot;The difficulty I have is how relevant those tests are to the environment...You're looking at the effect on a particular species...how many Pacific oyster embryos have we got in the Forth?&quot;</td>
<td>&quot;...how do you reassure the public if the polluter does all his own monitoring? There are other ways of checking whether results internally are correct; looking at lab procedures...looking back at hard lab data.&quot;</td>
</tr>
<tr>
<td>ICI</td>
<td>&quot;In an ideal world, you'd have continuous monitors for everything...but it's impossible.&quot;</td>
<td>&quot;I cannot see why the Agency are paying consultants to do monitoring......what they should be doing is...auditing what we do.&quot;</td>
<td>&quot;Direct toxicity; the EA needs to convince industry that this is a better way.&quot;</td>
<td>&quot;Self monitoring is a much more stringent activity than ever the old system was...you're putting yourself in jeopardy by monitoring.&quot;</td>
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</tr>
<tr>
<td>Shell</td>
<td>&quot;Now and again we have the EA consultants that come in and check on our discharges.&quot;</td>
<td>&quot;A few years ago the EA came along and wanted to look at discharges for the Red List substances......in the end we tracked it down to the fact that we brought in ship ballast onto site.&quot;</td>
<td>&quot;Essentially the monitoring we do is based on our authorisation to operate.&quot;</td>
<td>&quot;Essentially it's fair to say that industry has proved itself to be responsible in its self-monitoring.&quot;</td>
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</tbody>
</table>

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<table>
<thead>
<tr>
<th>Respondent</th>
<th>Scope</th>
<th>Scheme</th>
<th>Feedback</th>
<th>Biomonitoring</th>
<th>Self-monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Octel</td>
<td>&quot;They do a lot of work in the Manchester Ship Canal and the Mersey, particularly with liquid effluents.&quot;</td>
<td>&quot;The monitoring scheme had failed to pick up a particular characteristic of the process which meant that at certain times emissions were above that which we originally said.&quot;</td>
<td>&quot;We could do a lot of work at the moment on this but I don’t feel it’s robust enough.&quot;</td>
<td>&quot;In terms of monitoring ourselves I think they’ve got it about right.&quot; &quot;...As we’ve got more data available to say, ‘Look, this one’s really not a problem, do we need to spend the money?’ or continue monitoring irrespective of what the EA might say.&quot;</td>
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<tr>
<td>Alcan</td>
<td>&quot;In some areas we take more samples than we’re obligated to.&quot;</td>
<td>&quot;There had been a number of reports, commissioned by different people, which showed there might have been a slight effect on the marine life.&quot;</td>
<td>&quot;Is there too much self-monitoring? In some respects there is.&quot;</td>
<td>&quot;We want to know more than SEPA knows, so if anything comes up we are able to answer.&quot;</td>
<td></td>
</tr>
<tr>
<td>Lothian</td>
<td>&quot;They do go out and draw samples, they do survey reports.&quot;</td>
<td>&quot;It seems alright, with the exclusion that... their result being the only one on the public record.&quot;</td>
<td>&quot;...They asked the company to do some micro-tox on our effluent.... They asked us to do a benthos survey at the marine outfall.&quot;</td>
<td>&quot;I don’t think it should be self-regulated which is an odd thing to say.... It must be policed.&quot;</td>
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</tr>
<tr>
<td>FoE</td>
<td>&quot;A lot of it is over-simplified... it’s monitoring for a very small group of things...there isn’t much environmental monitoring...&quot;</td>
<td>&quot;...they can actually control when they emit their pollutants.&quot;</td>
<td>&quot;...it’s never going to test all the toxicity, it’s never going to test whether something’s going to bioaccumulate.&quot;</td>
<td>&quot;I don’t think it would be self-regulated which is an odd thing to say.... It must be policed.&quot;</td>
<td></td>
</tr>
<tr>
<td>Greenpeace</td>
<td>&quot;A huge amount of Chemicals aren’t on the consent&quot;.</td>
<td>&quot;The company will know when they are coming and turn things down&quot;.</td>
<td>&quot;Once they’d identified that Coalite was a problem... they took samples... they delayed and delayed.&quot;</td>
<td>&quot;Can you trust them? There needs to be a system of checks and balances.&quot;</td>
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</tbody>
</table>

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The operators are obliged to carry out much of their own monitoring under the terms of their authorisations. The large companies welcomed this self-monitoring and viewed it as a very stringent activity. They believed they have proved themselves to be responsible in performing this function. The regulators shared this view and regarded the resultant data as being of ‘high quality’, although they were concerned about the reassurance of the public when the polluters were seen to carry out all their own monitoring. The smaller company generally felt more comfortable being policed by the regulator rather than conducting its own monitoring, although this may be, at least in part, a resource issue.

Operators and regulators explained that monitoring schemes had been modified in the light of continued experience as data had built up to show that, for example, a particular discharge point was ‘not a problem’. Operators did carry out additional monitoring, that was not required by the regulators, in order to build their own data base. One operator explained:

“We want to know more than the Agency knows, so if anything comes up, we are able to answer.”

In this way, the operator’s own monitoring could provide an additional defence against possible enforcement action.

The regulators also carried out environmental monitoring which has, on a number of occasions, been successful in identifying previously unforeseen problems. One regulator described such a case involving the detection of methyl lindane in the Mersey, which was traced back to a particular operator with the result that the authorisation was changed. This was used by the regulator as an example where monitoring information had been successfully used to tighten up and improve authorisation conditions. With respect to
toxicity testing and biomonitoring, there was a general consensus that, although this seemed to be a more logical method of identifying environmental problems, a lot of work needed to be done to derive tests that were both relevant to the environment and sufficiently scientifically robust. As one regulator stated:

"There may be a role for ecotox testing, but this needs to be carefully worked out. It could be included in future authorisations, but it would have to be carefully targeted."

The discovery of hitherto unforeseen biological effects of discharged chemicals was viewed by operators and regulators as an issue which would eventually affect authorisation parameter limits. One operator identified the regulation of endocrine disruptors and the introduction of direct toxicity consents as the two main pollution management issues currently facing industry:

"...from an industry point of view, the two big issues for ourselves would be direct toxicity testing...the endocrine disruptors issue."

5.1.4. Structural

The regulatory agencies both felt there had been some positive benefits in creating the integrated structures within which they now work (see Table 5.4). In SEPA, the multi-functional licencing teams were seen as being responsible for improving licences and harmonising authorisation conditions across Scotland. SEPA have used cross-disciplinary teams to tackle specific issues and they saw this as the way forward. In contrast, the operators thought there were significant organisational deficiencies within the agencies, as exemplified by one operator who said of the lack of perceived integration within the EA:

"I'm still dealing with three groups of people who come together at a much too high a level."
Table 5.4. Thematic chart for structural factors.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Structure</th>
<th>Organisation</th>
<th>Relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA</td>
<td></td>
<td>&quot;There have been some very positive benefits ...I now have access to groundwater experts ...which assisted greatly in the prosecution case ...the Agency has gone for integration for integrations sake, forcing disciplines and functions to work together...&quot;</td>
<td>&quot;There have been the old chestnuts about the liaison with industry being too close ...I don't believe that's the case because a lot of improvements have resulted from that close working, from the advice and co-operation of the close working relationship...&quot;</td>
</tr>
<tr>
<td>SEPA 1</td>
<td></td>
<td>&quot;...to a certain extent we're strapped by the law, because we still have COPA and we still have Part I of EPA'90 and Part II and we still have the Radioactive Substances Act and these, themselves are not integrated.&quot;</td>
<td>&quot;We've been able to pull all these environmental regulatory strands together ...the multi-functional licencing team as well as dealing with enforcement actions actually improves licences ...Plus we've been able to harmonise across the country.&quot;</td>
</tr>
<tr>
<td>SEPA 2</td>
<td></td>
<td>&quot;We've been able to pull all these environmental regulatory strands together ...the multi-functional licencing team as well as dealing with enforcement actions actually improves licences ...Plus we've been able to harmonise across the country.&quot;</td>
<td>&quot;The legislation sees it as a partnership ...there has to be a dialogue ...the new breed of civil servants that got hold of HMIP seemed to think it could all be done by the check-list approach...That attitude has changed. It has to be working together.&quot;</td>
</tr>
<tr>
<td>ICI</td>
<td></td>
<td>&quot;I'm still dealing with 3 groups of people who come together at a much too high a level&quot;.</td>
<td>&quot;I don't think they've succeeded in their ultimate goal of having a one-stop shop. I don't think they've been able to become integrated yet.&quot;</td>
</tr>
<tr>
<td>Shell</td>
<td></td>
<td>&quot;I don't think they've succeeded in their ultimate goal of having a one-stop shop. I don't think they've been able to become integrated yet.&quot;</td>
<td>&quot;I would say that their knowledge is good and they are very pragmatic in their approach ....overall they've got a good perspective and because of that I think we've got a good working relationship with the EA.&quot;</td>
</tr>
<tr>
<td>Octel</td>
<td></td>
<td>&quot;...if for some reason he retired or the organisation changed into different areas then you're dealing with somebody else and their approach isn't the same.&quot;</td>
<td>&quot;The Inspector we've got, we've been able to work together very well and he's been able to be very pragmatic about the approach...&quot;</td>
</tr>
<tr>
<td>Alcan</td>
<td></td>
<td>&quot;There's a lot of confusion about at the moment as to how much of COPA '74 still exists, a lot of it has been rescinded or taken over by EPA '90 and it's very difficult for industrialists to know exactly what's in force and what's not.&quot;</td>
<td>&quot;...things were not working as they had promised - a one-stop shop ...it's not integrated.&quot;</td>
</tr>
<tr>
<td>Lothian</td>
<td></td>
<td>&quot;I think they had a political in-fight during the merger ...I think the resources are tight and they are short on the ground ...they're probably getting a mountain of information, whether they can collate that efficiently, I don't know.&quot;</td>
<td>&quot;As far as he's concerned, he's been in industry, he's well up on most things, he knows what's what and is very realistic.&quot;</td>
</tr>
</tbody>
</table>

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The lack of resources has also been highlighted as an impediment to efficient regulation and this was recognised by the operators, one of whom was doubtful about SEPA's ability to cope with the volume of work:

“I think the resources are tight and they are short on the ground. They’re probably getting a mountain of information; whether they can collate that efficiently, I don’t know.”

A more fundamental question was raised by a regulator who advised that integration of the agency’s functions necessitated a rationalisation and consolidation of the legislation which currently requires that different parts of the organisation work differently:

“We’re strapped by the law because we still have COPA and we still have Part I of EPA’90 and Part II and we still have the Radioactive Substances Act and these themselves are not integrated.”

With much of the regulatory practice deferred to the judgement of the individual Inspectors, the relationship between the Inspector and the operator is a key element in the process. The operators viewed the regulator’s approach as being ‘very pragmatic’ and valued their close working relationship, although they recognised this was criticised by the environmental groups as being too ‘cosy’. One regulator said:

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Table 5.4. Continued.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Structure</th>
<th>Organisation</th>
<th>Relationships</th>
</tr>
</thead>
</table>
| FoE        | "There clearly is this division between the EA and DETR; DETR make the new regulations and the EA has to apply them ...there may be conflicts between the two organisations ... the relationship between DETR and the EA is not properly worked out." | "I think it's still a bit of a mess ...they're still re-organising people ...it was something that needed to be done ...there was not enough resourcing ...different regions have different ideologies..." | "I think they rely a lot on industry ...it's an example of the power relationship between the EA and industry ...you have got this tradition of working closely with industry which means they are more likely to believe in industry..."
| Greenpeace | | | "We're well aware that some inspectors are much closer to the companies than others." |

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There have been the old chestnuts about the liaison with industry being too close. I don’t believe that’s the case because a lot of improvements have resulted from that close working, from the advice and cooperation of the close working relationship.

The operators felt there were significant benefits with the development of a long-term working relationship with an individual Inspector and expressed concern at the possibility of their particular Inspector being replaced, through retirement or promotion, for example. All respondents felt that, to some degree, the scope for interpretation of the non-statutory guidance by the regulators generally resulted in some inconsistencies in the application of the legislation across the UK. There appeared to be a lack of reciprocal knowledge between SEPA and the EA concerning their respective approaches to IPC enforcement.

5.1.5. Environmental groups

Whilst the regulators and operators shared a common approach to the pollution management regime, the environmental groups represented an alternative view. Environmental protection is based on a system of risk assessment, as exemplified by the EQS approach, which the environmental groups saw as being flawed. They rejected the idea of assimilative capacity on which the current pollution licencing system is based:

“The whole infrastructure is set up around pipes, air emissions and waste dumps...they’ve always got their eyes on the end of the pipe and not what’s causing the discharge.”

One group pointed to the paucity of information concerning industrial chemicals but which is required under a risk assessment scheme:

“The vast majority of chemicals have no toxicological or environmental fate data...”
As this data is a prerequisite for deriving an EQS comparatively few substances have an EQS defined. The growing issue of endocrine disruptors was seen by the environmental groups as a prime example of the problems associated with the lack of such data.

In the application of BATNEEC, industry was seen by the environmental groups as claiming that everything was too expensive, driven by an interest in making money out of its older plants, with the regulator at a distinct disadvantage in what they saw as a secretive process. Indeed, they did not believe BAT to be environmentally sound as it failed to explore alternative technologies.

The environmental groups interviewed said there was insufficient environmental monitoring and one group suspected that the regulators were worried about discovering new problems:

"Because so many environmental contaminants have been found by chance....it would be sensible to go out and say, ‘what’s there?’ both in the environment and in food.... but there is a real unwillingness to find problems."

The regulators carry out their own monitoring programme, which was regarded by the environmental groups as predictable, and given their belief that the operators can control when they emit pollutants, one group suggested that:

"The company will know when they are coming and turn things down."

The environmental groups raised concerns about the level of trust placed on industry by the regulator and were convinced that the relationship between the two was ‘cosy’. They particularly criticised the EA for being secretive on issues such as freemasons and access to Board meeting documents. SEPA was seen as more open, independent of government and more willing to make a fuss.
5.2. Questionnaire survey

Whilst the interviews provided detailed qualitative data concerning the perceptions of a small selective sample they could not be viewed as representative of the larger regulatory community. The questionnaire survey provided quantitative data which was analysed using statistical methods and allowed generalisations to be made. The analysis of interviews were used to develop the themes of the questionnaire and specific questions. In some cases, particularly relevant quoted responses were lifted from an interview and used as one of the 'Likert statements'. The results are presented in accordance with the themes of the questionnaire survey.

5.2.1. Univariate and bivariate analysis.

**UK industrial pollution policy**

Respondents did not perceive pollution emissions to be equally well controlled to all three media (Figure 5.1).

![Figure 5.1](image)

**Figure 5.1.** Responses to the survey question: “Which categories of industrial pollution are the most effectively controlled?” n=277.
Regarding the regulation of emissions to the environment, 45.6% of the respondents believed that aqueous discharges were more effectively controlled than releases to either air or land. The corresponding figures for the other media were air (31.7%) and land (22.7%).

There were significant differences between the operators and regulators (see Table 5.5), with the regulators selecting air releases as the most effectively controlled and solid waste disposal the least. Operators identified aqueous discharges as the most effectively controlled and their responses were more evenly distributed across the choices than those of the regulators. Regional differences were also identified, with 70% of the respondents from Scotland identifying aqueous releases as the most effectively controlled, while the corresponding figure for England and Wales was 42.7%.

Table 5.5. Association between respondent type and perceived most effectively controlled category of industrial pollution. Figures are given in percentages for each respondent type.

<table>
<thead>
<tr>
<th>Respondent type</th>
<th>Releases to air</th>
<th>Aqueous discharges</th>
<th>Solid waste</th>
<th>All categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulators</td>
<td>51.5</td>
<td>45.5</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Operators</td>
<td>28.9</td>
<td>45.6</td>
<td>25.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Overall</td>
<td>31.7</td>
<td>45.6</td>
<td>22.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Absolute values: Number of respondents, n=272; Chi-square statistic, $\chi^2=11.14$; Significant at p<0.05.

Regarding the regulation of various categories of contaminants (see Figure 5.2) toxic metals were identified as the substances the majority of respondents (56.3%) believed to be the most effectively regulated. By contrast, few (7.9%) selected organic micropollutants.
Figure 5.2. Response to the survey question: “What do you believe to be the most effectively regulated substances?” \( n=277 \).

The European Union was clearly perceived (72.3% of respondents) to have had the most influence on UK Government pollution policy (see Figure 5.3). The next most influential was indicated as the environment agencies (9.9%) and environmental groups (5.5%).

Figure 5.3. Survey question: “Which has had the most influence on government policy?” \( n=292 \).
The legislation that was considered to have had the most effects in controlling aqueous discharges from industrial sources was EPA 1990 (59.4%), followed by WRA 1991 (14.5%) (see Figure 5.4).

![Figure 5.4. Response to survey question: “What legislation has had the most effect in controlling aqueous discharges?” n=234](image)

This was not surprising since the sample had been selected from IPC operators and regulators. Again, regional differences were highlighted, with 42.9% of the Scottish respondents selecting COPA, but none selecting WRA. This reflects the case that WRA does not apply in Scotland. In contrast, only 4% of respondents from England and Wales identified COPA as the most effective piece of legislation.

**EQS and hazardous chemicals**

The results for all the variables measured using the Likert scale are tabulated for this and subsequent sections in Table 5.6. The analysis shows there were no significant (p<0.05) differences between the respective views of the regulators and operators towards the current system of EQS and the listing of hazardous substances. Respondents indicated that compliance with all relevant EQSs does not necessarily prevent environmental harm and
exceedence of an EQS would not always cause harm. It was also believed that the EQS system does not allow for additive/synergistic effects of mixed wastes, nor does it take into account chronic and/or subtle eco-system effects. The respondents agreed that the EQS should be widened to include sediment quality and thought the system would need to be revised in the light of improved detection limits. The view was expressed that an authorisation (or consent) does not specify discharge limits for all hazardous substances posing an environmental risk that could be present in an effluent. Regarding the priority lists of hazardous substances, fewer respondents from Scotland (49.1%) than from England and Wales (56.3%) felt that they reflected current environmental priorities. Although both operators and regulators agreed that there were chemicals which should be listed but were not, more regulators (88.2%) than operators (58.1%) expressed this view.
Table 5.6. Descriptive statistics calculated using responses measured on 5-point Likert scale; 'Strongly agree' (5) to 'Strongly disagree' (1). Significant differences between agency and operator responses are calculated using one way ANOVA test. Level of significance are indicated as, * P<0.05; ** P<0.01; ***P<0.001; absence of asterix indicates no significant difference.

<table>
<thead>
<tr>
<th>Variables</th>
<th>All respondents</th>
<th>Agencies</th>
<th>Operators</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>s.d.</td>
<td>n</td>
<td>Mean</td>
</tr>
<tr>
<td>Environmental Quality Standards and hazardous chemicals:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provided there is compliance with all relevant EQSs, then no harm will be caused to the environment.</td>
<td>2.68</td>
<td>1.17</td>
<td>282</td>
<td>2.81</td>
</tr>
<tr>
<td>Exceedence of an EQS will lead to environmental harm.</td>
<td>2.77</td>
<td>1.28</td>
<td>282</td>
<td>2.43</td>
</tr>
<tr>
<td>The EQS system allows for additive and/or synergistic effects of mixtures of pollutants.</td>
<td>2.43</td>
<td>1.19</td>
<td>226</td>
<td>2.30</td>
</tr>
<tr>
<td>Chronic and/or subtle eco-system effects are not considered in the derivation of EQS levels.</td>
<td>3.39</td>
<td>1.15</td>
<td>189</td>
<td>3.08</td>
</tr>
<tr>
<td>The identification of a hazardous chemical should result in the derivation of an appropriate EQS.</td>
<td>3.74</td>
<td>1.23</td>
<td>272</td>
<td>3.74</td>
</tr>
<tr>
<td>EQSs should be defined for sediment as well as water.</td>
<td>3.87</td>
<td>1.05</td>
<td>254</td>
<td>3.77</td>
</tr>
<tr>
<td>The EQS system will need to be revised in the light of improved detection limits.</td>
<td>3.42</td>
<td>1.30</td>
<td>274</td>
<td>3.38</td>
</tr>
<tr>
<td>The composition of the Red, Black and Grey lists etc, accurately reflects current environmental control priorities.</td>
<td>3.31</td>
<td>1.16</td>
<td>254</td>
<td>3.23</td>
</tr>
<tr>
<td>An authorisation (or consent) specifies discharge limits for all hazardous substances, posing an environmental risk, that could be present in that effluent.</td>
<td>2.69</td>
<td>1.42</td>
<td>288</td>
<td>2.58</td>
</tr>
<tr>
<td>BATNEEC and the economics of pollution control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The application of BATNEEC depends on the interpretation by the individual IPC Inspector.</td>
<td>3.75</td>
<td>1.13</td>
<td>291</td>
<td>3.24</td>
</tr>
<tr>
<td>The application of BATNEEC has resulted in environmental improvements.</td>
<td>4.08</td>
<td>0.88</td>
<td>285</td>
<td>4.80</td>
</tr>
<tr>
<td>It is the responsibility of the operator to prove to the Agency that what they propose is BATNEEC.</td>
<td>4.44</td>
<td>0.73</td>
<td>293</td>
<td>4.90</td>
</tr>
<tr>
<td>BATNEEC will differ depending on the quality of the receiving waters.</td>
<td>3.37</td>
<td>1.38</td>
<td>283</td>
<td>3.44</td>
</tr>
<tr>
<td>BATNEEC acts as a driver for technological change.</td>
<td>3.50</td>
<td>1.16</td>
<td>288</td>
<td>4.34</td>
</tr>
<tr>
<td>Variables</td>
<td>All respondents</td>
<td>Agencies</td>
<td>Operators</td>
<td>Significance</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>----------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>s.d.</td>
<td>n</td>
<td>Mean</td>
</tr>
<tr>
<td>The operator is in a better position to determine what entails &quot;Excessive Cost&quot; than the Agencies.</td>
<td>4.10</td>
<td>1.05</td>
<td>292</td>
<td>3.20</td>
</tr>
<tr>
<td>The Agencies cannot impose standards on industry which could radically affect an operation.</td>
<td>2.53</td>
<td>1.28</td>
<td>291</td>
<td>1.66</td>
</tr>
<tr>
<td>Economic instruments are the only way to ensure that the polluter pays principle is realised in practice.</td>
<td>3.29</td>
<td>1.19</td>
<td>267</td>
<td>3.11</td>
</tr>
<tr>
<td>Monitoring and compliance:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring schemes detect all breaches of conditions that could cause harm to the environment.</td>
<td>1.91</td>
<td>0.98</td>
<td>291</td>
<td>1.44</td>
</tr>
<tr>
<td>There should be more self-monitoring by operators.</td>
<td>3.64</td>
<td>1.07</td>
<td>290</td>
<td>3.98</td>
</tr>
<tr>
<td>Operators with recognised environmental management systems require less Agency monitoring.</td>
<td>3.64</td>
<td>1.25</td>
<td>295</td>
<td>2.80</td>
</tr>
<tr>
<td>As analytical methods improve, more hazardous substances will have to be included in authorisations and consents.</td>
<td>3.22</td>
<td>1.25</td>
<td>286</td>
<td>3.34</td>
</tr>
<tr>
<td>No operator should be prosecuted for a breach of authorisation (or consent) limit, unless significant environmental harm is caused.</td>
<td>2.94</td>
<td>1.41</td>
<td>293</td>
<td>1.83</td>
</tr>
<tr>
<td>Prosecution of operators for breach of authorisation conditions is seen as last resort.</td>
<td>3.81</td>
<td>1.22</td>
<td>291</td>
<td>3.49</td>
</tr>
<tr>
<td>Legal sanctions imposed for breaches of authorisation conditions are sufficiently severe.</td>
<td>3.17</td>
<td>1.38</td>
<td>286</td>
<td>2.34</td>
</tr>
<tr>
<td>The chemical industry:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry associations such as CIA and CEFIC help to counter the effects of environmental group lobbying.</td>
<td>3.61</td>
<td>0.94</td>
<td>262</td>
<td>3.50</td>
</tr>
<tr>
<td>It is in the interests of the chemical industry to adopt uniform environmental standards.</td>
<td>3.92</td>
<td>1.05</td>
<td>274</td>
<td>3.54</td>
</tr>
<tr>
<td>Tighter regulation of industrial pollution creates opportunities for competitive advantage within the chemical sector.</td>
<td>3.53</td>
<td>1.15</td>
<td>279</td>
<td>3.76</td>
</tr>
<tr>
<td>Most of the significant environmental improvements have already been made by the Chemical industry.</td>
<td>2.78</td>
<td>1.08</td>
<td>264</td>
<td>2.68</td>
</tr>
<tr>
<td>The public generally fail to understand the relative risk and benefits associated with the chemical industry and its products.</td>
<td>4.57</td>
<td>0.61</td>
<td>286</td>
<td>4.46</td>
</tr>
<tr>
<td>Variables</td>
<td>All respondents</td>
<td>Agencies</td>
<td>Operators</td>
<td>Significance</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>----------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>Mean  s.d. n</td>
<td>Mean  s.d. n</td>
<td>Mean  s.d. n</td>
<td></td>
</tr>
<tr>
<td>Implementation of the OSPAR agreement will require:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New legislation to be introduced.</td>
<td>3.76 1.14 200</td>
<td>3.46 1.10 26</td>
<td>3.80 1.14 174</td>
<td></td>
</tr>
<tr>
<td>Increased investment in effluent treatment capability.</td>
<td>4.22 0.71 217</td>
<td>4.10 0.74 28</td>
<td>4.24 0.71 189</td>
<td></td>
</tr>
<tr>
<td>The adoption of new, ‘cleaner’ production technologies.</td>
<td>4.13 0.73 216</td>
<td>4.24 0.74 29</td>
<td>4.12 0.73 187</td>
<td></td>
</tr>
<tr>
<td>The phase out of some older production technologies.</td>
<td>4.09 0.84 216</td>
<td>4.41 0.57 29</td>
<td>4.04 0.86 187 *</td>
<td></td>
</tr>
<tr>
<td>Substitution of some products by ‘cleaner’ alternatives.</td>
<td>4.03 0.78 218</td>
<td>4.14 0.69 29</td>
<td>4.01 0.79 189</td>
<td></td>
</tr>
<tr>
<td>New management and control techniques/systems.</td>
<td>3.77 0.96 215</td>
<td>3.55 1.06 29</td>
<td>3.81 0.94 186</td>
<td></td>
</tr>
<tr>
<td>Accelerated risk assessment for chemicals.</td>
<td>3.72 1.01 211</td>
<td>3.48 1.09 29</td>
<td>3.76 0.99 182</td>
<td></td>
</tr>
<tr>
<td>The implementation of the Precautionary Principle.</td>
<td>3.28 1.09 174</td>
<td>3.19 1.14 27</td>
<td>3.29 1.09 147</td>
<td></td>
</tr>
<tr>
<td>New chemicals should only be introduced to replace more hazardous existing substances.</td>
<td>2.55 1.36 213</td>
<td>2.46 1.37 28</td>
<td>2.56 1.36 185</td>
<td></td>
</tr>
<tr>
<td>The OSPAR targets are impractical and unlikely to be achieved.</td>
<td>3.29 1.02 156</td>
<td>2.92 1.10 24</td>
<td>3.36 0.99 132 *</td>
<td></td>
</tr>
<tr>
<td>The regulators and the chemical industry should work together to implement the OSPAR agreement.</td>
<td>4.21 0.79 217</td>
<td>4.24 0.87 29</td>
<td>4.21 0.78 188</td>
<td></td>
</tr>
</tbody>
</table>
The addition of hazardous chemicals to the prescribed list was perceived to be a lengthy process (see Figure 5.5). Approximately 60% of respondents thought it would take at least 5 years for a chemical to become prescribed.

![Chart showing respondent estimates of time taken for a non-prescribed chemical, found to have serious biological effects, to become prescribed.](chart.png)

**Figure 5.5.** Respondents estimate of time taken for a non-prescribed chemical, found to have serious biological effects, to become prescribed. \(n=282\).

Most respondents (64.8%) supported the concept of Direct Toxicity Assessments being included in the authorisation. Scottish respondents were particularly positive (91.7%).

**BATNEEC and the economics of pollution control**

There was a clear difference of opinion between the regulators and operators (Table 5.6) with the regulators exhibiting a more positive view of BATNEEC and its achievements. The regulators expressed the opinion that BATNEEC acted as a driver for technological change, while the operators were less positive, but both groups agreed that BATNEEC had resulted in environmental improvements. The operators indicated that the application of BATNEEC was affected by the interpretation of the individual IPC Inspector, while the regulators were
more equivocal. In the provision of information, the operators considered themselves to be in a better position than the regulators to determine what entails 'excessive cost'. The regulators generally accepted this but showed only weak agreement. Both groups identified operators as the regulators’ main source of economic information, with Guidance Notes seen as more influential in providing technological and process information, although operators considered themselves to be the most important source for both types of information.

Monitoring and compliance
No regulator thought that monitoring schemes could detect all breaches of conditions that could cause harm to the environment whilst operators expressed more confidence in the system (Table 5.6). Operators and regulators considered that there should be more self-monitoring by operators, who, in contrast with the regulators indicated that operators with recognised environmental management systems required less regulatory monitoring. Although prosecution was viewed by both groups as a last resort, operators indicated that the sanctions imposed for breaches of an authorisation were sufficiently severe, whereas the regulators did not. The operator’s main concern associated with prosecution for non-compliance with environmental legislation was negative publicity, according to 79.9% of respondents, with fines selected by 4.9%. No Scottish respondent identified fines as the main concern.

The chemical industry
There was a consensus that industry associations, such as the Chemical Industries Association and the European Federation of Chemical Industries, help to counter the effects of lobbying by environmental groups (Table 5.6). The operators believed more strongly than
the regulators that it was in the interests of the chemical industry to adopt uniform environmental standards, although it was recognised that tighter regulation creates opportunities for competitive advantage within the sector. Neither group indicated that most of the significant environmental improvements had already been made by the chemical industry. It was felt, very strongly, that the public generally failed to understand the relative risks and benefits associated with the chemical industry and its products. This was the strongest response observed in the entire survey.

The future

Valid response numbers for the OSPAR 2020 questions were substantially lower than for the other sections of the survey and 83 respondents (28%) indicated they had insufficient knowledge to answer the questions. The operators considered the targets to be impractical and unlikely to be achieved, whereas the regulators were more positive (Table 5.6). However, there was a recognition that the operators and regulators would need to work together if the targets were to be achieved. The respondents generally believed that the implementation of the OSPAR agreement would require new legislation, increased investment in effluent treatment capability as well as substitution of some products by ‘cleaner’ alternatives. Regulators indicated more strongly than the operators that some older production technologies would need to be phased out. New management and control techniques and accelerated risk assessment for chemicals were also seen by the two groups as necessary to achieve the targets. When questioned about future environmental policy, the overriding concern of the operators was the need for a ‘level playing field’ across Europe and world-wide so that UK industry would not become uncompetitive as a result of tighter environmental legislation.
5.2.2. Multivariate analysis

Since the aim was to develop operator clusters, the pre-requisite factor analysis was carried out on the operator data only. In the first phase of the analysis, ten key attitude variables relating to the use of science in regulation were selected after an examination of the correlation matrix and subjected to principal components analysis. A varimax rotation (orthogonal method) was performed and the standard criteria of eigenvalue = 1 (factors = 3) and scree test (factors = 4) were used as guidelines to determine the number of factors. Although some of the factor scores were rather low (Tabachnick and Fidell, 1989) the model satisfied the diagnostic tests of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy, Bartlett’s test of Sphericity and the Determinant of the Correlation Matrix. The latent root variables (underlying dimensions) were subsequently named to reflect the strategic dimension that they represent. Two interpretable and distinct factors explaining 43.4% of total variance appeared to give the best representation of the underlying relationship among the selected variables. Factor loading scores are listed in Table 5.7.

Table 5.7. The results of principal components analysis, showing factor loading scores.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Variable</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The EQS system allows for additive and/or synergistic effects of mixtures of pollutants.</td>
<td>0.27</td>
</tr>
<tr>
<td>1</td>
<td>The composition of the Red, Black and Grey lists etc, accurately reflects current environmental control priorities.</td>
<td>0.26</td>
</tr>
<tr>
<td>1</td>
<td>An authorisation (consent) specifies discharge limits for all hazardous subs, posing an environmental risk, that could be present in that effluent.</td>
<td>0.35</td>
</tr>
<tr>
<td>1</td>
<td>Monitoring schemes detect all breaches of conditions that could cause harm to the environment.</td>
<td>0.38</td>
</tr>
<tr>
<td>2</td>
<td>Exceedence of an EQS will lead to environmental damage.</td>
<td>0.18</td>
</tr>
<tr>
<td>2</td>
<td>EQSs should be defined for sediment as well as water.</td>
<td>0.24</td>
</tr>
<tr>
<td>2</td>
<td>The EQS system will need to be revised in the light of improved detection limits.</td>
<td>0.49</td>
</tr>
<tr>
<td>2</td>
<td>As analytical methods improve, more hazardous substances will have to be included in authorisations and consents.</td>
<td>0.37</td>
</tr>
</tbody>
</table>
Table 5.8. describes the distinct underlying dimensions that the factors represent. Factor 1 is associated with the effectiveness of the current hazard and risk assessment methods used to control and assess industrial pollution. High scores on this factor relate to a perception of the current system operating effectively. Factor 2 is associated with the need to improve and widen the scope of the current system of assessment and control. High scores on this factor relate to the perceived need to revise and improve the current system.

Table 5.8. The underlying dimensions represented by the factors and the variance they account for.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Underlying dimension</th>
<th>Variance accounted for</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Confidence in the system</td>
<td>22.3 %</td>
</tr>
<tr>
<td>2</td>
<td>System needs revision</td>
<td>21.0 %</td>
</tr>
</tbody>
</table>

Each of the operators' response pattern to the variables used in the factor analysis was summarised by the score achieved for each dimension. These factor scores were used in the subsequent cluster analysis using hierarchical and non-hierarchical algorithms. The hierarchical method identified a three-cluster solution, which was accepted as the most meaningful solution as this was readily interpretable. The three-cluster solution, based on 142 cases, was ‘fine-tuned’ using the non-hierarchical technique. The three clusters (based on the cluster means for the derived factor scores and the cluster sizes) were named as ‘conservative’, ‘progressive’ and ‘flexible’, according to the regulatory approach that the groups appeared to adopt. Mean factor scores for operators in each group are illustrated in Table 5.9. High mean scores indicate that a particular dimension is important. Conservative cluster members do not score highly on either dimension but well below average on the revision requirement. This suggests that, although they do not have much confidence in the
current system, they feel very strongly that revision is not required. The progressive cluster members score highly on the revision dimension and very low on the confidence dimension. They have low confidence in the ability of the current system to protect the environment and believe that revision is required. Flexible cluster members score highly on both dimensions. This indicates that although they have confidence in the current system, they believe it will need to be revised.

Table 5.9. Characteristics of three groups derived from cluster analysis.

<table>
<thead>
<tr>
<th>Underlying dimension</th>
<th>Conservative</th>
<th>Progressive</th>
<th>Flexible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence in the system</td>
<td>-0.1713</td>
<td>-0.7597</td>
<td>0.9715</td>
</tr>
<tr>
<td>System needs revision</td>
<td>-1.1273</td>
<td>0.6435</td>
<td>0.5049</td>
</tr>
<tr>
<td>Number of operators</td>
<td>48</td>
<td>48</td>
<td>46</td>
</tr>
</tbody>
</table>

n=142.

5.2.3. Profiling of strategic groups

In order to develop grouping profiles, statistical tests were employed to delineate and describe each cluster profile to identify the variables where values differ significantly from one group to another. Intercluster differences attributable to each variable were tested using F ratio comparisons of variances among the mean of variables from a one way ANOVA analysis and Tukey’s Honestly Significantly Different (HSD) Test. A considerable amount of data relating to the operators was collected as part of the survey. In addition many variables, relating to aspects other than science, such as BATNEEC, economics and compliance were not used in the cluster analysis. For a number of these variables the test results indicate there are significant differences between strategic groups supporting external validity of the clusters. There appeared to be a significant inter-group difference between the location of the operator (Table 5.10). In England and Wales the operators were evenly
distributed between the three groups. In Scotland 75% were assigned to the conservative cluster and none to the flexible cluster.

Table 5.10. Association between operator groups and area. Figures are given in percentages.

<table>
<thead>
<tr>
<th>Operator group</th>
<th>England/Wales</th>
<th>Scotland</th>
<th>All areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>87.5</td>
<td>12.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Progressive</td>
<td>93.7</td>
<td>6.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Flexible</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Absolute values: n=133; χ²=6.18; p<0.05. For explanation of terms refer to Table 5.5.

The size classification of the operator companies also revealed significant differences (Table 5.11) with the progressive cluster containing the highest number of large companies, the conservative cluster dominated by medium sized companies and the flexible cluster comprised mostly of small and medium enterprises. Examination of other variables, such as age, education, experience, process type did not reveal any significant differences between the clusters.

Table 5.11. Association between operator groups and size classification. Figures are given in percentages.

<table>
<thead>
<tr>
<th>Operator group</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>All categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>12.8</td>
<td>68.1</td>
<td>19.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Progressive</td>
<td>25.0</td>
<td>39.6</td>
<td>35.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Flexible</td>
<td>36.4</td>
<td>52.3</td>
<td>35.4</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Absolute values: n=139; χ²=15.09; p<0.05. For explanation of terms refer to Table 5.5.

Environmental quality standards and hazardous chemicals

Table 5.12 depicts descriptive statistics for the attitude scale variables not used in the factor and cluster analysis showing variables for which there were significant inter-cluster differences.
Table 5.12. Descriptive statistics for operator clusters using 5-point Likert scale measurement; 'Strongly agree' (5) to 'Strongly disagree' (1). Significant differences are calculated using Tukey HSD Test. Asterix (*) indicates significant difference (p<0.05) between numbered groups as shown.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cluster 1 (Conservative)</th>
<th>Cluster 2 (Progressive)</th>
<th>Cluster 3 (Flexible)</th>
<th>F ratio</th>
<th>F prob.</th>
<th>Tukey HSD Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>s.d.</td>
<td>n</td>
<td>Mean</td>
<td>s.d.</td>
<td>n</td>
</tr>
<tr>
<td>Environmental Quality Standards and hazardous chemicals:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Provided there is compliance with all relevant EQSs, then no harm</td>
<td>3.01</td>
<td>1.25</td>
<td>48</td>
<td>1.85</td>
<td>0.87</td>
<td>48</td>
</tr>
<tr>
<td>will be caused to the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BATNEEC and the economics of pollution control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 Economic instruments are the only way to ensure that the polluter</td>
<td>2.89</td>
<td>1.19</td>
<td>45</td>
<td>3.28</td>
<td>1.19</td>
<td>46</td>
</tr>
<tr>
<td>pays principle is realised in practice.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring and compliance:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 Legal sanctions imposed for breaches of authorisation conditions</td>
<td>3.38</td>
<td>1.18</td>
<td>48</td>
<td>2.77</td>
<td>1.36</td>
<td>48</td>
</tr>
<tr>
<td>are sufficiently severe.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The chemical industry:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 Tighter regulation of industrial pollution creates opportunities for</td>
<td>3.10</td>
<td>1.17</td>
<td>48</td>
<td>3.83</td>
<td>0.91</td>
<td>48</td>
</tr>
<tr>
<td>competitive advantage within the chemical sector.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 Most of the significant environmental improvements have already</td>
<td>2.98</td>
<td>1.09</td>
<td>46</td>
<td>2.40</td>
<td>1.05</td>
<td>45</td>
</tr>
<tr>
<td>been made by the Chemical industry.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation of the OSPAR agreement will require:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38 New chemicals should only be introduced to replace more</td>
<td>1.87</td>
<td>0.99</td>
<td>38</td>
<td>2.74</td>
<td>1.45</td>
<td>39</td>
</tr>
<tr>
<td>hazardous existing substances.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39 The OSPAR targets are impractical and unlikely to be achieved.</td>
<td>3.72</td>
<td>1.10</td>
<td>29</td>
<td>3.13</td>
<td>0.97</td>
<td>28</td>
</tr>
</tbody>
</table>

143
Both the conservative and flexible clusters were neutral to whether compliance with all relevant EQSs prevented harm to the environment. The progressive cluster, however indicated that compliance with all relevant EQSs does not necessarily prevent environmental harm. As to whether there are chemicals which should be listed (for priority control) there were also significant inter-cluster differences (Table 5.13).

**Table 5.13.** Attitudes of operator groups to listing hazardous chemicals. Are there chemicals which should be listed but aren’t? Figures given in percentages.

<table>
<thead>
<tr>
<th>Operator group</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>52.2</td>
<td>47.8</td>
</tr>
<tr>
<td>Progressive</td>
<td>93.3</td>
<td>6.7</td>
</tr>
<tr>
<td>Flexible</td>
<td>42.9</td>
<td>57.1</td>
</tr>
</tbody>
</table>

Absolute values: n=134, \( \chi^2=9.32, p<0.05 \). For explanation of terms refer to Table 5.5.

The progressive cluster clearly indicated that there were chemicals, currently unlisted, which should be listed. The other two clusters were rather equivocal.

*BATNEEC and the economics of pollution control*

There were no significant inter-cluster differences on perception and attitude towards BATNEEC. There are clear differences between the conservative cluster and the flexible cluster regarding the use of economic instruments to implement the polluter pays principle. The conservative cluster appear to be negative towards their use, whilst the flexible cluster indicate that economic instruments could be useful.

*Monitoring and compliance*

No significant differences were identified between the clusters with the exception of the view towards the severity of legal sanctions. The progressive cluster were alone in indicating
that sanctions imposed for breaches of authorisation (or consent) conditions were not sufficiently severe.

*The chemical industry*

A range of significantly different views were identified. Concerning industry wide standards, whilst all clusters indicated that uniform standards were in the best interests of the chemical industry, the conservative was the least positive. The conservative cluster also indicated a much less enthusiastic response, compared to the other clusters, to the concept that tighter regulation created opportunities for competitive advantage within the chemical sector. The progressive cluster also indicated the strongest disagreement of all the clusters that most of the significant environmental improvements had already been made by the chemical industry.

*The implementation of the OSPAR agreement.*

The conservative cluster indicated more strongly than the other two clusters that the OSPAR targets were impractical and unlikely to be achieved. The conservative cluster also disagreed more strongly than the other clusters that new chemicals should only be introduced to replace more hazardous existing substances.
5.3. **Focus groups**

The focus group research was designed to probe and explore the questionnaire survey findings in order to illustrate and confirm conclusions from the survey. The purpose was to improve the depth of understanding regarding the attitudes and beliefs at the regulatory interface. The focus groups were also used to develop solutions to the problems identified with the regulatory system. There was a significant degree of consensus between the individual participants within the focus groups as well as between the different groups. Thematic charts, which show the consensus between the various groups, were constructed using representative quoted responses from the four focus group discussions. The charts are shown for the main themes of the discussions which were: (1) The principles underlying regulatory standards, (2) New developments within the current framework, (3) The practical derivation of conditions within the BATNEEC framework and (4) The implications of the OSPAR strategy.

5.3.1. **The key principles underlying regulatory standards**

*EQS system*

Deficiencies in the EQS approach were discussed in depth and a broad consensus within and between groups was established (see Table 5.14). A number of weaknesses in the EQS system were identified which were used to explain why adherence to all EQSs would not necessarily protect the environment from harm. For many of the potentially hazardous industrial chemicals currently in use, no EQS has been defined. Due to the lack of relevant toxicity data for most of the chemicals currently in use by the chemical industry it had not been possible to set appropriate EQSs. The impracticality of setting EQSs for the ever
increasing number of chemicals being manufactured and used by the chemical industry was thought to present another major problem. Furthermore, the growing evidence of subtle and combined effects of industrial chemicals and their mixtures, such as found in complex industrial effluents, was seen as another contributing factor to the failure of EQSs to ensure environmental protection.

Table 5.14. Thematic chart relating to EQS system.

<table>
<thead>
<tr>
<th>Group</th>
<th>Data gaps</th>
<th>Practicality</th>
<th>Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators 1</td>
<td>“We don’t know enough about the long-term effects because EQS haven’t been promulgated for very long.”</td>
<td>“If you talk about metals then it probably works reasonably well, but if you’re talking about organic chemicals then I’m not so sure that it does because you need to know firstly what they all are and secondly what the effects of them are.”</td>
<td>“They hope that EQS adherence will minimise or prevent environmental harm, but I don’t think, hand-on-heart, anyone knows it will.”</td>
</tr>
<tr>
<td>Operators 2</td>
<td>“One of the things is there are so few chemicals which have a quality standard.”</td>
<td>“With the number of chemicals on the market, it’s impossible to get blanket coverage.”</td>
<td>“Effluents can be complex. You don’t know how things are going to interact. I’ve got a feeling that some of the EQS figures we’ve got now are possibly out of date as more and more evidence on the subtle effects of chemicals come out.”</td>
</tr>
<tr>
<td>Regulators</td>
<td>“There must be lots and lots of harmful chemicals for which no EQS has been set, so by definition, if you meet 100% of the EQS levels that have been set, it doesn’t necessarily mean you’d be safe.”</td>
<td>“If you were to end up with a massive list of EQSs for 99% of the most commonly used chemicals, the cost of analysis would be phenomenal.”</td>
<td>“The problem you’ve got is like additive and synergistic effects.”</td>
</tr>
<tr>
<td>Academics</td>
<td>“The point is that the vast bulk of chemicals we’re using have totally inadequate toxicity data.”</td>
<td>“….every day new chemicals are coming and if we’re making the tests more and more complicated…. the logistics of being able to set EQSs for every single chemical – it’s just impossible.”</td>
<td>“I know some pathologists who regularly detect pathology in wildlife where things are orders of magnitude below the EQS and they know they’re caused by pollution.”</td>
</tr>
</tbody>
</table>
However, one area where the EQS system was thought to be effective was the regulation of metals, which are by their nature a finite and relatively small group of chemical elements.

The expansion of the EQS system was not seen as a sensible solution to these weaknesses however, due to the practical and financial implications of performing ever more complicated tests on an ever increasing number of chemicals.

The consent to discharge

Responses concerning whether consents specified limits for all hazardous substances that could be present in an effluent are given in Table 5.15. It was thought that, due to the complexity of industrial effluents and the lack of knowledge concerning their exact composition, it was impractical to set up a consent that specified limits for all the potentially hazardous chemicals that might be present. For example, it was pointed out that a single product such as gasoline would in fact contain several hundred different components. The other problem highlighted was that, in the case of high volume discharges, the concentrations of some hazardous substances present in the water sourced from the water suppliers can result in discharge limits being exceeded. Both the regulators and the operators recognise that consents should be set up to be practical for operators to work to and for regulators to control against.

There was a consensus that to expand the number of chemicals listed on consents, in order to overcome the acknowledged flaws, would result in a huge cost and the system would become practically unmanageable.
Table 5.15. Thematic chart relating to consents.

<table>
<thead>
<tr>
<th>Group</th>
<th>Scope</th>
<th>Practicality</th>
<th>Anomalies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators 1</td>
<td>“…there’s a whole host of other things, by-products of our reactions, some of them we know about and some of them we don’t. But our consent, apart from metals, doesn’t mention any particular component at all.”</td>
<td>“Do you deal with the unknowns by putting COD and solids on the consent?”</td>
<td>“On many of the things that we are actually emitting more than the trigger point, it’s actually coming in with the water we buy from Yorkshire Water.”</td>
</tr>
<tr>
<td>Operators 2</td>
<td>“How do you set up a consent that covers everything?”</td>
<td>“It’s totally unrealistic because something like gasoline will have several hundred compounds in it.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>“…you’ve got to have consents which are practical for the company to work to and practical for the regulator to come in and control against.”</td>
<td></td>
</tr>
<tr>
<td>Regulators</td>
<td>“It won’t limit all the dangerous chemicals, but if you can’t actually do anything about them, what’s the point?”</td>
<td>“There are a lot of people in the Agency who would express surprise that we in PIR/IPC don’t set limits on all these things.”</td>
<td>“If you’re setting release standards that are less than the input water, it brings the regulatory framework into disrepute.”</td>
</tr>
<tr>
<td>Academics</td>
<td>“The best you can hope is that you are minimising in the most general broad sense the harm to the environment.”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3.2. Alternative approaches

Direct Toxicity Assessment

Direct Toxicity Assessment (DTA) was seen as an alternative solution to the problems with the EQS based system (Table 5.16) and there was some consensus that the concept was sound. However, there was a clear view that a methodology needed to be developed which was relevant, scientifically robust and practical to apply. It was unclear what role that DTA

149
should take in regulation with operators believing they should not replace, but be complimentary to, the current chemical consent system with which people were comfortable.

Table 5.16. Thematic chart relating to DTA.

<table>
<thead>
<tr>
<th>Group</th>
<th>Implementation</th>
<th>Method</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators 1</td>
<td></td>
<td>&quot;It's actually convincing people that the toxicity, which is an acute toxicity rather than a chronic one, actually tells the story that people need to know.&quot;</td>
<td></td>
</tr>
<tr>
<td>Operators 2</td>
<td>&quot;DTA is fine as long as it's introduced in a sensible fashion. I'd be opposed initially for absolute consents ... I think they're an indicator.&quot;</td>
<td>&quot;I'd hate to think that there's actually consents associated with that at the outset because, at the end of the day, you probably don't know what is the toxic component of your effluent.&quot;</td>
<td>&quot;They'll be complimentary. I'm sure they won't replace chemical consents because people are comfortable with these.&quot;</td>
</tr>
<tr>
<td>Regulators</td>
<td>&quot;It has to be accepted and some sort of method defined that is practical... it has to be on a good scientific basis.&quot;</td>
<td>&quot;To actually get an agreed range of toxicity measurements is very, very difficult.&quot;</td>
<td>&quot;As I understand it there's been a hell of a lot of resistance from industry regarding that particular technique.&quot;</td>
</tr>
<tr>
<td>Academics</td>
<td>&quot;It's a very nice idea but hard to implement.&quot;</td>
<td>&quot;The problem in toxicity testing is that it's very susceptible to peaks which may be momentary.&quot;</td>
<td>&quot;I think it has to have a role. I'm not sure what that role is.&quot;</td>
</tr>
</tbody>
</table>

Sediment Quality Values

The issue of sediment quality values raised more questions than answers, (see Table 5.17). The logic of applying SQVs was accepted by the groups but the method of implementation was unclear. There was some consensus that SQVs should be used to prevent deterioration of sediment quality, i.e., used to measure change as opposed to setting absolute values. The main problem concerned what action to take in the case of non-compliance, with the physical cleaning of the sediment a possible, but very expensive and potentially
environmentally damaging process. The ‘ownership’ and therefore the liability for historical sediment contamination was thought to be very difficult to due to the lack of understanding of the geochemical and hydrological processes involved. There was a broad consensus that an understanding of the processes involved should be developed further.

Table 5.17. Thematic chart relating to SQV.

<table>
<thead>
<tr>
<th>Group</th>
<th>Implementation</th>
<th>Non-compliance</th>
<th>Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators 1</td>
<td>“I think the change in sediment levels rather than just an absolute level would be better if you wanted to do it with sediments, but as an absolute measure, no.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operators 2</td>
<td>“From an environment point of view you can’t argue about having standards which cover all parts of the environment.”</td>
<td>“If it exceeds, are you going to dig them up and take them away?” “If you were looking at remediating this contamination, who would pay?” “What would the disposal route be?”</td>
<td>“In practice I don’t think people know enough about the development of sediment layers and how the information can be used.”</td>
</tr>
<tr>
<td>Regulators</td>
<td>“The EQS should be aimed at preventing any deterioration in sediment quality.”</td>
<td></td>
<td>“It’s a good idea to have a target level, but whose pollution is it?”</td>
</tr>
<tr>
<td>Academics</td>
<td>“….anything that’s in the sediment would have to be treated as a historical base.”</td>
<td>“But if you have a system that’s failing a sediment EQS, I don’t know how else you can make it meet the EQS apart from physically cleaning the sediments…. “</td>
<td>“The biggest advantage of the sediment is that it’s not subject to these fluctuations that we see in water quality. There may be a peak event in the water which will be absorbed in the sediment. The record of it is encapsulated in the sediment.”</td>
</tr>
</tbody>
</table>
5.3.3. Practical derivation of standards using BATNEEC

Responses relating to the BATNEEC discussions are given in table 5.18.

Economic considerations and the negotiation

The English operator group perceived the NEEC element of BATNEEC as a major area of contention where the issues of jobs and employment were a part of the, often combative, debate. In contrast, the Scottish operators were less concerned and explained that the regulators didn’t push it. The inspectors also considered the NEEC arguments were rarely contentious. Operators believed that the detailed economic information and expertise, required to make BATNEEC judgements, resided with them rather than with the regulators. Furthermore, operators considered that only those inspectors who had previous experience within industry were able to make valid BATNEEC judgements. The regulators accepted that the first major tranche of economic information will come from the operators as part of their application and that the operators were likely to make it favourable to themselves. Within the regulators, the lack of detailed economic knowledge necessary for making BATNEEC judgements, was not viewed as a particular problem. Ordinarily, the regulators would rely on the significant degree of trust between them and the operators. However, if the NEEC element became crucial to the BATNEEC judgement, the regulators explained that they would commission consultants, at a cost, to report on the detailed economics. There is a clear consensus amongst the regulators and operators that the process involves a negotiated compromise with the regulator taking a pragmatic and flexible approach.
<table>
<thead>
<tr>
<th>Group</th>
<th>Economics</th>
<th>Negotiation</th>
<th>Pragmatism</th>
<th>Inspector</th>
<th>Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators 1</td>
<td>“The only people who have any second guess or insight are those Inspectors who have been in industry themselves and actually have operated similar plants.”</td>
<td>“We reach some sort of compromise, sometimes satisfactory, sometimes not.”</td>
<td>“We’ve had very much less rigorous imposition on us in the 2nd round of IPC on one of our plants...they (EA) could see that what was economic before was not economic now.”</td>
<td>“It makes a hell of a difference.”</td>
<td>“It’s heading towards the tick-sheet approach rather than the pragmatic approach that we’re probably used to.”</td>
</tr>
<tr>
<td>Operators 2</td>
<td>“Often the decision is not necessarily made by NEEC. It’s usually quite clear cut in terms of technology available.”</td>
<td>“The regulators are pragmatic. They won’t be looking for the nth degree of reduction.”</td>
<td>“I think the regulators recognise that if they ask for the impossible, they won’t get it.”</td>
<td>“In the last 5 years we’ve had 3 Inspectors... we’ve not noticed any change in approach.”</td>
<td>“They work in teams now, so they always have a reference point.”</td>
</tr>
<tr>
<td>Regulators</td>
<td>“If NEEC is really the be all and end all, then you do ultimately spend a lot of money getting the expertise that you need. ....it’s rare to get a case where you have to say, &quot;You’ve got it wrong, I don’t believe you and I need to get some expert advice.”</td>
<td>“IPC does work on significant degree of trust.”</td>
<td>“...there’s no point in putting in plant costing 3 times as much to get another 2% improvement.”</td>
<td>“It might depend on how tough the individual Inspector is and how seriously he views that particular location and dispersion.”</td>
<td>“...there was going to be a group of Inspectors who would be looking to authorise particular sectors, which proposed a draft permit so there would be a consistency of authorisation... I think we’re coming back to that method.”</td>
</tr>
<tr>
<td>Academics</td>
<td>“The EA have next to no information on the economic basis of the industries. When I’ve collated information, it’s all come from the operators, not from the regulators.”</td>
<td>“The first stop for BATNEEC is to say, “OK, this is one company in the sector that’s using that equipment therefore we can say it’s BATNEEC. Anything less is not BATNEEC.”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The role and influence of the inspector

There was a clear difference between the Scottish and English operators, in the perception of the importance of the individual inspector on the consistency of regulation. In England, individual inspectors, with their different backgrounds and perspectives were believed to have an influence on BATNEEC standards. In Scotland, however, the Inspectors were considered to have a more consistent and consensual approach. This was thought to because they worked in teams and therefore had a reference point to ensure consistency. The Scottish operators respected their SEPA inspectors as knowledgeable and professional. In England, however, the operators appeared to hold their EA inspectors in much lower regard. The EA Inspectors were perceived by operators to be driven by a lack of knowledge regarding industry towards a ‘tick-sheet’ approach to regulation, but the EA indicated that sector teams would be established.

5.3.4. Implementing the OSPAR strategy

Responses are given in Table 5.19. The target of zero emissions of hazardous substances was seen as a laudable goal and there was little direct antipathy towards what was perceived as a political concept. The Sintra Statement was likened to a company ‘vision’ statement. However, the economic implications of achieving zero emissions in practice were viewed as being extremely serious resulting in the closure of individual businesses and perhaps some entire smaller industrial sectors. Inspectors believed that the political will would be critical in deciding how the strategy was implemented with the government possibly allowing the closure of smaller and less important sectors, resulting in a few plant closures, but not interfering with the larger sectors.
Table 5.19. Thematic chart relating to OSPAR strategy.

<table>
<thead>
<tr>
<th>Group</th>
<th>Concept</th>
<th>Economics</th>
<th>Compiling lists</th>
<th>Defining zero</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators 1</td>
<td>&quot;It might sound nice environmentally - economically speaking, it’s ridiculous.”</td>
<td>&quot;There isn’t the money to get to those levels. There isn’t the money in industry…. It would mean the closure of processes.”</td>
<td>&quot;It depends what those hazardous materials are.”</td>
<td>&quot;There’d be the practicalities of it – what do you call background levels?”</td>
</tr>
<tr>
<td>Operators 2</td>
<td>&quot;It’s a laudable goal, but why not turn it around the other way and say, “It’s not zero emissions but no damage to the environment.””</td>
<td>&quot;My company would be out of business if zero emissions came in.”</td>
<td></td>
<td>&quot;The goal of zero emissions of hazardous chemicals is as difficult as zero emissions of anything.”</td>
</tr>
<tr>
<td>Regulators</td>
<td>&quot;I think it’s a nice political concept, but technically…. It might present some difficulties.”</td>
<td>&quot;If the political will is there and it’s a relatively small sector you can do it. You can take a cost – benefit analysis and OK, shut a few plants.”</td>
<td>&quot;It depends how many are on the list at the end of the day…..”</td>
<td>&quot;Those emissions that stand out like a sore thumb will get the major attention, the ones that are bumbling along the bottom will go for much longer.”</td>
</tr>
<tr>
<td>Academics</td>
<td>&quot;I take it as one of those sort of vision statements.”</td>
<td>&quot;Zero pollution can easily be achieved by zero industry…. We shouldn’t unfairly impose something which is blatantly impossible on industry.”</td>
<td>&quot;There must be a precise definition of what substances for which we must achieve zero emissions.”</td>
<td>&quot;You can’t measure zero, you can only say the concentration is ‘less than’, but you can’t say it’s zero.”</td>
</tr>
</tbody>
</table>

Continued…

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Table 5.19. Continued.

<table>
<thead>
<tr>
<th>Group</th>
<th>Substitution</th>
<th>Consumer influences</th>
<th>Regulatory focus</th>
<th>Regional implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators 1</td>
<td>“It needs some really radical re-thinks of processes to achieve those targets.”</td>
<td>“It would mean a change in consumer thinking.”</td>
<td>“Our regulator exists from one authorisation to another. They haven’t got time to think about the big picture any longer.”</td>
<td>“There will be more imports into Europe from people who aren’t as tightly regulated, or jobs will be exported by the companies, who are mostly multi-national anyway.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Short of shutting down large parts of industry, getting to background levels is a virtual impossibility. Either you want industry or you don’t.”</td>
<td></td>
</tr>
<tr>
<td>Operators 2</td>
<td>“It will become a driving force to look at alternative materials.”</td>
<td>“…as long as there is a demand for the product, then I think it would be very difficult for people to try and legislate a product of existence on environmental grounds.”</td>
<td>“It’s probably too early, 2020. It’s still draft, they need to thrash out some of the issues.”</td>
<td>“I would suspect, with international companies, that they would go elsewhere.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“I don’t think any European country is going to jeopardise its own industry to achieve absolute zero emissions.”</td>
</tr>
<tr>
<td>Regulators</td>
<td>“I suppose the key thing is whether there are viable alternatives.”</td>
<td>“It may be that benefit outweigh some of the other considerations but at least we’ll get better options chosen in the future.”</td>
<td>“We are regulating to the limits that are set…. Basically 99.9% of our time is spent out there making sure that we are regulating.”</td>
<td>“If you penalise the existing remaining manufacturing industry, that, let’s face it, has taken a serious decline anyway, it will just go somewhere else.”</td>
</tr>
<tr>
<td>Academics</td>
<td>“Part of the solution is replacement. If you’re using substance A, is there a non-toxic substance B that will equally do that job in the manufacturing process?”</td>
<td></td>
<td>“If it’s going to be achieved then regulation has to start looking at much longer time scales.”</td>
<td>“I think it’s important to have more legal clout, which they haven’t really got at the moment.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“Europe would never agree to those proposals unless N America did. The burden you’d impose on European industry would be enormous and North America’s never going to agree to that.”</td>
</tr>
</tbody>
</table>
A key part of the practical implementation of the OSPAR strategy was identified as the process of categorisation and subsequent listing of hazardous chemicals and it was recognised that the criteria used to select these substances was a critical factor. The other main practical issue was seen as the definition of ‘zero’ or ‘near zero’ and how this would be translated into concentration limits within a discharge licence.

The earlier part of the discussions relating to the OSPAR strategy were focussed on the groups’ perception of the many problems concerning the implementation of the agreement, but they developed to constructively debate some of the wider issues. One of the key areas was the issue of product and process substitution. The implementation of the agreement could be a driving force to examine alternative, less toxic in-process materials and lead to a fundamental re-think of existing production processes. The necessary changes in the processes would lead to changes in the end product and it was suggested that this would involve the consumer playing an important role in the acceptance of alternative since it was thought to be very difficult to legislate a product out of existence if there was a continuing public demand for it. In some cases the benefit of the product may outweigh the environmental costs. However it was accepted that the phasing out of products on environmental grounds had been successful in the case of CFCs via the Montreal Protocol.

The long time-scale of the implementation of the agreement was thought to be incompatible with current regulatory horizons. The regulators were considered to operate on a short-term basis ‘from one authorisation to another’. The achievement of the OSPAR targets were therefore seen as requiring the regulator to work to longer time-scales.
In all cases, the groups believed that one of the overriding issues relating to the OSPAR strategy was the implications of imposing tighter regulations in some countries or regions vis-à-vis other regions of the world. The groups all believed that industry would shut down or re-locate to the other regions where the regulation was not so strict. This was seen as particularly the case for large multi-national manufacturers who have plants in many regions. The likelihood of the strategy being implemented in the USA was seen as remote.
Chapter 6. Developing the current regime

This study is one of the first to use a three stage methodology which successfully combines qualitative and quantitative techniques to study the regulatory interface. Although the primary purpose of the exploratory interviews was to define the issues for the subsequent questionnaire survey, they provided useful data in their own right. The quantitative data obtained from the survey enabled statistical comparisons to be made between the attitudes of the operators and regulators and were used to develop distinct sub-groups within the operator sector. Quantitative data also allowed wider generalisations to be made concerning the views of the regulator and operator communities. The focus groups explored the findings from the questionnaire in more depth, provided insight into the failings of the regulatory regime and helped to define the improvements that need to be made. This chapter deals with the development of an improved regime arising out of the perceived flaws in the current regulatory system, as described in Chapter 2. The concepts emerge from solutions suggested and supported by the respondents. The Chapter also provides evidence to support and challenge the regulatory theories discussed in Chapter 3.

6.1. The (dis)integrated regime

The regulatory system of IPC is a classic command-and-control regime and is presented as scientific, technically driven and strictly enforced but this work shows the reality is rather different. Although IPC aims to be an holistic and integrated regime, with releases to the three media optimised through BPEO and BATNEEC, there are different views
concerning how effectively this is achieved in practice. The operators clearly indicated that discharges to water were better regulated than those to air or land. The regulators' belief that releases to air were better regulated than aqueous discharges may be a reflection of the historical responsibilities of the Agencies which have their roots in HMIP/HMIP1 and the Air Inspectorate. Coupled with the regulators' view that solid waste is by far the least well regulated of the three, this indicates that the inconsistent application of the BPEO principle has failed to produce the holistic solution first envisaged by RCEP in 1976 (RCEP, 1976). This is due to the informal and pragmatic interpretation of BPEO (Goldson and Murphy, 1998) resulting from the lack of a rigorous methodology (ENDS, 1995) and this has created a gap between the legislative aims of IPC and the reality at the regulatory interface.

From the interviews, there appeared to be a consensus amongst the regulators and operators that COPA, together with the NSC reduction in PARCOM pollutants had effectively addressed the issue of aqueous discharges prior to the introduction of IPC. This was not supported by the survey responses which identified IPC as the most influential piece of legislation, but nevertheless, there was a complacency that the issue of water pollution was well under control despite evidence of continuing pollution of coasts and estuaries (EA, 1999). This attitude supports the theory that an over-emphasis on standards produces complacency (McEldowney and McEldowney, 2001).

Another example of the discrepancy between the perceptions and the evidence is the view of the operators and regulators that toxic metals were the most effectively regulated
substances. However, despite the reduction of metal inputs, studies of the marine environment consistently highlight the problems caused by metal contamination (Baeyens, 1998) and industrial pollution has resulted in metal levels in shellfish exceeding proposed food safety standards (ENDS, 1999c). EA figures show that, since 1991, mercury has decreased by 75%; cadmium by 75%; lead by 57% and copper by 41% (EA, 1998a). The focus groups explained that, in contrast to the large number of synthetic organic chemicals, the relatively small and finite number of toxic metals were simple to manage. There is also a better understanding of their environmental fate and effects compared to synthetic organic chemicals. It has been suggested that too much emphasis has been placed on the study of metals in the marine environment (Goldberg, 1998) but there is a need to continue to develop understanding because there is likely to be long-term contamination in some areas, such as the Humber and Mersey Estuaries (Millward and Glegg, 1997; Williams et al., 1998) and toxic metals continue to cause harm in the marine environment (Sindermann, 1996).

The perceived difference between the respective regulation of metals and organics was encapsulated by one of the focus group respondents, who explained:

"If you talk about metals, then it [the regulatory system] probably works reasonably well, but, if you're talking about organic chemicals, then I'm not so sure that it does because you need to know, firstly what they all are and secondly, what the effects of them are."

Although toxic metals have been the subject of a great deal of environmental research over the previous three decades, it is only comparatively recently that organic chemicals
have become the major focus. New research highlights an ever increasing number of organic chemicals, not regulated under the existing regime, that are cause for concern and few respondents identified organic pollutants as being well regulated. There is growing awareness that these chemicals are responsible for a range of subtle and chronic biological effects. Industrial organic chemicals may be the most significant environmental oestrogens in estuarine and coastal waters (ENDS 1998a). From the survey respondents indicated that endocrine disrupting chemicals were the least well regulated of all the categories of hazardous substances.

Ten years after its introduction as a holistic regime, the perception of IPC from the regulatory interface is that both emissions to the three media and different categories of hazardous substances are regulated in an inconsistent way. This is due to the way that the principles and standards are interpreted, derived and enforced. The following section discusses these aspects of the regime.

6.2. Recognition of weaknesses

Although the operators and regulators expressed different views concerning the practical application and enforcement of the regulations, they nevertheless shared a perception of the underlying scientific principles of the EQS-based approach to environmental management.
6.2.1. Science underpinning regulation

Operators and regulators both had their doubts about the effectiveness of the EQS system and believed that compliance with all relevant EQSs would not necessarily prevent harm to the environment, yet exceedence would not necessarily lead to harm. This highlights an ambiguity and implies that the system is unable to encompass either the range of chemicals that might be present in a discharge, or the information concerning their complex effects which is required to set 'safe' concentration limits. Crommentuijn et al. (2000), found that the lack of relevant ecotoxicological data seriously undermined the derivation of reliable 'safe' concentrations and extrapolation often resulted in EQSs being set too low (ie., unnecessarily strict), as in the case of copper in estuarine waters. In other cases EQS levels are set either too high or, as is the case for the vast majority of commercial chemicals, including potential endocrine disruptors, are not derived at all. Most respondents were unsure as to whether chronic and subtle biological effects were included in the derivation of EQS concentrations. Furthermore, although there is evidence of additive and synergistic effects between effluent components (Johnston et al., 1996; Matthiessen et al., 1993), most respondents did not know that these effects were not incorporated into the derivation of an EQS, as is currently the case (Zabel and Cole, 1999).

Due to the complex nature of industrial effluents, the list of chemicals detailed in an authorisation does not specify discharge limits for all hazardous substances that could be present in a particular effluent, and this was recognised by most respondents. There are practical difficulties in fully analysing effluent for all constituents (Johnston and Stringer,
1991) and both regulators and operators admitted that they did not always know what was in an effluent, or what the toxic components were. A licence is therefore based, not on environmental considerations of what is actually present in an effluent, but it is a compromise specifying limits which are practical and achievable within the resources available. Nevertheless, regulators and operators appeared happy to continue supporting the system which they view as being ‘practical’ and ‘pragmatic’. The key benefit of the EQS based approach may be that it is a familiar, convenient bureaucratic system that facilitates uncomplicated management. The use of EQSs conveniently defines ‘harm’ and therefore ‘harmless’ for the regulator. Indeed the use of and compliance with EQSs is a good example of the theory of goal displacement within a bureaucracy, where the instrumental value (EQS) has become the terminal value (Merton, 1940). One of the major criticisms made by the environmental groups was that the current regime has this narrow, bureaucratic focus and this appears to be the case.

6.2.2. The BATNEEC principle and the enforcement of standards

Differences between the respective attitudes of the operators and regulators were most apparent in the practical areas of regulation, such as information exchange, prosecution and enforcement. Significant differences between the perceptions of the operators and regulators were discovered in the practical aspects of IPC regulation. The regulators were clearly more positive about the environmental benefits achieved by the implementation of BATNEEC than the operators.
Some industrial sectors and individual companies experience a closer regulatory relationship with the inspector than others (Fineman, 2000) which affects the way standards are set and enforced. This study has shown that an inspector who made the final BATNEEC judgement was perceived by both groups to affect the outcome, although the regulators were more equivocal, but this individual discretion could lead to inconsistencies in the determination and enforcement of emission limits. The approach was seen to vary in England but was much more consistent in Scotland and this was attributed to the fact that in Scotland, inspectors worked in teams. The EA split up personnel from a few large offices into more smaller ones and the resultant ‘isolation’ of inspectors may have led to inconsistency. The fact that the inspectors in England were held in low regard is of concern because this is likely to influence their bargaining position and the response of the operators. Focus group discussions demonstrated that the operators believed that inspectors who had worked in industry were the only ones to have the necessary knowledge to interpret BATNEEC and the operators showed little respect for those who did not have this background. As with any negotiation, a lack of trust or respect will weaken the regulators bargaining position with the likely result being that lower environmental standards may be set.

The BATNEEC negotiation requires detailed economic, technological and process information from the operator and this has led to the involvement of industry in defining their own performance standards (Smith, 1997). This involvement is not a new phenomenon, however: In his address to the Society of Chemical Industry, Muspratt (1886, p409) explained that, “Means are well known which will render the waste
[sulphur-containing waste from caustic soda manufacture] comparatively innocuous, and it is satisfactory to know that the method now recommended by the Alkali Inspector for the prevention of the nuisance from waste heaps, emanated from the manufacturers themselves.” This could be viewed as an early example of industry defining BAT for the sector.

The regulators recognised that they were dependent on the operators to provide the economic information and therefore the operators were better able to determine what entailed “excessive cost”. In a relationship where knowledge represents power, this dependency places the regulators at a disadvantage in the negotiation process, a situation identified by Smith (1997). It is this power dependency that has created and maintains the policy community which strongly influences both policy and regulation. It is clearly in the operators’ interest to perpetuate this dependency, since it draws the regulators into a negotiation and constrains them from imposing standards in a ‘top down’ implementation of policy. Industry can therefore shape the policy outcome so that it is more to their liking. It appeared that the definition of NEEC was rarely contentious to the point that inspectors had to engage consultants and even less frequently was it tested through the legal system. Both these eventualities entail economic costs for the regulator and operator and they are likely to avoid conflict by negotiating a compromise. This study found that regulators and operators believed it was crucial to maintain a collaborative relationship and this supports previous work (Fineman, 1998). The early predictions that BATNEEC would be routinely defined through the courts (Harris, 1992) has not proved to be the case.
Regulators and operators appeared to interpret ‘excessive cost’, not only on a site, or company specific basis, as identified by previous study (Pearce and Brisson, 1993), but on a temporal basis as well: What might be regarded as excessive cost in a difficult economic climate may not be when the general economy or sector is performing well. This widens the interpretation of this vague principle so that BATNEEC is much less systematic and rigorous than was intended in the original legislation. Although political will to implement environmental legislation may weaken as a result of poor economic conditions (as was the case with the implementation of COPA in the 1970s and early 80s), the interpretation of BATNEEC should be immune to such factors. Such is the flexibility of the BATNEEC principle, that it can be interpreted to mean what the regulators and operators agree at any particular time. Regulation in IPC can therefore be seen to be carried out, not by rigid bureaucrats employing limited scope for subjective interpretation (Hood, 1986; Merton, 1940), but by street-level bureaucrats continually defining the rules in a ‘bottom-up’ implementation (Lipsky, 1980). The flexibility of BATNEEC was viewed as a mixed blessing with some inspectors seeing it as a limitation of what they could achieve and this accords with Fineman’s (2000) view, that BATNEEC both “empowered and frustrated” inspectors. They could use it to bully operators, but it’s imprecise nature means that decisions were always open to dispute. Industrial operators appeared confident that the regulators could not impose standards which would severely affect their operations, although the regulators did not agree. The reduced number of enforcement orders issued during 1999/2000 (EA, 2000c) suggest that it is the opinion of the operators which most closely reflects the reality of the situation. This provides support for the theory that the regulators have been captured by the operators. Although
the EA and SEPA are relatively new organisations, they are comprised of a number of mature regulatory bodies and therefore they may be viewed as mature organisations and consequently likely to have been captured (Bernstein, 1955; Wilson, 1980). Regulatory capture has therefore been perpetuated, rather than reduced, by the formation of the new agencies. On the occasion when the Agency has attempted to impose conditions, it has led to a protracted and bitter court case (ENDS, 1998c). According to Hawkins, (1984, p2), “The power to define and enforce consents is ultimately a power to put people out of business, to deter the introduction of new industry or to drive away going concerns”. Whilst this power exists in theory, the regulator appears reluctant to use it.

Resistance by industry to tightening environmental regulation on the grounds of economic costs may be misplaced. Recent case studies (Sharratt and Sparshott, 1996) have demonstrated that an improvement in environmental performance can result in considerable cost savings through reduced raw materials consumption and increased output. Innovations borne of the increasing environmental pressures are gradually translating into new commercial processes and products, thus providing the industry with new opportunities. Both operators and regulators indicated that significant improvements have yet to be made by the chemical industry, but within the BATNEEC framework, it is likely that the regulators will require increasingly sophisticated and detailed information concerning the operators in order to propose improvements as they become less obvious. Whilst there are easily identifiable improvements to be made under BATNEEC, it is unlikely to be an area of contention, but as progressively smaller and proportionately more expensive changes are required there will be more likelihood for disagreement
between the regulators and the operators and this will test the collaborative approach that they have indicated in this study is such an integral part of IPC. This highlights the fundamental limitation of BATNEEC, which is that, at some stage, it will become extremely difficult for the regulator to demand and justify further improvements, even if their current lack of economic and technological expertise could be remedied.

When standards have been set, compliance is normally measured using monitoring schemes. Operators and regulators indicated that current monitoring schemes could not detect all breaches of an authorisation which could lead to environmental harm. As part of an authorisation the operator is obliged to provide monitoring data to the regulator whilst the regulators carry out their own routine monitoring to establish compliance and to assess environmental effects.

The sanctions imposed for non-compliance were perceived by the regulators to be insufficiently severe, although there are signs that this is changing (ENDS, 1998b). Fineman (2000) found that inspectors viewed prosecution as their “poisoned chalice”. They were reluctant to prosecute due to a lack of trust in the judicial process to deliver punishments, insufficient evidence, the superior legal resources of the company and the legacy of antagonism that could compromise future relations. This may explain why, in accordance with existing organisational theory (Kipnis et al., 1980), prosecution was seen by both parties as a last resort. Petts et al. (1999) found that most respondents indicated that prosecution is not the main driver for compliance and that the penalties were too low. Bigger fines were mentioned as being required and this was supported by the regulators
questioned in this study. Operators indicated that the sanctions for breach of authorisation conditions were sufficiently severe and that they should not be prosecuted for such breaches, unless significant environmental harm is caused. Indeed, operators sought to portray environmental offences as trivial but this trivialisation has been found to act as an impediment to enforcement generally (De Prez, 2000). The flexible enforcement response is typical of regulatory agencies (Hood, 1986) where inflexible responses are rare. A ‘soft’ response, such as providing guidance and information is seemingly preferred, where in fact a ‘hard’ response involving detection and punishment would be more likely to deter opportunistic non-compliance (Hood, 1986). In this study, negative publicity, not fines were the operators’ main concern associated with prosecution, particularly in Scotland where the legal system does not really support the regulator and fines remain low (ENDS, 1997e). This is of concern because low fines produce an incentive to violate (Burrows, 1979). The operators are being inconsistent: They regard the fines as being sufficiently severe, yet they view the negative publicity as their main concern. These findings indicate that whilst the financial penalties of ‘last resort’ are not a deterrent, the EA’s recent “Hall of Shame” approach to naming the worst polluters may be an effective sanction.

6.3. The perceived solutions

The solutions to the perceived problems, suggested by operators and regulators are summarised in Table 6.1. The improvements were related to the statutory standards and the enforcement of those standards, rather than a re-appraisal of BATNEEC/BPEO.
Focus groups highlighted the need for better consistency in the EA and suggested this could be achieved by the formation of inspector teams. However, they did not address the key issue with BATNEEC, which is the lack of a rigorous system of cost-benefit analysis, which has resulted in the flexible, pragmatic approach to regulation under IPC. There needs to be a fundamental change in the way that environmental cost-benefit is carried out, so that the qualitative approach of considering environmental benefits is replaced with a quantitative approach where these benefits can be financially accounted for (Roos, 1999). The flexibility resulting from the requirement to interpret the BATNEEC/BPEO suited both the regulators and the operators and they identified little need for change. This flexibility has led to compromise, but flexible regulation *per se* is not always undesirable and may facilitate innovative environmental solutions: A report by Boyd (1998) examined trial projects at three major chemical companies in the USA and concluded that industry’s desire to develop pollution prevention technology was often inhibited by rigid prescriptive regulations. With the introduction of the Integrated Pollution Prevention and Control (IPPC) Directive (EC, 1996), operators will have more flexibility to manage their site emissions which may provide them with more scope to develop novel techniques, but this will only happen if there is a driver for improvement.
Table 6.1. The flaws in the current IPC regime. A comparison of previous study findings with the perceptions of personnel at the regulatory interface. The solutions proposed in this study are summarised and discussed in the text.

<table>
<thead>
<tr>
<th>Break Point</th>
<th>Process</th>
<th>Previous study</th>
<th>Interface perception</th>
<th>Proposed solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Classification and priority listing of hazardous substances</td>
<td>Incomplete lists.</td>
<td>Many chemicals not listed.</td>
<td>List more substances.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long time delay for listing.</td>
<td>Long time delay for listing.</td>
<td>None proposed.</td>
</tr>
<tr>
<td>2</td>
<td>Alternative regulatory regime.</td>
<td>Leads to lower priority and fragmented system</td>
<td>Some non-IPC processes are major sources of pollution</td>
<td>More regulatory attention on non-IPC processes</td>
</tr>
<tr>
<td>3</td>
<td>BPEO</td>
<td>No rigorous methodology.</td>
<td>Not seen as a problem</td>
<td>None required.</td>
</tr>
<tr>
<td>4</td>
<td>BATNEEC</td>
<td>No rigorous cost-benefit analysis.</td>
<td>Rarely contentious.</td>
<td>None required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Knowledge asymmetry.</td>
<td>Knowledge asymmetry.</td>
<td>Regulators 'buy in' economic expertise.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual inspectors regulate differently.</td>
<td>Variability caused by individual inspector.</td>
<td>Inspectors work in sector teams.</td>
</tr>
<tr>
<td>5</td>
<td>Definition of mixing zone</td>
<td>Modelling leads to inconsistencies.</td>
<td>No problem</td>
<td>None required.</td>
</tr>
<tr>
<td>6</td>
<td>Derivation of EQSs</td>
<td>Lack of data.</td>
<td>Lack of data</td>
<td>Generate more toxicity data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No account of synergistic &amp; chronic effects.</td>
<td>No account of synergistic &amp; chronic effects.</td>
<td>Implement DTA.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No sediment quality standards.</td>
<td>No sediment quality standards.</td>
<td>Develop SQVs</td>
</tr>
<tr>
<td>7</td>
<td>Consultation process</td>
<td>Many generic responses form statutory consultees.</td>
<td>Not perceived as a problem.</td>
<td>None required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public lack of understanding</td>
<td>Public lack of understanding</td>
<td>Improve public understanding</td>
</tr>
<tr>
<td>8</td>
<td>Enforcement and prosecution</td>
<td>Sanctions not effective.</td>
<td>Publicity, not fines the main deterrent.</td>
<td>Tougher sanctions.</td>
</tr>
<tr>
<td>10</td>
<td>Identification of environmental harm</td>
<td>Harm difficult to define and detect</td>
<td>Harm difficult to define and detect.</td>
<td>None proposed.</td>
</tr>
</tbody>
</table>

The solutions suggested by the personnel at the regulatory interface have been incorporated into the existing IPC framework to re-construct the regulatory process and is shown in Figure 6.1.
Figure 6.1. Improved IPC regulatory process based on respondents' suggestions. Improvement areas are shown by dotted-line boxes and described in italics. 'Break' points 1 - 9 are shown.
Although no improvement to the BATNEEC/BPEO was thought necessary, possible improvements to other aspects of regulation were identified in the study. Most respondents supported the listing of more substances and the derivation of EQSs for chemicals found to be hazardous. The regulators believed particularly strongly that there were chemicals which should be priority listed but were currently not. However the process of officially listing chemicals was perceived by operators and regulators to be a lengthy procedure. It took the EU a whole decade to issue the first 10 daughter Directives relating to the regulation of individual priority black listed substances (ENDS, 1992). Despite the discovery of the serious biological effects of tributyltin (TBT), an anti-fouling compound, it still took several years for legislation, now considered to be inadequate, to be adopted (Evans et al., 1995). The listing of more chemicals for priority control and the subsequent derivation and implementation of appropriate limits is therefore likely to be a slow process.

One of the main reasons for the relatively small number of chemicals on priority lists is the lack of toxicity data required to derive ‘safe’ environmental concentrations. However, attempts are being made, with the support of global chemical industry associations, to generate toxicity data concerning industrial chemicals. Even for the 4100 High Production Volume (HPV) chemicals designated by OECD, there are problems generating the necessary data and the current target is to have information relating to 1000 by 2004 (Cooke, 2000; Stevenson, 2000). In addition to the routine testing of chemicals, the emergence of new biological effects has resulted in new requirements. For example, the USEPA, in conjunction with the Chemical Manufacturers Association, has
suggested that 87,000 possible endocrine disruptors should be tested (C & I, 1999a). The
lessons from the TBT debacle however, show that laboratory tests are unable to predict
long-term subtle effects. It is disappointing, therefore, that the EA’s ‘new’ strategy for the
regulation of endocrine disrupting chemicals (EA, 2000d) perpetuates the concept that
‘safe’ concentrations, in the form of EQSs, can be defined and subsequently used to
control exposure on a chemical by chemical basis. On an operational basis, the focus
groups accepted there were inherent difficulties in identifying the many components of
complex industrial effluents which created serious problems with determination, control
and enforcement. This supports previous study conclusions (Johnston et al., 1991). An
expanded list would present obligations to the regulator which, given finite resources, it
may not be able to fulfil and this was identified by the focus groups as being a major
problem of adding more chemicals to priority lists, with one respondent explaining that it
would be ‘impossible’ to routinely test for all hazardous chemicals.

The possibility of combined and subtle effects in industrial effluents further highlights the
limitations of the chemical-by-chemical approach to regulation and this was recognised
by operators and regulators. It would be impractical to test all possible combinations of
synthetic chemicals for toxicity since due to the number of combinations. For example,
there are over 275 million different combinations of 5 different chemicals selected from
the EU ‘list of 129’. One suggested solution to the problem of these effects is to use an
integrated response, such as DTA and most respondents, particularly those in Scotland,
were positive about this. However, the EA’s pilot programme, which was hailed as a
“complete success” (ENDS, 2000b), found little correlation between the toxicity of
effluents and the concentrations of chemicals. This underlines the lack of understanding of cause-effect relationships in pollution regulation. The EA has not decided whether toxicity conditions will be incorporated into licences or whether they will be used less formally to indicate where operators need to take remedial action. The operators in this study did not want to see toxicity parameters become an integral part of their authorisation and it is unlikely that the regulators would impose DTA without the co-operation of industry. One of their main criticisms was the lack of an appropriate and practical methodology. The methodology needs to be sufficiently robust for the results to be accepted in any legal dispute following a non-compliance. The EA’s programme has only assessed acute toxicity using single species of organism and there are problems extrapolating data to predict ecosystem effects (Elliot, 1996). There will need to be further work on the development of toxicity assessment techniques for liquid effluents discharged to the environment before it can be widely applied to pollution management (Coombe et al., 1999). In the USA, a programme to reduce toxicity of industrial effluents has been successful in reducing both the incidence and severity of acute and chronic toxicity (Fischer et al., 1998), and in the Netherlands, Whole Effluent Toxicity parameters are being considered for inclusion in the discharge permits (Tonkes et al., 1999). Therefore, although UK regulators and operators have their reservations concerning the application and incorporation of effluent toxicity measures into the licence, there is evidence of a positive approach in other countries.

The elevated contaminant levels in sediments in the proximity of industrial discharges stand testament to the failings of the regulatory regime to predict future environmental
problems. Contaminated sediment is a potential source of future contamination of the water column and could have a significant ecotoxicological impact in rivers and estuaries (Lang et al., 1998; Matthiessen et al., 1995) and this was widely recognised by those surveyed. Hydrophobic organic substances, such as TBT, PCB and pesticides, are accumulating in coastal sediments and can significantly alter the nature of marine communities (Goldberg, 1998). Indeed it has been argued that monitoring sediment quality is more relevant to the protection of the marine environment than water column measurements (Gray, 1999). A recent study by Sanudo-Wilhemy and Gill (1999) found that although regulation of point sources had reduced the levels of some dissolved trace metals in the Hudson River, benthic remobilisation of sediment was now a significant source of such contaminants. Although sediments are therefore an important component of the marine environment, there are currently no statutory environmental quality standards. The operators and regulators surveyed agreed that sediment quality should be included in the EQS system but it was not clear how sediment quality standards could be incorporated into the regulatory regime. The focus groups recognised the current lack of understanding of geochemical processes and the geographical variation in contamination precluded the use of absolute quality criteria and suggested that change in sediment quality represented a more pragmatic management approach. The USEPA has recently acknowledged that current scientific understanding does not support the setting of enforceable numerical standards for sediment quality (Renner, 1998). Focus groups also questioned what action would be taken in the event of an absolute standard being exceeded. The option of physically cleaning the sediment, whilst possible, would be likely to cause extensive environmental problems. The EA suggests they may dredge and
treat some sediments contaminated by PCBs (EA, 2000d), although they accept that it may be better to leave them undisturbed. The question of liability was another issue raised by the focus groups who pointed out that current understanding limited the capacity to link specific effluent discharges with long term sediment contamination. There is also a problem in predicting sediment toxicity from chemical measurements (O’Connor and Paul, 2000). Therefore, in yet another example of the inability to link cause and effect for pollution regulation, sediment quality guidelines, based on chemical parameters, are not easily related to biological hazard. Chapman and Mann (1999) propose the use of sediment quality values in ecological risk assessment procedures for environmental monitoring, rather than for regulatory purposes and it is perhaps in this role that sediment quality measures will be most appropriate.

The ability to detect all breaches of conditions could be improved by the use of continuous monitoring and ‘tamper-proof” technology is currently being developed. The regulators, in particular, believed that operators should carry out more of their own monitoring. The motivation for the regulators may be that this would free up resources and for the operators would give them more control over data. However, this could result in the regulators developing increasing dependence on the operators for information and shift the power balance even further in favour of the operators. It is a reflection of the trust that exists between the regulators and operators that more self-monitoring is an option being promoted by the regulators. However there appeared to be a limit to the trust. Operators believed that registration with an accredited environmental management scheme (EMS) should lead to less regulatory monitoring but the regulators did not
support this. To the operators, self-monitoring is a stringent activity, but they indicated that this ‘stringent activity’ cannot detect all breaches of an authorisation that could cause harm.

The EA has recently reported a range of compliance behaviour amongst the industrial community (EA, 2000a) and consequently they intend to target resources using their OPRA system (EA, 1997). This approach is based, not only on the intrinsic hazards associated with a process, but also takes into account the management performance. Attitudes have been shown to influence environmental performance in the chemical industry through the Responsible Care programme (Stevenson, 1999a). The evidence from the cluster analysis, in this study, therefore, provides support for the OPRA approach, since the attitudes of the different operator groups towards regulation were shown to vary widely. The regulators, for example, may find that the conservative cluster type demands more regulatory input than those with progressive cluster characteristics. The regulator could also utilise ‘public regulation’ to improve compliance in the chemical industry by making more information, such as the OPRA ratings available to public scrutiny. Such disclosure has proved to be effective in other countries (World Bank, 2000) and the RCEP has recommended wider public involvement in setting and enforcing environmental standards (RCEP, 1998). In the questionnaire survey, regulators and operators indicated, very strongly, the public did not understand the risks and benefits associated with the chemical industry and this may be the reason why the EA does not publish OPRA ratings and the chemical industry resists disclosure. However, by refusing
to publish OPRA data, the EA is effectively obstructing support from the public who are potentially a very powerful stakeholder.

Although prosecution is regarded by the regulators as the ‘last resort’, the accompanying sanctions are seen as ineffective. This suggests a very weak last resort. With respect to sanctions, the inspectors indicated that there should be tougher penalties for offenders and this is officially supported by the EA (EA, 2000a). The introduction of tougher penalties would also help to change attitudes towards environmental crimes, so that they are no longer regarded as trivial offences and this could overcome the apparent reluctance of the inspectors to prosecute offending operators. Due to the increasing complexity of environmental law and science, magistrates do not always fully understand the complex issues involved in environmental prosecutions (De Prez, 2000) and there have been suggestions of a specialist court (Carnwarth, 1992) but this would have the disadvantage of making environmental crime distinct from other ‘traditional’ crimes. It is probably the conflicting roles of the inspector as “prosecutor-as-advisor” (Fineman, 2000) and the need to maintain the traditional consensual style of regulation, identified as important in this study, that are the main reasons why there are fewer prosecutions under IPC than expected.

6.4. Conclusion

The study findings have been used to re-construct the model for IPC regulation (Figure 6.1). Both parties in the regulatory negotiation recognise the weaknesses in the IPC regime which stem from the need to interpret the vague principles of BATNEEC and
BPEO. The limitations of cost-benefit analysis within BATNEEC has resulted in standards being negotiated where the balance of power is stacked in favour of the operators due to their superior knowledge of process technology and costs. This information asymmetry has created and maintains the policy community which influences the style of regulation and the information resources are used as the 'currency' with which the operators 'buy' their preferred regulatory limits. The regulator's apparent main objective is to achieve the maximum environmental protection whilst maintaining a harmonious relationship with the operator and this would seem to provide evidence of continuing regulatory capture (Bernstein, 1955; Wilson, 1980). The regulatory approach is viewed by operators as 'pragmatic' and 'practical', but these are essentially euphemisms for a weak, compromised system involving the minimum expenditure. The current approach has led to inconsistencies and reduced environmental protection. Whatever the shortcomings of BATNEEC are, the requirement under the legislation to "render harmless" should, in theory, ensure environmental protection. Unfortunately, the system of EQS, which underpins IPC, and is designed to ensure that safe levels are not exceeded (thus "rendering harmless"), has many faults, which were identified in this study, and therefore this 'backstop' protection is ineffective. In a classic case of displacement of goals (Merton, 1940), the regulators supported the use of EQSs, compliance with which appears to have become a terminal value. This aspect of the regulatory regime therefore appears to share the characteristics of a classic Weberian bureaucracy (Weber, 1947), with clear rules administered by rigid bureaucrats. However, the main regulatory activity within IPC follows the Lipsky (1980) model of street-level bureaucrats exercising substantial discretion. Hawkins (1984) identified that one of the
major regulatory problems was the growing number of synthetic organic chemicals and this has proved to be the case. A regulatory model that was devised to manage a limited number of simple parameters, such as BOD and metals, has proved to be totally inappropriate for the regulation of the tens of thousands of synthetic organic chemicals. The regulators and operators were comfortable with the current framework and did not appear to want to change it, although they appreciated the need for improvement. This desire and ability to maintain the status quo is characteristic of a policy community which is inherently conservative and produces only incremental changes in policy implementation (Bresser and O'Toole, 1994; Smith, 1997). The solutions to the many weaknesses with the derivation of standards, limits and their enforcement, suggested by those at the regulatory interface in this study, merely add to the complexity of the system and would exacerbate any resource and practical problems, which was recognised by operators and regulators. This underlines the shared policy core beliefs of the regulators and operators that industrial pollution control remains a technological issue (Smith, 1997) and highlights the need to incorporate policy-oriented learning into the regulatory process. Their solutions essentially lead to ‘more of the same’ type of command-and-control regulation (Fiorino, 2001). Direct Toxicity Assessment, which is proposed as a solution, is thought to be impractical by those that suggested it. Such an expansion of the regulatory system is also contrary to the EA’s latest objective, to simplify both legislation and their own business (EA, 2000e). The ‘improved’ regime would continue to rely on the policy of identifying harm and controlling outputs to ‘safe’ levels. However, there is a critical lack of the understanding essential for effective regulation, particularly in the areas of cause-effect relationships and complex marine processes. This approach
therefore does not work and there is no practical solution to the problems of the IPC regime identified in this study. The ‘pragmatic’ and ‘practical’ approach, that is so valued by the operators will only become more unworkable as the necessary increases in complexity, required to address the many problems, are realised. Consequently this study has provided support for the hypothesis that the current regulatory regime is incapable of responding to the ever-increasing number of hazardous chemicals and the increasing new knowledge concerning their environmental effects. The solutions proposed by the main policy actors are mechanistic, not strategic and a new approach is needed.
Chapter 7. A new regulatory paradigm

The implementation of the OSPAR strategy was a key issue throughout all three stages of the study. This chapter explains the significance of the strategy and proposes a new regulatory model for the implementation of the strategy, based on the study findings.

7.1. The strategic dimension

The OSPAR strategy heralds a new policy for pollution management and it may even be seen as re-defining the term ‘pollution’, because, for ‘hazardous’ substances, there is no longer a distinction between contamination and pollution. Establishing zero discharges defines pollution in absolute terms, there is no requirement for ‘adverse effects’ or ‘harm’ to be included, as in the GESAMP definition (GESAMP, 1990), since any concentration detected above zero or a defined ‘background’ level will, by definition, represent pollution. This type of definition, which uses the presence of hazardous substances as the primary criterion, represents a reversion to earlier definitions of marine pollution (Tomczack, 1984). However, for other, ‘non-hazardous’ substances or other activities, it will be necessary to use the more widely accepted definitions of pollution such as that developed by GESAMP.

Operators acknowledged that IPC, through BATNEEC, has had an impact on their operational activities and has resulted in environmental improvements. Regulators, in particular believed that IPC had encouraged the introduction of new technologies and techniques which have been integrated into the existing processes. However, the
operational mind set, evident from this study, demonstrates that the regime has not led to the inclusion of environmental issues into the strategic decision making of the operators. This accords with the views of Gouldson and Murphy (1998). The focus of the existing regulatory paradigm on ‘continuous’ operational improvements, rather than a fundamental re-think of existing processes, will lead to progressively smaller incremental improvements, but the operators indicated that there were significant improvements still to be made under BATNEEC. The implied logical end-point of ‘continuous’ improvement is eventually to reach zero discharges, but the lack of a strategic dimension and long term vision within IPC, means this is not a stated objective. This deficiency is overcome by the OSPAR strategy, which formally links the long term protection and improvement of the marine environment with a strategic approach for the regulation of industrial pollution. The strategic target will enable the regulators to work to the longer regulatory time horizon identified by operators and regulators in this study as necessary, rather than working, as one focus groups respondent explained, ‘from one authorisation to another’. In this way, the OSPAR strategy could empower the regulators to drive long-term environmental improvements. Focus groups thought that such an approach, if implemented, would require radical innovations leading to new processes and products.

The more precautionary approach, long-advocated by the environmental groups, has now been incorporated in OSPAR strategy. This will be seen as a victory for the environmental groups who have been influential in the adoption of a precautionary approach by other policy-makers such as the North Sea Conference and in establishing a European ban on phthalate plasticisers in baby toys. The major policy change represented
by OSPAR strategy can be viewed in terms of the success of an advocacy coalition framework influencing the policy process over decades (Sabatier, 1998). This ACF was comprised of NGOs, academics and other bodies, including regulators. It is therefore surprising that few operators or regulators perceived environmental groups to have much influence on pollution policy, but may be partly explained by the fact that operators indicated, in the survey, that their industry associations were effective in countering the lobbying of the environmental groups. It may also be a reflection of the tight policy network (community) excluding groups that challenge their views and failing to observe external changes (Bressers and O'Toole, 1994). A further explanation is that the regulators (as opposed to the ACF) may not see OSPAR as a high priority or meaningful driving force for change.

7.2. Incorporating the strategy into the legal framework

From the study, there appeared to be a lack of awareness concerning the details and implications of the OSPAR agreement. Those operators who did respond indicated that, even at this early stage, the targets were unlikely to be achieved, with even the most progressive operator cluster expressing doubt over its implementation. The goal of zero emissions was generally viewed as 'a laudable goal' but impractical. However, operators and regulators had supported the expansion of the EQS system, which they also admitted would become impractical. Few respondents in the survey identified OSPAR or NSC as having much influence on government policy and this may explain why respondents considered the OSPAR strategy as merely a 'vision statement' and assumed it would not be implemented. This lack of perceived influence may partly be a result of the
respondents being unaware of the OSPAR strategy. However, OSPAR together with the NSC have a proven track record of establishing marine protection measures, such as the ban on the marine dumping of sewage sludge, which was implemented in the face of opposition from the UK, and therefore there is no reason to assume that the OSPAR strategy will not be implemented. There is clearly a failure to publicise and highlight the past successes of OSPAR in getting measures and controls adopted.

The responses to the survey and the subsequent focus groups highlighted the uniformity of the attitudes within the chemical industry to the implementation of the OSPAR agreement. There is no evidence of a change of values within the operators in an autogenic response to regulation (King, 2000; Hoffman, 1997). This solidarity, together with the influence of their industry associations, creates a powerful voice in the policy community, which effectively weakened the IPC regime during its implementation (Smith, 1997). Encouraged by this previous ‘success’, it is likely that the chemical industry will attempt to control the post-OSPAR agenda and change it into something that is more to their liking. In the questionnaire survey, the regulators expressed more enthusiasm for the OSPAR strategy than their industrial counterparts, but their focus group questioned the practicality of its implementation. They concentrated on the practical issues of implementation within their familiar framework rather than examining a strategic approach which would challenge the status quo.

The focus groups indicated that, in the end, political will would be needed to implement the strategy successfully. Most survey respondents indicated that the EU had the greatest
influence on government policy, with OSPAR and NSC only marginal. Consequently, until the OSPAR strategy, which currently has limited legal force, is fully incorporated into EU legislation, it is unlikely that the targets will be taken seriously. The European Parliament attempted to incorporate the OSPAR strategy into the Water Framework Directive, but EC Environment Ministers resisted this and instead incorporated a mechanism for the selection and phasing out of certain hazardous substances (ENDS 2000c). This apparent lack of political will could prove to be critical to the implementation of the OSPAR strategy. Despite its lack of incorporation into UK or EU legislation, the EA lists the achievement of the OSPAR strategy as one of its key long-term targets (EA, 2000e) and intends to place more emphasis on setting long-term targets to be achieved by individual industries and sites. This is an important step and should help to change the operational mindset of the chemical industry and move the regulatory focus to the longer term.

One of the main concerns expressed by the operators was that the tightening of controls, required under the agreement, could result in the re-location of some chemicals production to areas outside the OSPAR region where less stringent regulation applied. Indeed, even under the existing regulation, one of the main concerns expressed in the survey was the requirement for 'a level playing field' across Europe and globally. Despite this, operators are keen to exploit the flexibility of BATNEEC to provide themselves with lower compliance costs and by extension a competitive advantage. Focus groups expressed some concern about the likelihood of the USA adopting OSPAR and how this would affect their competitive position. Sindermann (1996) called on the USA to assume
an aggressive international role in reducing ocean pollution. This is rather unlikely, given their recent position on other global environmental issues such as global warming (Pearce, 2000), but Europe, through OSPAR, has taken the international initiative and the USA should be encouraged to follow. In order to achieve this, there will need to be some attempt to incorporate the OSPAR strategy into a global agreement, such as under UNEP. However, this should not be used to delay the implementation. Indeed, Sweden has unilaterally taken steps to implement the OSPAR strategy through a largely voluntary ban on selected hazardous substances (C&I, 1999b). This approach has the potential to create new, ‘clean’ product sectors and industries, which, according to Kuhn (1998), can avoid the loss of competitiveness that can be caused by tighter regulation.

7.3. A new regulatory model

Provided there is the political will, the implementation of the strategy will depend upon an appropriate management process which incorporates new decision-making areas. A new management model has been developed using the study findings (Figure 7.1). The key areas in this process have been identified (Table 7.1) and are discussed below.

Table 7.1. Summary of key decision areas (1 - 6) within the new management model.

<table>
<thead>
<tr>
<th></th>
<th>Hazardous substances defined using existing methodology, but a more precautionary approach. Current listing procedure perceived as slow so need to fast-track substances.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>OSPAR will act as a driver for product substitution and clean process innovations.</td>
</tr>
<tr>
<td>3</td>
<td>Stakeholders to be involved in decision-making. Final arbiter on acceptability of products and processes, such as beneficial pharmaceuticals.</td>
</tr>
<tr>
<td>4</td>
<td>Limits for hazardous substances to be gradually ratcheted down to zero over 20 years. Regulator needs to operate on longer time horizons.</td>
</tr>
<tr>
<td>5</td>
<td>Monitoring of emissions and environmental impact to facilitate strict enforcement and assess effectiveness of measures.</td>
</tr>
</tbody>
</table>
Evaluation of process

Classification of hazardous substances:
- Faster risk assessment.
- More precautionary approach.

② Introduction of cleaner processes & product substitution.

③ Socio-economic considerations

Full analysis of emissions

Hazardous substance(s)

Non-hazardous alternative

Substitute substance

Define mixing zone

Set emission limits for site

Monitor environment & emissions

Compliance with limits

Due to listed substance

Environment harm

REVIEW

Figure 7.1. Proposed management model for the implementation of the OSPAR strategy indicating key areas ① - ⑥.
7.3.1. The key areas

The key decision-making areas, essential for the implementation of the strategy, will determine how effectively the policy objectives are achieved. Each decision-making process will have to reconcile environmental protection with other factors, such as economics and technology. These areas are likely to be the 'battlegrounds' that will shape the future regulatory landscape.

① Categorising and identifying hazardous substances

Operators and regulators accepted that effluents from the chemical industry could contain unidentified hazardous chemicals not specified in their discharge licences, a problem previously identified by Nyholm (1992) and Johnston et al. (1991). At present, there is little comprehensive analysis of industrial effluent and the starting point for the new management process should therefore, entail a full chemical analysis to determine all components (as suggested in one of the initial interviews) which could be combined with a Direct Toxicity Assessment. The results could then be matched against lists of hazardous substances and the necessary control measures introduced. This perpetuates the reliance on lists that was acknowledged as flawed by respondents, but lists, *per se*, are not inherently flawed, rather it is the mechanisms used for selection and the subsequent management of the listed substances that are the problem. The process of classification of substances to compile priority lists is a relatively straightforward and rapid process using well established criteria (Agg and Zabel, 1990). However, the subsequent derivation of 'safe' concentrations (EQSs) for regulatory purposes is, as explained in the previous chapter, intrinsically flawed and very time-consuming.
One of the key features of the new model is that it does not require EQSs for hazardous chemicals, although they will still be necessary for non-hazardous chemicals. The categorisation of a substance as ‘hazardous’ has much more serious implications under the OSPAR strategy than under the current IPC regime, since OSPAR requires zero emissions whereas IPC requires emissions to be prevented, or minimised and rendered harmless. The choice of criteria and methodology for selection of hazardous substances is therefore one of the critical areas of the implementation of the strategy and this was recognised by the focus groups. The mechanism for selection needs to be open and robust as well as flexible and responsive. The OSPAR Commission is developing a ‘dynamic mechanism for selecting and prioritising hazardous substances’ (OSPAR, 1999) with risk assessment an integral part of the process, but it is being delayed by the lack of agreed risk assessment procedures for hazardous substances in the marine environment (ENDS, 1999d). Currently, the OSPAR Commission is supposed to adopt programmes and measures within 3 years of categorising a substance as a priority.

Article 16 of the European Commission (EC) Water Framework Directive (EC, 2000) requires the EC to identify priority water pollutants and categorise them into ‘priority hazardous substances’ (PHSs), ‘priority substances for review’ and ‘priority substances’. Of the 32 priority water pollutants, 11 have been classified as PHSs, 10 as priority substances and a further 11 are under review (EC, 2001). For PHSs, the EC ‘aims’ for the cessation or phasing out of discharges, emissions and losses within 20 years of ‘daughter’ Directives being adopted. These daughter Directives will set cessation or phase out targets for PHSs, using community-wide emission controls. However, the requirement for
daughter Directives is likely to delay the implementation of controls and measures, as was the case with the Dangerous Substances Directive. Less stringent controls, which include the continued use of EQSs, will be applied to the 'priority substances'. Thus PHSs will be subject to the OSPAR target but other priority substances will not. Furthermore, economic considerations appear to have influenced the decision to categorise hazardous substances and this is inappropriate for a procedure that should be based primarily on scientific data. For example, although lead gave rise to similar levels of concern as mercury and cadmium, it has been placed on the review list due to the severe consequences of classifying it as a PHS (EC, 2001, p8). The EU legislation represents a significant weakening of the OSPAR strategy, both in terms of the classification of hazardous substances and the potential for missing the 2020 deadline.

The problem of a number of similar lists, each with a slightly different emphasis, perpetuates the confusion and overlap of the EU, PARCOM, INSC and UK's red lists. The selection methodology should be harmonised and lists consolidated. Whilst there will clearly be substances that are of higher priority than others, this must not be translated into lack of action, but perhaps relate to the time-scale and urgency of the implementation of measures. The new testing procedures must address the range of chronic and subtle toxic effects that are not currently taken into account, so that endocrine disrupting chemicals will be placed on the priority list. The current contention concerning the regulation of endocrine-disrupting chemicals highlights the difficulties that need to be addressed by this key area. Despite evidence to implicate certain chemicals of endocrine effects, the Chemical Industries Association rejected calls for action to be taken and
refused to acknowledge the reality of endocrine effects (ENDS, 1998d). The EA recently published a strategy for the regulation of endocrine-disrupting chemicals which has been criticised as ‘pathetic’ by environmental groups but welcomed as ‘sensible and pragmatic’ by the CIA (ENDS, 2000d). This illustrates the difficulty in reaching consensus on the need for regulating certain chemicals that exists even under the current regime. It is likely to become more contentious under OSPAR, where discharges must be reduced to zero.

For non-hazardous discharges, such as BOD which can be broken down into harmless components, the existing ‘dilute and disperse’ approach to industrial pollution regulation should continue. The suggestion by Sinderman (1996) that all sea outfalls should be of drinking water quality is not a realistic proposition, nor is there any underlying sound reason why this should be so.

© Product substitution and clean production

There was recognition among the respondents that a range of measures and improvements would be required, including the phasing out of some older production technologies and products. The regulators indicated more strongly than the operators that older technologies would need to be replaced. The replacement of products through substitution with a non or less hazardous substance is critical to the successful implementation of the OSPAR strategy. The process should be seen as an iterative process whereby a less hazardous substance was itself replaced with substances of a lower hazard and in this way the hazard can be ‘ratcheted down’. It has been argued
(Santillo et al., 1999) that such a substitution mechanism should not be limited to the replacement of one substance with another, but should include some consideration of alternative approaches to meet the same need of the original hazardous chemical.

The ‘ratchet principle’ is a common feature of regulation and refers to the use of current performance as a partial basis for setting future targets (Weitzman, 1980). It is referred to as the ratchet principle because current performance (or in this case level of hazard) acts like a notched gear wheel in fixing the point of departure for future targets and so provides a type of dynamic incentive framework. It is more appropriate to use the term ratchet principle in this context, as opposed to ‘adaptive management’ since adaptive management is essentially used in a management-as-experiment in complex, dynamic situations, such as ecosystem management, where strict controls are not possible (Holling, 1998).

It will be very difficult for industrial operators to achieve the OSPAR targets through ‘continuous improvement’ of existing processes because increasing marginal abatement costs will make successive incremental improvements prohibitively costly and inefficient. Figure 7.2 illustrates the limitations of the ‘continuous improvement’ approach of environmental performance under IPC. The factory’s cost is measured on the vertical axis and the pollution per unit of output (pollution intensity) is on the horizontal scale. Pollution abatement is subject to a law of diminishing returns. Each additional (or marginal) unit of pollution control costs more than the previous unit. The lines shown
represent the marginal abatement cost. It shows that pollution control can be inexpensive at low levels of abatement, but becomes more expensive at higher levels.

Figure 7.2. Schematic plot of factory costs versus pollution intensity and depicting marginal abatement cost (MAC) lines for three situations: MAC, for existing process; MAC', for improved process; MAC'', for ‘clean’ technology process. Current regulatory limit and OSPAR ‘near zero’ target are illustrated. Hollow arrow indicates reduction in MAC required to implement OSPAR strategy. Adapted from World Bank (2000).

The factory with line MAC may reduce its cost through the application of improved management techniques, (World Bank, 2000), so that it reduces MAC to MAC'. However the achievement of near zero emissions, required under the OSPAR strategy, becomes increasingly expensive as this target is approached, so that, even if it is
theoretically possible to achieve it using existing processes, the cost becomes prohibitive. Some processes may be inherently unable to meet the near zero target at any cost. The solution, identified by the focus groups, is a radical re-think of the process to develop clean technology which has a lower MAC (MAC\textsuperscript{II}). The line shown illustrates that, if technology can be developed with this MAC\textsuperscript{II}, the OSPAR targets are achievable.

Some industries may prove to be unsustainable within the OSPAR context and consequently, despite a vigorous defence of some older processes and products it may be the case that some, PVC and bromine for example, will naturally disappear from the market (C & I, 1999b). Indeed, the focus groups recognised that products, such as CFCs, had been phased out on environmental grounds. Along with cost and utility, environmental performance is having a growing influence on the shortening market lifespan of chemicals (Stevenson, 1999b). The setting of clear long-term, strategic targets should encourage fundamental re-appraisal of some processes and lead to innovations (March and Simon, 1993) which lead to the development of clean production. The setting of a zero emission target may provide the shock of draconian regulation that Porter and van der Linde (1995) argue is likely to promote innovation. This innovation should not be stifled by narrow prescriptive technologies such as BAT which is inherently biased against innovation (Milliman and Prince, 1988). From the initial interviews, the environmental groups believed that BAT failed to explore alternative substitution technologies. Although industry has a history of resisting regulation on the grounds of economic cost, which is facilitated through the use of BATNEEC, the development and innovation of new, cleaner process technology may provide economic benefits and
competitive advantages (C&I, 1997; Porter and Van der Linde, 1995; Rumazo et al., 2000; Sharrat and Sparshott, 1996). However, the current regime perpetuates the incremental approach, whereas regulatory change (within a progressive policy framework) could encourage innovation. Tighter regulation was seen by some operators as an opportunity to create competitive advantage, but was more generally perceived as a threat. The operators surveyed supported uniform standards across the industry, probably because it leads to lowest common denominator standards (C & I, 1998).

Integrating stakeholders

Inevitably, for some process and products there will be no practical ‘clean’ alternative. An integral part of the process will, therefore, be to decide, when there is no less hazardous alternative, whether the product is of such benefit to society that it should be manufactured nevertheless. The focus groups highlighted that it would be difficult to legislate a product out of existence if there was a continuing public demand for it and there would need to be a change in consumer thinking. It is therefore important that the decision-making process should involve wider stakeholders, not just the manufacturers and regulators and a methodology is required to integrate socio-economic factors. Indeed, the Water Framework Directive makes it clear that controls on PHSs will be set only after socio-economic impact assessment (EC, 2000), but there is no methodology for achieving this and it is unclear which key stakeholders would be involved. There are calls for wider stakeholder involvement in the setting of environmental standards (RCEP, 1998) and it is an integral part of the Water Framework Directive (Bloch, 1999). However, there is a clear message from the operators and regulators in this study that they do not believe the
public understand the relative risks and benefits of the chemical industry and its products. This perception underlines the theory that regulators and operators are united in their policy core belief that pollution is an engineering problem to be solved by the regulator working in partnership with industry (Smith, 1997). This could inhibit public involvement and therefore diminish their influence on future regulatory decision-making. In order to overcome this, the EA has stated that it will be more inclusive and will develop a strong approach to education of both the regulated operations and the public (EA, 2000e). The tight policy community may therefore be opened up by the exogenous influence of OSPAR and the EU which have the potential to disrupt the inherent conservatism of the community (Rhodes and Marsh, 1998). A well informed and educated public will be critical to the successful implementation of the OSPAR strategy, if the correct balance between environmental costs and societal benefits is to be struck. The stakeholder forum set up by the government may be a suitable assembly to facilitate such decisions (DETR, 2000). The forum should be able to consider mechanisms for innovation and product substitution, rather than merely end-of-pipe considerations where technical and cost issues limit any controls and measures.

© Achieving zero emissions

The practical difficulty of defining ‘zero’ or ‘near zero’ was recognised by the focus groups as one of the main practical difficulties in implementing the OSPAR strategy. Practically, ‘zero’ concentration can only be defined in terms of the detection limit. There are wide variations in the detection limits for different chemical species. The Method Detection Limit (MDL) is the lowest concentration at which individual measurements are
statistically different from a blank. However, there is a probability that the contaminant concentrations near the MDL will not be detected and so a Reliable Detection Limit (RDL) is normally set at twice the MDL (Chapman, 1998). The analytical variation increases as concentrations become smaller, so that near the detection limits, the uncertainty in the results increases significantly. Furthermore, as they are based on ideal, rather than on environmental, samples, published MDLs must be treated as approximate values. In order to operationalise the concept it is therefore necessary to accept that ‘zero’ concentrations of hazardous substances will be expressed in terms of ‘less than’ a defined detection limit and this limit will vary for different chemical substances. The method of detection will have to be practical and routine and therefore may not represent the most sophisticated techniques. Therefore, while ‘zero’ appears initially to be clearly defined and absolute, it will be subject to pragmatic interpretation. In this respect, it is no different from existing regulatory standards. Continuous improvements in detection limits also suggest that ‘zero’ may reduce over time and this will have implications for the regulation. The zero emissions target is a long-term goal but interim milestones and targets will need to be set by the regulator. As with the current IPC regime, the regulation is likely to be based on emissions control, although there will be a phased reduction to zero, rather than the setting of precise concentrations.

© Monitoring and enforcement

The implementation of the OSPAR strategy with its absolute limits for emissions will require some check monitoring to ensure compliance. More comprehensive analysis of effluents will be required to identify all the hazardous components, rather than the limited
number of chemicals currently tested for. However, the chemical monitoring of water quality should become less of a requirement as the emissions of hazardous chemicals are phased out. Instead, the emphasis should focus more on environmental health monitoring, including such measures as eco-system quality. Strict enforcement of limits will be required to maintain the credibility of the targets and the regulators, and these strict targets may also increase innovation (March and Simon, 1993). Penalties for non-compliance must be sufficient to remove any incentive to violate (Hood, 1986) and to ensure the investments are made to drive the necessary improvements. A ‘hard’ enforcement strategy (Hood, 1986) is therefore necessary.

7.4. Conclusion
The OSPAR strategy represents a powerful exogenous influence on the established policy community and the policy process. It provides the long-term regulatory horizons that have hitherto been lacking from industrial pollution regulation. This study has highlighted the perceived practical difficulties in operationalising the strategy, such as defining zero and selecting hazardous substances, but these are not unsurmountable, despite the watered down provisions of the EU legislation. The attitudes of the operators and their regulators to the implementation of the strategy is currently negative, and this will need to be changed. None of the operator groups, identified in the cluster analysis, were positive towards the implementation of the OSPAR strategy and this indicates that a major shift in attitudes is required, even amongst the most progressive operators. This will not be easy, but chemical industry attitudes towards environmental issues have been successfully changed in the past (Stevenson, 1999a). The focus group discussions
demonstrated that operators and regulators are capable of thinking strategically, but they prefer to work on a short-term operational basis. The study showed that those at the regulatory interface, who will shape the outcome of the strategy, believe it will provide an impetus for a fundamental re-appraisal of current chemical products and production process technology and this should lead to the development of clean alternatives. However, the regulatory approach will need to change and this may have implications for the relationship between the regulators and the operators. The hypothesis that the current regulatory regime is incompatible with the implementation of the OSPAR strategy is thus confirmed. OSPAR also offers the opportunity for (and requires) wider stakeholder involvement to input into the environmental management decisions that will be necessary to implement the strategy. It thus offers the prospect of the existing policy community opening up in response to the exogenous influence of OSPAR.
Chapter 8. Conclusion

Examination has been made of the implementation of pollution policy relating to hazardous substances in the marine environment by exploring the interface where the regulators and their operator counterparts shape the policy outcomes. The study is the first to use a combination of qualitative and quantitative methods to identify the problems associated with the current regulatory system and propose improvements. The findings show that those who operate the system are aware of the fundamental flaws in the system but are unable offer practical solutions. The findings have been used to develop a new regulatory model for the implementation of long-term policy commitments regarding the inputs of hazardous substances to the marine environment. The findings also provide evidence to support a number of theories relating to regulation, policy networks, organisations and bureaucracy. These theories have, in turn, been used to explain the results of the study.

8.1. Long-term problems and short-term solutions

There are fundamental problems with the current regime, both regarding the science that is used to underpin the regulatory standards and the practical application and enforcement of those regulatory standards within the system of Integrated Pollution Control.

8.1.1. The science underpinning the regime

This study has shown that the EQS system, the scientific ‘cornerstone’ of the UK regulatory system that underpins the IPC regime, is perceived by most regulators and
operators to be flawed. Those involved at the regulatory interface recognised the many weaknesses in the system, including lack of relevant toxicity data, inadequate priority lists and no incorporation of additive or synergistic effects of complex effluents. The key personnel responsible for implementing pollution policy have thus indicated a lack of confidence in the ability of the system to deliver its primary objective, which is to prevent environmental harm. However, despite their reservations, the regulators and operators continue to promote the familiar and convenient bureaucracy of the EQS concept within the regulatory system. The EQS system is characteristic of a classic Weberian (Weber, 1947) bureaucracy where clear rules are applied in a ‘top-down’ manner and, in this case, the goal of environmental protection has been displaced by the compliance with the rules. Compliance with these rules offers the individual inspector a measure of security. Through the use of standards, the current system has delivered significant reductions in inputs of the relatively small number of toxic metals, such as mercury and cadmium, where environmental fate and effects are well established. This reliance on targets may have led to complacency that the issue of toxic metal pollution has been effectively addressed, despite evidence to suggest continuing widespread contamination. The system that has facilitated some success in toxic metal pollution is, however, totally inappropriate for the management of the large number of synthetic organic chemicals, for which there is a critical lack of knowledge regarding environmental fate and effects. Despite the general recognition of these problems, no innovative solutions were offered by operators or regulators. There were a significant number of operators who clearly did not (or refused to) recognise there were problems with the current EQS system and
neither did they see any need to change. This response is typical of the members of a tight policy network (community) (Bressers and O’Toole, 1994).

Merely expanding lists of contaminants and generating toxicity data will not solve the problem, although many respondents identified this as the way forward. As more becomes known about the biological effects of an ever increasing number of chemicals and their interactions in complex effluents and, as detection limits are improved, the current regime will be overwhelmed. The requirement to test, control, monitor and enforce will create a system that is impossibly complex and costly, eventually rendering it unmanageable and thus removing the only positive feature of the current EQS-based bureaucracy. Direct Toxicity Assessment (DTA), seen as a solution by some, is not envisaged to become an integral part of the licence, but may be more appropriately used as a screening tool. If DTA is to be used as a regulatory tool, a methodology must be developed to assess a range of toxic effects, both acute and chronic, to a number of indicator organisms representative of a different of trophic levels. However, DTA suffers from the same intrinsic problems as the chemical-by-chemical approach: Laboratory tests are poor indicators of environmental toxicity, especially regarding subtle or chronic effects and the assumption that ‘safe’ concentrations (or levels of toxicity) can be defined and used to control exposure, is flawed. DTA continues the reliance on the identification and prediction of harm as the main criterion for control, which has been shown to be inadequate.
The recognition that contaminated sediment is a significant future source of pollutants necessitates the incorporation of sediment quality into the regulatory system but it is not clear how this should be achieved. Sediment quality is a measure of the effectiveness of past and current regulation and clearly illustrates the failures of the past and current regimes. Sediment quality should therefore be mapped and a strategy developed to monitor and improve quality. This should signal a shift in regulatory emphasis, from attempting to define safe concentrations of contaminants, to improved monitoring of environmental health and increased understanding of environmental processes.

8.1.2. The practical application and enforcement of standards

The fundamental problem with the application of standards within IPC results from the flexibility and discretion required to interpret the vague principles of BPEO and BATNEEC to produce the conditions of the authorisation. This has led to regulatory capture leading to inconsistencies in the expected performance standards, whilst the contestable nature of the outputs from the process means that they are very difficult to legally enforce, even if there is the will to do so. The regulators act more like ‘street-level’ bureaucrats using discretion to set the rules in a ‘bottom up’ implementation of policy. The knowledge asymmetry at the regulatory interface has produced a tightly bound policy community where there is an imbalance in the power relationship between the regulator and operator which both parties recognise places the regulator at a disadvantage. This power balance may shift even further in favour of the operators should proposals for more self-monitoring be implemented. In order to redress the balance, the regulatory bodies should urgently address the need for more economic and technological
expertise within their organisations, investigate new working methods and establish robust audit procedures regarding operator self-monitoring.

More severe penalties for breach of conditions must be introduced, since the level of fines is clearly of little concern to most operators. Such rigorous enforcement, will be particularly important following the introduction of IPPC which should provide operators with increased flexibility to manage their site emissions. There should be less regulatory prescription regarding technology, thereby encouraging more product and process innovations which would result in cleaner processes with less emissions. Encouragingly, there is some evidence that some operators are prepared to move in this direction, although there are a number who seem likely to resist such radical changes. In order to facilitate wider public involvement in the enforcement of environmental standards, ‘league’ tables, which detail the environmental performance of industrial operators should be introduced. Operator ‘scores’ could be based upon the EA’s Operator and Pollution Risk Appraisal ratings, which are currently confidential.

The current IPC regime continues the pollution management paradigm that was established over 100 years ago to analyse and manage the environmental effects of pollution. Over the decades, analytical capabilities have improved and pollution abatement techniques have become more effective, but there is still too much focus on mitigating the effects and there must now be an examination of the fundamental causes. This will require the regulators to shift the emphasis away from the reductionist science of toxicology and endless risk assessment and move towards facilitating improvements in
process technology. The technological improvements prescribed within the IPC framework, however, are likely to be incremental, rather than radical, because there is no strategic dimension to IPC that encourages long-term improvement. The narrow focus does not encourage the more fundamental assessment of established processes and products, which is essential if the point of regulatory intervention is to move away from end-of-pipe emissions. The current regime is consequently a regulatory cul-de-sac, which lacks the strategic vision required to deliver long-term improvements in environmental performance.

8.2. Implementing the OSPAR strategy: A long-term solution

Although the regulatory system has become increasingly sophisticated, the principle of ‘dilute and disperse’ underlying the consenting of industrial discharges has remained essentially unaltered for 50 years. There is clear evidence of the existence of a policy community characterised by the desire to maintain the status quo, even when the system is clearly failing to protect the environment. It is time that pollution regulation moved out of this ‘comfort zone’ with a new approach, more appropriate to the environmental problems of the 21st century.

Although the requirement for continuous improvement under the current UK regime logically implies an eventual reduction to zero emissions, this is not a stated aim. OSPAR provides the strategic vision lacking in the current system. The precautionary approach developed by the OSPAR Commission represents the formal adoption of the strategy agreed at the fourth INSC in 1995 and is consistent with UNEP Global Programme of
Action for the Protection of the Marine Environment from Land-Based Activities, also agreed in 1995. This major policy change may be thought of in terms of as the result of the influence over decades of an advocacy coalition framework, members of which now have a legitimate voice at the OSPAR Commission meetings. Although the OSPAR strategy addresses the policy failures of the past, its implementation is dependent on the necessary controls and measures being introduced at regional and national levels (Figure 8.1).

8.2.1. Policy issues

At the policy level, a global body, such as the UNEP must address the complex issue of regional and global inconsistencies in water pollution regulation, which may undermine national and regional efforts to implement the strategy. Global consistency is also required to prevent industry from exporting production and its associated pollution to regions where less stringent controls may apply. The OSPAR Commission needs to positively contribute to policy development in other regions, such as the USA and Asia-pacific, by utilising its influence with the UNEP. The objective should be to raise global aspirations, rather than to level down to the lowest common denominator. The dissemination of information and advice relating to cleaner production and product substitution is also better addressed at the global level. Implementation of the OSPAR strategy should accelerate the introduction of new cleaner technology and products by moving the focus from the end-of-pipe emissions to a fundamental reappraisal of process technology and product design.
Figure 8.1. Schematic diagram relating to the implementation of the OSPAR strategy and illustrating the interfaces (indicated by dashed lines) between policy, legislation and regulation in marine environmental protection. The appropriate application of key processes, ① - ⑥ (taken from the proposed management model, depicted in Figure 7.1) are indicated by hollow arrows. Dotted arrow lines indicate parallel process for development of UK legislation.
OSPAR will challenge the operational mind set of industry, so that instead of fighting a doomed rearguard action to preserve products and processes, as is often the case under the current regime, they will innovate solutions. If Europe develops clean processes they may prove to be more efficient and the ‘green’ products more marketable, thus providing a competitive advantages. Any such perceived market opportunities may also encourage other regions to adopt the OSPAR approach.

Other issues, highlighted by this study, such as categorising hazardous substances and defining zero emissions, are best resolved at the regional or global level to ensure consistency in approach and to minimise any duplication of effort. The categorisation of hazardous substances should be based on a precautionary scientific approach and should not be influenced by the economic or technical consequences of phase out. The selection mechanism used by the OSPAR Commission, rather than the EC procedure, should therefore be used as the basis for subsequent regulatory measures taken by individual states.

8.2.2. Legislation

In order to implement the OSPAR strategy, the EU and national governments need to establish the required legal basis for its strict enforcement, but regrettably, the opportunity to fully incorporate the strategy into the EU Water Framework Directive was denied by EU Environment Ministers. As a consequence, the objectives of the OSPAR strategy have been significantly watered down in its translation into EC legislation. The incorporation of the zero emissions target into legislation will require the adoption of
daughter Directives relating to individual substances and industry sectors. It is through these specific Directives that threshold levels for discharges will be set and where technical and economic considerations will be taken into account. This is the critical process for reconciling environmental protection with socio-economic factors. For 'priority hazardous substances', controls will be determined only after socio-economic impact assessment. The methodology has yet to be developed, but it must include key stakeholders in the decision-making process, not just legislators. Addressing these issues will act as a catalyst for the involvement of an informed public in industrial pollution management. There is a need for regional stakeholder forums to contribute to decisions on hazardous substances regulation and it should be through these forums that exempt products, or derogations of the zero emissions targets are be determined and used to set the legislative standards and controls. The proposed legislative process involves issuing daughter Directives and this procedure has caused significant delays in the implementation of previous environmental controls, but there should be no such procrastination relating to the OSPAR strategy. In theory, the UK government could unilaterally introduce legislation to accelerate the implementation of the OSPAR strategy, but this is extremely unlikely.

8.2.3. Regulation

The delivery of the OSPAR strategy in the UK could be strongly influenced by what happens at the interface between the regulator and industrial operator and this has been the main focus of the study. The new management model reduces the scope for the regulators to exercise discretion at this interface and should therefore reduce the degree to
which the regulators are captured but this runs counter to the traditional style of regulation in the UK. Consequently, there is likely to be resistance from the existing policy community to the new approach. However, regulators should be able to determine emissions limits for non-hazardous substances and retain the responsibility for environmental and compliance monitoring. The main obstacles to the implementation of the OSPAR strategy may not be the practical and resource implications, but the attitudes of the operators and regulators to changing the status quo, together with the new requirement for them to think strategically and to manage long-term regulatory horizons. In order to develop the new skills required to manage the new regime, the regulators could benefit from appropriate training and this should be provided. The lack of awareness of the OSPAR strategy and the general perception, identified in this study, that it will not be achieved, is of concern and needs to be addressed by government and the regulatory bodies. The powerful influence of industry has, with the complicity of the regulators, frustrated previous policies and government must therefore take the initiative, by developing an implementation strategy, which will prevent industry from setting the agenda.

8.2.4. Scale-matching regulatory activity

There is a potential for scale mis-match between the regional objectives of OSPAR and the local conditions in such areas as estuaries. Contamination by heavy metals may be a problem on a local scale, such as an estuary, but generally not on a regional sea scale. Therefore, even though implementation of the OSPAR strategy may stop any future anthropogenic inputs, the historical legacy of pollution (for example in sediments) may
continue to cause ecological problems. Ecological problems are thus rarely confined to a single scale and therefore environmental decision-making needs to be at an appropriate scale of governance, where the most relevant information is available and where the management response can be rapid and efficient (Constanza et al., 1998). For mature industrial estuaries, local objectives may need to be considered in addition to regional policies, so that, in some cases, a fundamental re-appraisal of how the estuary system is managed may be the most appropriate solution (Jickells et al., 2000).

8.3. Summary

Marine pollution from land-based sources continues to be of global concern as a result of unambitious policies and the failure of successive regulatory regimes to effectively deliver environmental protection. The OSPAR strategy recognises the uncertainty that currently exists in the science used in regulation, especially the difficulties inherent in predicting and defining harm. The new precautionary approach moves the regulatory focus from end-of-pipe and 'dilute and disperse' towards a fundamental and holistic reappraisal of product and process technology. For the foreseeable future OSPAR provides the most appropriate strategy to ensure long-term protection of human health and the marine environment from the effects of hazardous chemicals and it should be implemented, but there must be a stronger political commitment from the EC.

As a result of the examination of the existing IPC regime, an improved regulatory process, based on the current system was proposed. However, it was subsequently concluded that the improved regime would not provide a suitable framework for the
implementation of the OSPAR strategy. A further model was developed to show how the implementation of the OSPAR strategy could be achieved through a new regulatory process. This model shows that implementation should be more top-down, rather than being determined at the regulatory interface. The new framework retains a command-and control approach and, whilst reducing the flexibility at the regulatory interface, should reduce regulatory capture, open up the existing policy community and increase the involvement of other stakeholders in the decision-making process. This framework, whilst the result of study of the UK regulatory system could, with good effect, be applied to all regions, including developed and developing economies.
8.4. Recommendations for future work

Future work concerning the development of the management processes for the implementation of environmental policy commitments should focus on the following:

- A comparison of the attitudinal measures of industrial operators with a measure of their actual environmental performance should be made to determine whether there is correlation and to assess whether this could be used, in conjunction with the Operator and Pollution Risk Assessment methodology, to target regulatory effort.

- Develop methodologies for a regional stakeholder forum, that will facilitate wider participation, particularly public involvement, in decision-making necessary for the implementation of the OSPAR strategy.

- An international study across the OSPAR region Contracted Parties should be conducted to determine how regulatory regimes vary and how this will affect the implementation of the strategy across the region.

- An international study to determine the application of the new approach to other regions, including developing countries.

- A study of the regulation of hazardous substances throughout their life-cycle to identify gaps and inconsistencies, with the aim of developing a new management framework for the regulation of these substances, from production, through use and disposal.
References


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Appendix I

Interview structure: Themed questions with supporting prompting questions
Interview structure: Themed questions with supporting prompting questions

1. Application for authorisation/consent
The application process is well-defined and includes the requirement for external consultees to have an input.

Q: Can you outline your interpretation of the process?
- What level of guidance is provided by the EAs prior to and during the application process?
- Do you think that the level of guidance is uniform across the UK?
- Do you think that there are other groups of people whose views should be taken into account?
- How are recommendations and objections raised by the consultees (e.g., English Nature, MAFF, WWF, public) considered and included in the consent?
- Does/should the process reach a consensus on what should be authorised or are there always people for and against?
- When there is disagreement, whose views carry the most weight and why?
- How are conflicts resolved?
- Have there been occasions where public/press concern has influenced the decision?
- Have there been occasions where other external factors, e.g., local or national politics, has influenced the decision?
- What about the review process?

2. Control parameters
It is not entirely clear how the individual parameter limits are set within an authorisation or consent.

Q: Can you explain to me how you think these limits are derived?
- Is the decision re BATNEEC influenced by who applies it?
- How rigidly do you consider that BAT(NEEC) applied?
- Do you think it leads to progressively improving environmental standards?
- To what extent is its scope limited by the investment made in existing plant?
- When a consent is broken how is the decision taken to recommend prosecution (are there clear rules/guidelines? - if not how is discretion exercised? - is this a good or bad thing?)
- Is there an appeals process?
- What kind of thing might change a consent and how often does this happen?
- Are you familiar with how decisions on consents are taken in other countries and is there a learning opportunity?
3. National policy/legislation
The COPA (1974), the Environmental Protection Act (1990) and the Environment Act (1995) are all major pieces of legislation, specifically aimed to improve the quality of the environment.

Q: **How effective have these been?**
- What, in your view are the most significant pieces of environmental legislation?
- How successfully, in general, do you think these have been implemented?
- How have these impacted on the running of your business?
- Do you consider the legislation to be fair?
- What have been the major obstacles to implementation?
- What is anticipated concerning new legislation?
- What about the European Commission?

4. Organisational/structural
There have been a number of structural and organisational changes within the regulatory domain eg Water Authorities privatised in England and Wales, the creation of the NRA and HMIP(I) and the subsequent formation of the Environment Agencies.

Q: **What impact have these changes had on the regulatory process?**
- Are all of these changes viewed as improving the management of pollution control?
- If structural changes have changed decisions, how have they done so?
- Can you explain who is involved in a particular decision and how information is exchanged?
- Do you see any obvious problems with the current structure?
- How would you propose this be improved?

5. Policy
There has significant development and agreement of policy from bodies such as The North Sea Conference and PARCOM, particularly over the last 10 years.

Q: **What influence have these agreements had?**
- How do they influence the setting of consents?
- Is their influence apparent to you in your job?
- What role do you think that NGOs play in policy-making?
- Do you think that concepts like sustainable development and intergenerational equity have influenced decisions (eg. since Rio) and how?
6. Influence of science and technology
Quality Status Reports (North Sea, Irish Sea) and the Royal Commission on Environmental Pollution reports have highlighted environmental pollution and made recommendations for improvements.

Q: **What is the role of science in the regulatory process?**
- If scientific developments have influenced the process, how have they done so (e.g., via policy change, regulation change, or being more or less cautious in how the rules are applied?)
- What influence have the QSRs had on environmental management?
- What scientific developments have most influenced your activities?
- Are there scientific developments that should have influenced the process but haven’t?
- How scientific/rigorous do you consider BATNEEC?
- How does the concept of the Precautionary Principle influence regulation?
- How predictable are the impacts of discharges (short, long-term and local/distant?)
- Do you try to predict these impacts and if so, how? (e.g., extrapolate from past experience or data, include known processes in computer model, use UK or EU standards that are set by someone else but applied by monitoring near pipe?)
- Is predictability/uncertainty taken into account - how? -(if not, why not?)
- How much investment do you make in improving knowledge of aquatic marine science?

7. Monitoring and information
Monitoring performs 2 distinct functions;
a). Environmental monitoring provides a measure of the health of a water body, ie information concerning its quality status.
b). The monitoring of discharges is a policing operation to ensure that consent limits are not exceeded.

Q: **What is your opinion of the current monitoring scheme?**
- How effectively does the current environmental monitoring scheme reflect the state of the environment? (does it cover all inputs? What about timing and frequency?)
- Regarding the monitoring of discharges, how do you see the relative role of the operator and the EA?
- Is there scope for more or less self-monitoring?
- Can you think of examples where monitoring led to a change in consent and if so what was the process by which this happened?
- If no, is this because monitoring has never shown a problem, or has it been judged not to be significant?
- How would an environmental problem revealed by monitoring be taken into account?
- How are long-term and/or distant impacts taken into account?
- What about mixtures of pollutants, ecosystem effects, chronic effects, effects on vulnerable species?
8. Economics, jobs etc
It is an often held belief (by both the EA and industry) that it is inconceivable a factory be made to invest in process changes or equipment if the expense would jeopardise the future of the company leading to closure, or job losses.

Q: How important are these considerations?
- Do you think there is a kind of balance between science, economics, environment and other factors in a decision?
- If so, is the balance about right? What level of economic expertise do the regulators possess? Do they depend on the industrial operators for information?
- How are the issues of enforcement and employment reconciled? (purely by BATNEEC or on an individual site basis - how is discretion exercised?)
- What effect will proposed pollution charges have on the regulatory process?
- How do you assess the economic status (or local importance) of a company?
Appendix II

Questionnaire survey form
Government Policy and its Implementation:
The Case of Marine Pollution

QUESTIONNAIRE

The contents of this form are absolutely confidential:

Information identifying the respondent will not be disclosed.

This questionnaire is part of a PhD study which aims to identify and quantify the factors which influence the implementation of legislation, especially the decisions made concerning authorisation of industrial discharges. The conclusions reached will provide an insight into the way policy decisions translate into pollution control and may be used to develop management models for sustainable development.

The questionnaire follows a number of in-depth interviews conducted with Agency personnel, industrial operators and environmental groups during 1998 and aims to investigate the ideas and opinions of the operators and regulators, particularly within the context of IPC.

If you have any questions concerning the questionnaire please do not hesitate to contact me, either by telephone (01752 232459/232463), fax (01752 232406) or e.mail (jprichards@plymouth.ac.uk).

Thank you for taking part in this survey and I look forward to receiving your views.

Signed...........................................(J. P. Richards)

Date: March 4 1999
Guidance notes for answering questions

There are a number of styles of question in the questionnaire which have been designed to make your response simple and straightforward. If you are not clear how to respond, the following guidelines should help you in making your answer.

**Ordering priorities:** This style of question asks you to prioritise a number of possibilities by placing a number in a box (□). Please place a number in all such boxes, if you can. If you consider the choices provided are insufficient, please enter your own in the spaces provided.

**Text:** Please write your answer in the space provided.

**Agreement scaling:** Here you will be provided with a statement followed by a string of five boxes set out as follows:

<table>
<thead>
<tr>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you strongly agree with the statement please place a tick in the extreme left-hand box, as indicated above. If you strongly disagree please place a tick in the extreme right-hand box. Intermediate boxes are for weaker agreement or disagreement, with the central box indicating that you neither agree nor disagree with the statement.

In addition there is a 'Don’t know' box which you should tick if this is appropriate.

**Hybrid:** This is a question followed by tick boxes and you are asked to write a short explanation, or to expand on your answer.

**General guidance:** The term ‘Agency’ refers to the Environment Agency and/or the Scottish Environment Protection Agency. If you would like further guidance please do not hesitate to contact me, via telephone, fax or E-mail, using the numbers provided on the cover sheet. Please also feel free to offer additional information or opinions and ideas - it will all be useful!
1. UK Industrial pollution policy

1.1. Which categories of industrial pollution are the most effectively controlled?

*Please rank in order (1 = most effectively regulated).*

- Releases to air
- Aqueous discharges
- Solid waste disposal
- Other (please specify)

1.2. What do you believe to be the most effectively regulated substances?

*Please rank in order (1 = most effectively regulated).*

- Nutrients
- Toxic metals
- Organic micropollutants
- Endocrine disruptors
- Oil pollution
- Bacteria, viruses, GMOs
- Other (please specify)

1.3. Which of the following has the most influence on Government industrial pollution policy?

*Please rank in order (1 = most influence).*

- Royal Commission
- OSPAR, NSC
- Environment Agencies
- Environmental groups
- European Union
- Industry
- Other (please specify)

1.4. Which piece of legislation do you believe has had the most effect in controlling aqueous discharges from industrial sources?

2. Environmental Quality Standards (EQS)

<table>
<thead>
<tr>
<th>Agree</th>
<th>Disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

2.1. Provided there is compliance with all relevant EQSs, then no harm will be caused to the environment.

2.2. Exceedence of an EQS will lead to environmental harm.

2.3. The EQS system allows for additive and/or synergistic effects of mixtures of pollutants.

2.4. Chronic and/or subtle eco-system effects are not considered in the derivation of EQS levels.

2.5. The identification of a hazardous chemical should result in the derivation of an appropriate EQS.

2.6. EQSs should be defined for sediment as well as water.

2.7. The EQS system will need to be revised in the light of improved detection limits.
3. Hazardous chemicals and risk assessment

3.1. The composition of the Red, Black and Grey lists etc, accurately reflects current environmental control priorities.

3.2. An authorisation (or consent) specifies discharge limits for all hazardous substances, posing an environmental risk, that could be present in that effluent.

3.3. Are there chemicals which should be listed, but aren't? Yes ☐ No ☐ Don't Know ☐

If yes, please give examples with reasons........................................................................................................

Why are they not currently listed? ......................................................................................................................

3.4. If a non-prescribed chemical was found to have serious biological effects (e.g., carcinogenic) how long, in your opinion, would it take for that substance to become prescribed?

6 months ☐ 1 year ☐ 5 years ☐ 10+ years ☐

3.5. There are many chemicals for which there are no toxicity data. How should these substances be included in the pollution management system?

Assume not harmful ☐ Use generic data ☐ Assume hazardous ☐ Other (please specify) ☐

3.6. Do you believe that direct toxicity assessments of complex effluents should be part of the authorisation system?

Yes ☐ No ☐

Please give reasons..................................................................................................................................................

3.7. Do you use a decision support system to assess environmental impacts? Yes ☐ No ☐

If yes, what type? ..................................................................................................................................................

4. BATNEEC and the economics of pollution control

4.1. The application of BATNEEC depends on the interpretation by the individual IPC Inspector.

4.2. The application of BATNEEC has resulted in environmental improvements.

4.3. It is the responsibility of the operator to prove to the Agency that what they propose is BATNEEC.

4.4. BATNEEC will differ depending on the quality of the receiving waters.

4.5. BATNEEC acts as a driver for technological change.

4.6. The operator is in a better position to determine what entails "Excessive Cost" than the Agencies.

4.7. The Agencies cannot impose standards on industry which could radically affect an operation.
4.8. What are the Agencies’ main source of economic information regarding operators?
- Company Accounts
- Operators
- Consultant Reports
- Other (please specify)

4.9. What are the Agencies’ main source of technological and process information?
- Guidance Notes
- Operators
- Consultant Reports
- Other (please specify)

5. Monitoring and Compliance

5.1. Monitoring schemes detect all breaches of conditions that could cause harm to the environment.

5.2. There should be more self-monitoring by operators.

5.3. Operators with recognised environmental management systems require less Agency monitoring.

5.4. As analytical methods improve, more hazardous substances will have to be included in authorisations and consents.

5.5. No operator should be prosecuted for a breach of authorisation (or consent) limit, unless significant environmental harm is caused.

5.6. Prosecution of operators for breach of authorisation conditions is seen as last resort.

5.7. Legal sanctions imposed for breaches of authorisation conditions are sufficiently severe.

5.8. The operator’s main concern associated with prosecution for non-compliance with environmental legislation is:
- Fines
- Imprisonment
- Negative publicity
- Other (please specify)

6. The chemical industry

6.1. Industry associations such as CIA and CEFIC help to counter the effects of environmental group lobbying.

6.2. It is in the interests of the chemical industry to adopt uniform environmental standards.

6.3. Tighter regulation of industrial pollution creates opportunities for competitive advantage within the chemical sector.

6.4. Most of the significant environmental improvements have already been made by the Chemical industry.

6.5. The public generally fail to understand the relative risk and benefits associated with the chemical industry and its products.
7. The future

7.1. Do you believe the implementation of the IPPC Directive will improve pollution control management in the chemical industry?

Yes ☐ No ☐ Don’t know ☐

If yes, how? .................................................................

7.2. What are the major issues regarding the implementation of IPPC Directive?

.................................................................................................

7.3. Economic instruments are the only way to ensure that the polluter pays principle is realised in practice.

Agree ☐ Disagree ☐ Don’t know ☐

7.4. Which are the most effective economic instruments for the control of water pollution?

Tradeable permits ☐ Charges based on volume and toxicity of effluent ☐ Licence fees ☐

Other (please specify) .................................................................

7.5. The recent agreement at the Ministerial meeting of the OSPAR Commission in July 1998 set targets for the cessation of discharges of hazardous substances by the year 2020.

The achievement of the OSPAR targets will require:

New legislation to be introduced.

Increased investment in effluent treatment capability.

The adoption of new, ‘cleaner’ production technologies.

The phase out of some older production technologies.

Substitution of some products by ‘cleaner’ alternatives.

New management and control techniques/systems.

Accelerated risk assessment for chemicals.

The implementation of the Precautionary Principle.

New chemicals should only be introduced to replace more hazardous existing substances.

Agree ☐ Disagree ☐ Don’t know ☐

7.6. The OSPAR targets are impractical and unlikely to be achieved.

7.7. The regulators and the chemical industry should work together to implement the OSPAR agreement.

7.8. The UK should follow the example of the Swedish Chemicals Policy Committee

7.9. All the organisations concerned with marine pollution policy are ‘pulling’ in the same direction.

7.10. What are the key issues for future industrial pollution policy?

.................................................................................................

250
8. Personal and organisation details.

Please indicate whether you work for an operator ☐, or a regulator ☐.

The results of this survey will be treated as personally non-attributable. However, it would help enormously if you could complete the following section (give as much or as little information as you wish). Any information you provide will remain totally confidential.

8.1. About you:

Name: ............................................................ Job title: ........................................................................................................

Age group: <30 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60+ ☐

Is your background mainly in:

- Life Sciences ☐
- Chemical Engineering ☐
- Chemistry ☐
- Environmental Sciences ☐
- Other (please specify) ☐ ......... ........ .................. ............

Further qualifications/training: ..........................................................................................................................................

8.2. About your organisation (if Agency please indicate whether EA ☐ or SEPA ☐ and go to 9.3.):

Name of organisation ...................................................... Location .............................................................

Size of organisation: Small (<100) ☐ Medium (>100<1000) ☐ Large (>1000) ☐

Main activity ..............................................................................................

Is your organisation a member of any industry associations?

- Chemical Industries Association ☐
- CEFIC ☐
- Other (please specify) ☐ .................................................

Does your organisation have accreditation to any of the following?

- ISO 9000 ☐
- ISO 14000 ☐
- EMAS ☐

8.3. If you have given your details, please indicate whether you would like to receive a summary of the survey results by ticking this box: ☐

9. Comments

What additional comments comments would you like to make? Please write in this space, or add a separate sheet.

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Thank you for your time and effort spent completing this questionnaire.

Please return it using the FREEPOST envelope.
Appendix III

Environmental regulation: Industry and the marine environment

J. P. Richards¹*, G. A. Glegg¹ and S. Cullinane²

Control of industrial pollution remains high on the UK political agenda. The implementation of industrial pollution policy is, in practice, deferred to individual Integrated Pollution Control inspectors who make their decisions taking into account such factors as environment, technology and economics. Structured interviews with regulators and industrial operators reveal similarities between their respective attitudes. Scientific, technical and economic information is used in the negotiation which forms a key part of the regulation process and in some areas an imbalance between the regulators and the operators has been found. The established system of Environmental Quality Standards and authorised release limits is viewed by the regulators and operators as effectively safeguarding the environment and making it manageable. It is, however, criticised by environmental groups for being bureaucratic, poorly enforced and for not taking into account the possible biological effects of a growing number of industrial chemicals. Attitudes towards compliance with environmental regulations suggest that industrial operators and regulators view limits as being flexible. There is a general consensus that more environmental monitoring is required. Despite the organisational changes that have taken place in the regulatory bodies, there is a perceived lack of functional integration. This paper calls for a reappraisal of the current system which is unlikely to be able to manage the growing number of chemicals found to cause biological effects. A fresh approach and new skills are required by the regulators if the ambitious targets, agreed at the 1998 Ministerial Meeting of the Oslo and Paris Commission, are to be achieved.

Keywords: environmental regulation, integrated pollution control, implementation, marine pollution, industrial discharge, monitoring, compliance.

Introduction

Criticism of the regulation of industrial pollution in the UK has been voiced by politicians (House of Commons Environment Committee, 1997), environmental groups (Peak Associates, 1998) and academics (Smith, 1997). This indicates that a review of the current regulatory system is urgently required. Additional impetus has recently been provided by the Ministerial meetings of the Oslo and Paris (OSPAR) Commission (OSPAR, 1998) where 'near-zero' environmental concentration targets for hazardous substances have been agreed. Pollution control decisions are influenced by diverse factors, such as technology, economics, environment and social considerations and involve inevitable value judgements (RCEP, 1976; 1988). Despite public involvement and the establishment of public registers, the regulatory decision-making process remains unclear. The purpose of this investigation is to identify areas of contention or uncertainty in the process of setting and managing authorisation conditions for industrial discharges and to recommend changes to the current regime.

Implementation is usually interpreted to mean taking a statement of intent (policy) and translating it into specific activity. Weale (1992) remarked that; 'Implementation failure is like original sin: it is everywhere and it seems ineradicable'. Several major factors affecting implementation were identified by Mitchell (1997) and can be used to explain unexpected outcomes. In a comparison of national policies for the control of chemicals, Brickman et al. (1985) observed that, as a result of the considerable discretionary power exercised by the administrators, the classic distinction between policy

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and implementation is relatively unimportant. They concluded that, 'The British carry flexibility to the extreme, developing policy wherever possible through close, informal contacts among government officials and private groups. Flexibility characterises policy outcomes as well, with guidelines, recommendations and informal persuasion substituting as far as possible for statutory orders and prosecutions'.

**Marine pollution**

Globally, 80% of marine pollution stems from land-based sources and reaches the oceans via the atmosphere, direct discharge and through runoff (GESAMP, 1990). Due to the nature of contaminant sources and transport routes, the majority of the contaminants entering the marine environment from land-based sources are delivered to the nearshore where a large proportion may be efficiently trapped and re-cycled (Windom, 1992). Contaminants with significant atmospheric transport, such as polychlorinated biphenyls, may become globally distributed.

The UK was a contracting party of the 1974 Paris Convention which aims to prevent marine pollution from land-based sources. The Convention was administered by the Paris Commission (PARCOM) but has subsequently been replaced by OSPAR. The UK also became associated with the commitments in the North Sea Declarations which aimed to reduce inputs into the North Sea of targeted specified contaminants by at least 50% by 1995, taking 1985 as a baseline. PARCOM selected contaminants on the basis of their toxicity, persistence and tendency to bioaccumulate, thus the PARCOM list I and list II of hazardous substances were compiled. The UK then refined the PARCOM index to devise its own 'red list', using a procedure similar to that described by Agg and Zabel (1990). The subsequent monitoring programme demonstrated that the major source of mercury, cadmium, arsenic and chromium was direct industrial discharge (NRA, 1995b).

The continuing significance of industrial point sources to the total flux of contaminants to the marine environment has been highlighted in a recent study of the water quality for Eastern UK rivers (Robson and Neal, 1997) which showed that regional variations in contaminant concentrations could be attributed to industrial sources. They concluded that, long-term, changes in point source inputs are likely to have more of an impact than diffuse inputs on load estimates. The removal of just one or two major point sources, such as a factory closure, can have a significant impact on water quality (NRA, 1993). This is illustrated by the effective elimination of pentachlorophenol from the Forth River catchment, through the use of an alternative chemical by one paper mill (Campbell and Ridgway, 1989) and, more generally, in the Mersey Estuary where a reduction in the input of a range of industrial pollutants was achieved through the adoption of cleaner technologies, improved effluent treatment and tighter regulation (NRA, 1995a). Research by the Ministry of Agriculture, Fisheries and Food (MAFF), however, concluded that some of the more industrialised estuaries still contain waters and sediments which are acutely toxic to a range of bioassay organisms (Matthiessen et al., 1995).

**Pollution legislation**

Although the problems caused by the discharge of untreated sewage into the river Thames resulted in the first piece of legislation to control water quality in 1876, it was not until 1937 that the growing problem of industrial discharges was addressed through the Public Health (Drainage of Trade Premises) Act. Subsequently, the Rivers (Prevention of Pollution) Act 1951 introduced the consent system but covered non-tidal waters only. A number of large industrial operators therefore constructed factories in tidal waters and it was not until 1961 that tidal waters were included in the consent system (Garbutt, 1995). There followed two major periods of concern and activity which were given focus by the global environmental conferences of Stockholm in 1972 and Rio in 1992. In the UK they were associated with major legislation; the Control of Pollution Act 1974 (COPA), the Environmental Protection Act of 1990 (EPA'90) and the Environment Act of 1995 (Osborn, 1997).

The implementation of the provisions within COPA took nearly ten years and
involved transcribing many consents granted under the existing legislation, including numerous consents which had been 'deemed' in the 1960s and detailed discharge limits on some chemical parameters but imposed no further restrictions. This and subsequent legislation established the general approach to water quality management which enabled the determination of discharge consent or authorisation conditions in relation to protecting the use of the receiving waters. These uses are expressed in the form of Water Quality Objectives (WQOs) which are defined by concentration thresholds, known as Environmental Quality Standards (EQSs), for a range of pollutants. Once EQSs have been set, effluent discharge consents should be reviewed so that the EQS will be achieved after allowing for initial and acceptable dilution around the discharge point. However, according to Gray (1995), these guidelines are often derived using questionable toxicity data and whilst useful, do not provide a logical scientific framework for the protection of the marine environment.

The EU took a key role in the control of dangerous substances in water through its 1976 framework Directive, 76/464/EEC (EC, 1976), setting discharge limits, based on Best Available Technology (BAT), for specific types of industrial sources of 17 'black list' (List I) substances as well as establishing EQSs for them, under daughter Directives. Member States were required to reduce pollution resulting from the discharge of 'grey list' (List II) substances and in the UK, the Water Research Centre (WRC) was contracted to recommend suitable EQSs. In 1984 the WRC published inter alia technical reports relating to chromium and inorganic lead (Mance et al., 1984a, b). Both these reports referred to the difficulties caused by the lack of available data, particularly concerning chronic toxicity and chemical speciation. It is only recently that substances from the grey list have been the subject of proposed EQSs which have already been criticised for not being sufficiently stringent (ENDS, 1997a). Other influences, such as the EU Habitats Directive, should, in theory, lead to a review of authorisation conditions in areas such as estuaries where there may be special habitats supporting for example, wading bird populations.

**Integrated pollution control**

The case for an integrated reform of UK industrial pollution control, by considering wastes to all receiving systems, was proposed by the RCEP in 1976 but the legislative framework was not introduced until the Environment Act in 1990. The flagship of the new Act was the regulatory system of Integrated Pollution Control (IPC) which applies to the industries with the greatest potential to cause pollution (DoE, 1991). In the UK there are over 2000 sites and processes which are currently regulated under IPC (EA, 1997). The decisions concerning regulatory standards were deferred to Her Majesty's Inspectorate of Pollution (HMIP) in England and Wales and Her Majesty's Industrial Pollution Inspectorate (HMIPI) in Scotland. These organizations have since been subsumed by the Environment Agency (EA) and the Scottish Environment Protection Agency (SEPA), respectively. In practice, the subsequent negotiation of the authorisation conditions between the industrial operator and the regulator determines the 'regulation' (Smith, 1997).

Implementation is particularly important for IPC, as the regulatory body exercises considerable discretion in setting the standards within a legislative framework which includes such vague statutory principles as the Best Available Techniques Not Entailing Excessive Cost (BATNEEC) and the Best Practicable Environmental Option (BPEO). The implementation stage therefore has a significant impact on policy output. There have been a number of studies concerning the effectiveness of the IPC regime; Allot (1994) pointed out that the balance HMIP was striking between environmental and economic factors was obscure and at no point did it offer a cost-benefit analysis of its proposed standard. Despite the fact that there is a clear need for economic information, assessments of the economic impact of proposed regulatory measures have been criticized as being ad hoc, implicit, narrow and non-systematic (Brickman et al., 1985). The information tends to be provided through informal discussions between regulators and industry, consultation with governmental departments and representation of economic interests on advisory committees.
The practical problems encountered during the implementation of IPC, resulting from the tight timetable and lack of resources, led to an increasing involvement of the operators in setting standards. The use of the Chief Inspector's Guidance Notes (CIGNs) initially envisaged as representing a prescriptive, top-down implementation became purely advisory and were later seen as the starting point for a negotiation of standards, where the site-specific circumstances of an operation would be taken into account. An extract from a recent CIGN illustrates the approach: ‘Inspectors should not impose any release levels given in this Note as uniform release standards. They should, however, be taken into account when framing conditions in authorisations, together with any local effects and site-specific effects of releases (e.g. the release of mobile and persistent pollutants which might harm distant receptors), and other site-specific issues’ (HMIP, 1995).

The original ‘arms length’ approach adopted by HMIP therefore developed into one of close cooperation and consensus, although there is evidence that the regulated operators do not all experience this to the same degree, but that it varies according to their size (Mehta and Hawkins, 1998). Often the information concerning releases, provided by the operator in the application for authorisation, was incorporated into their authorisation thus effecting a status quo. In the absence of specified parameter limits for aqueous discharges in an application, the relevant limits set by the National Rivers Authority (NRA) under the Water Act 1989 were incorporated unchanged into the new authorisations.

Once the standards are set, they need to be enforced. The practical problem of strict enforcement was quickly recognised by the regulator who conceded that, ‘For various reasons, absolute limits came to be regarded in practice as not really applying as strictly as they were stated in consents. The notion that compliance for ‘most of the time’ was acceptable became widespread’. (NRA, 1990). Part of the enforcement process is the monitoring of effluent streams and the environmental quality. There has been much debate about the effectiveness of the current monitoring regime particularly given the complexity of some industrial effluents (Johnston et al., 1991; Matthiessen et al., 1993). The legally binding authorisation conditions should facilitate stricter enforcement but this requires a monitoring regime capable of ensuring compliance and detecting breaches. It is also important that the regulator is willing to impose sanctions, where appropriate, something which has been criticised as lacking (ENDS, 1997b). The issue of compliance with environmental legislation was highlighted recently by Friends of the Earth in their report into the pollution from ICI's Runcorn site (Peak Associates, 1998), which followed a number of high profile incidents (ENDS, 1998a). The report strongly criticized the Environment Agency for failing to control pollution from the factory and questioned whether their authorisation represented BATNEEC particularly given what they see as the lack of enforcement of the Improvement Programmes, an issue previously identified by Allot (1994). The control of pollution from industrial installations remains a key issue in the protection of the aqueous environment. Indeed, the EA's annual report summary for 1997 (EA, 1998), showed an increase in major water pollution incidents with industry identified as the largest single contributor. The report stated that ‘The increase in major incidents in the last year is a serious cause for concern and shows that we can not assume a continued reduction in pollution’.

**UK policy developments**

Policy for pollution control continues to be developed. The Ministerial Meeting of OSPAR in July 1998 agreed to ‘make every endeavour to move towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020’ (OSPAR, 1998). This echoes the agreement made at the Fourth North Sea Conference of Ministers, in 1995 (DoE, 1996). This approach has not yet been implemented but the UK government recently stated that it would develop ways of meeting its commitments under OSPAR. The Department of the Environment, Transport and the Regions (DETR) produced a consultation paper as part of a review of government chemicals policy, but there has already been criticism that little consideration has been given to the sustainable production and use of chemicals.
and too much emphasis is placed on the acceleration of risk assessments (ENDS, 1998b). In other countries, however, a more fundamental approach is already being taken. The Swedish Chemicals Policy Committee finalized a report in June 1997 which suggested eliminating hazardous substances from products and imposing controls on uses as well as releases (ENDS, 1997c). Other UK policy proposals include a range of economic instruments to control water pollution. However, the government's consultation paper on this subject revealed there was little enthusiasm for charges on point source emissions and no support for tradeable pollution permits (TPP) (ENDS, 1998c). The European Environment Agency supports the use of environmental taxes and proposes the incorporation of the precautionary principle into what it describes as a 'new paradigm' for chemicals management (EEA, 1998).

Given the levels of uncertainty regarding the implementation of pollution policy, this paper explores the factors which influence decisions concerning the authorisation of industrial discharges and examines the effectiveness of the current regulatory regime. The investigation aims to identify the areas where there is a lack of clarity in the decision-making process and explain how diverse factors, such as environmental protection, technology and economics are reconciled by regulatory bodies. Furthermore, the study aims to examine the attitudes of operators, regulators and environmental groups towards environmental regulation and show how their attitudes influence the process.

Methods and analysis

The methods used to investigate the regulatory process included structured interviews and informal discussions with industrial operators, regulators and environmental groups, supplemented by examination of official documents. A qualitative approach, involving exploratory interviews, was used to provide data for underpinning further research and analysis (Oppenheim, 1992). Two geographical areas were selected for the study; the industrialised estuaries of the Mersey in England and the Forth in Scotland, which, it was envisaged would provide a comparison of the different regulatory regimes. With respect to the qualitative research, quota selection (Miles and Huberman, 1994) was used for the key groups operating at the 'sharp end' of policy implementation, who were identified as regulators, industrial operators and environmental groups. Expert scientists from government and academic institutions were considered to be comparatively remote from the regulatory interface and were therefore not included in this study. Through discussions with EA and SEPA personnel and from information obtained from the Public Registers concerning authorisations, industrial operators with significant emissions to the aqueous environment were selected for study. Structured interviews were conducted with environmental managers from these companies, together with IPC Inspectors relevant to the area of study. In addition, industrial pollution campaigners from two prominent international environmental groups were interviewed (see Table 1). A condition of some of the interviews was anonymity should be preserved. For the sake of consistency, this condition was therefore applied to all of the subjects.

The field work was conducted during the period April to August 1998 and a total of ten structured interviews, using established methods (Oppenheim, 1992), were completed. The interviews focused on the derivation and management of the parameter limits for releases to controlled waters, including monitoring and enforcement of authorisation conditions. The duration of the interviews varied from between one to three hours. The interviews were tape-recorded and subsequently transcribed. The data obtained were processed using framework analysis (Ritchie and Spencer, 1994). The thematic considerations below draw extensively on quoted responses from the operators and regulators. These quotes are used throughout the text to illustrate the perceptions held by the two parties. The views expressed are those of a targeted group and therefore may not represent a general consensus. Indeed, the methodology was designed to identify areas of conflict and uncertainty within the existing regulatory framework rather than establish consensus.
Table 1. Details of respondents and their roles within the organisations

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Location</th>
<th>Main activity</th>
<th>Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Agency</td>
<td>NW</td>
<td>Regulator</td>
<td>IPC Inspector</td>
</tr>
<tr>
<td>Scottish Environment Protection</td>
<td>East Region</td>
<td>Regulator</td>
<td>IPC specialist</td>
</tr>
<tr>
<td>Agency 1</td>
<td>East Region</td>
<td>Regulator</td>
<td>Specialist environment protection officer</td>
</tr>
<tr>
<td>Scottish Environment Protection</td>
<td></td>
<td></td>
<td>Toxics campaigner</td>
</tr>
<tr>
<td>Agency 2</td>
<td></td>
<td></td>
<td>Industrial pollution campaigner</td>
</tr>
<tr>
<td>Environmental Group 1</td>
<td>London</td>
<td>Environmental campaigner</td>
<td>Site environment manager</td>
</tr>
<tr>
<td>Environmental Group 2</td>
<td>London</td>
<td>Environmental campaigner</td>
<td>Environment manager</td>
</tr>
<tr>
<td>Large company 1</td>
<td>Mersey</td>
<td>Chlorine manufacture (4.4)</td>
<td>Environment officer</td>
</tr>
<tr>
<td>Large company 2</td>
<td>Mersey</td>
<td>Chlorine manufacture (4.4)</td>
<td>Environment manager</td>
</tr>
<tr>
<td>Large company 3</td>
<td>Mersey</td>
<td>Petroleum refining (4.1)</td>
<td></td>
</tr>
<tr>
<td>Large company 4</td>
<td>Forth</td>
<td>Alumina production (2.2)</td>
<td>Environment manager</td>
</tr>
<tr>
<td>Small company 1</td>
<td>Forth</td>
<td>Solvent recovery (5.2)</td>
<td>Works manager</td>
</tr>
</tbody>
</table>

Process schedule references for operators are given in brackets.

Setting of authorisation conditions

It is a requirement that the regulators must consider and then reconcile the environment, technology and economics in the derivation of authorisation conditions. One of the aims of this study was to determine the relative significance of these factors in the setting of parameter limits within authorisations. However, it was clear from these interviews that another significant influence in this 'balancing act' was historical. Many of the consent conditions issued under previous legislation were simply written into the new authorisations as one operator explained: '...they didn't expect existing processes to suffer too much under this first raft of applications, because they had been controlling the existing operations for a number of years and it would be very strange to suddenly go “Stop!” in the main it was, “Start from where you are now”'.

This authorisation of the status quo was not perceived as a problem by the regulators because they believed prior controls had been effective in controlling aqueous emissions. One of the regulators expressed this view concisely: 'One would have expected the previous regulatory regime to have put controls in place which were sufficient to prevent harm. I think that COPA did that and did it well'.

When questioned about the influence of environmental protection in the derivation of parameter limits, regulators and large companies identified the importance of EQSs in the equation. The meeting of an EQS is seen as a key criterion in the approval of a discharge, and also as a useful tool. In essence, an EQS combined with some simple dispersion modelling will then make the determination of limits relatively straightforward and the regulator can assume that the discharge has been 'rendered harmless' as required by the legislation. One regulator explained: 'The use of EQSs is very helpful, you don’t have to worry about the impact; provided the concentration isn’t above that, we’re all right'.

A key part of the legislation is the requirement to use BATNEEC which attempts to reconcile the technology and economic factors. All the industrial operators questioned believed that it was up to them to define BATNEEC; according to one company representative: 'BATNEEC is very much dependent on the local situation, it’s up to you, the applicant, to say what that is, to make your case'.

The onus is therefore seen to be very much on the operator, rather than the regulator to define BATNEEC. Indeed, in one case where the operator was installing novel pollution abatement technology it was said that, if it proved successful, the EA would then promote its use. In effect, the operator was setting BATNEEC standards for the industry as a whole. The subsequent alteration of the parameter limits in the authorisation would be based on the actual performance of the equipment after a 'proving period'. In making a judgement on what constitutes BATNEEC, the area where the regulator is at the greatest disadvantage is in the assessment of the financial element. In this they depend very much on their relationship with the
operators. Both the operators and regulators are well aware of interdependency and it results in a classic negotiation scenario. The regulators explained that, in the early days of IPC, this was not necessarily a problem because unacceptable emissions were easy to identify and companies readily agreed to spend in order to provide large environmental benefits. However, according to one regulator, further improvements may be more difficult to justify: 'The position we're getting into now, is that we've done all these and now there needs to be a much more detailed and objective consideration of what does entail excessive cost... it's basically a case of me pushing until companies squeal'.

The operators and regulators expressed the view that there is no point in the regulator putting targets on industry which they just cannot meet or imposing a financial burden which could radically affect the operation. The regulators pointed out that it was not within their remit to consider the issue of jobs, nor impacts on the local economy during their decision-making. These were considered to be political matters and operators could use the appeals procedure, provided for under the legislation, if they felt they had been unfairly treated.

Part of the aim of the Environmental Protection Act was to facilitate wider involvement of the public and interested parties in pollution regulation, something which is addressed by the requirement to seek responses during the application period. Operators and regulators observed that there appeared to have been little significant input, which had no effect on the final authorisation. The regulators and the operators attributed this mainly to the lack of technical or reasoned objection by the public and one Inspector suggested: '...if the public were well educated they could make our lives very difficult'.

The responses from the statutory consultees, such as MAFF and English Nature, were also seen by the regulators to have little influence on the authorisation conditions, but, according to one regulator, for different reasons: 'MAFF... have a small team working on IPC applications and a lot of their responses were fairly generic, saying if the company complied with Guidance Notes relevant for the particular process then they wouldn't have any objections'. There is no requirement to seek similar consultation during the statutory review process which one regulator thought was a possible weakness in the legislation.

In addition to the factors that influence parameter limits within an authorisation, new policy initiatives are seen by both operators and regulators to have had a direct effect on authorised discharge limits. The link between the policy making fora of the North Sea Conference (NSC) and PARCOM and the imposition of tighter discharge controls was identified, in this case by an operator: 'The NSC did come into it with the 50% mass emission reduction by 1995 compared with the base of 1985. That was part of the original consents... That really started to drive things'.

**Enforcement of authorisation conditions**

There are two main issues regarding enforcement: (1) The regulatory assessment of compliance with legally binding conditions and (2) the subsequent response of the regulator to cases of non-compliance. Compliance with authorisation conditions is essential if the system is to work effectively. This is another area where the regulators operate under guidance and the decision to take any action is subject to the Inspector's professional judgement, although within SEPA this involves a wider discussion with a licencing team. The introduction of the IPC legislation created immediate problems of non-compliance for one operator: 'The NRA's method... was to set limits which they expected you to meet 95% of the time. Legislation changed overnight; the agency took those limits and wrote them into our authorisation. We now have to meet those limits 100% of the time'.

This change resulted in a sudden and dramatic increase in the number of reported non-compliances by this operator. Regulators and operators generally expressed the view that a small exceedence of the authorisation parameter limits should not and does not warrant sanctions and that the environmental impact of any non-compliance must be taken into account, as this example, given by one of the operators, illustrates: 'Say we have a pH limit of 5–10; does it really affect
the environment if we are, for 10 minutes, 10.6? Most of the regulatory non-compliances are, say, like doing 32 mph in a 30 mph zone. Occasionally you're going to get a 70 mph in a 30 mph zone and that's when we're prosecuted'.

Both the operators and the regulators perceive these breaches of consent limits as 'trivial' and as one regulator explained: 'The majority of breaches have no effect—they are not set at a level where if you go over them, you're suddenly going to cause harm'.

In the case of a highly visible incident, which has an instantaneous and definitive impact, such as a fish kill, the regulators believe that they have no choice but to take enforcement action. The type of sanctions that are exercised can include prosecution with consequent fines. The decision to prosecute an operator is taken as a last resort and very rarely happens as a result of a simple exceedence of authorisation limits, as one operator confirmed: 'Generally we would not expect to be prosecuted for what we regard as a minor offence, i.e. a breach in water quality or air emission standards as compared to what's set in the authorisation'.

There are legal aspects to the sampling and sample evidence which complicate the issue and have to be taken into account by the regulator when deciding on appropriate enforcement action. Summing up the difficulty, one regulator explained: 'The use of consent numbers sounds great, but they're open to all sorts of legal argument'.

**Monitoring**

Monitoring serves both to police authorisation conditions, and assess environmental impacts. It was accepted by all parties that, due to practical and resource limitations, it was impossible to monitor everything all of the time and therefore an unauthorised emission may go undetected. This was recognised by the regulators, one of whom admitted: 'If someone does spill a 45 gallon oil drum down the drain, the chances are that no monitoring programme will ever pick that up'.

The operators are obliged to carry out much of their own monitoring under the terms of their authorisations. The large companies welcomed this self-monitoring and viewed it as a very stringent activity. They believed they have proved themselves to be responsible in performing this function. The regulators shared this view and regarded the resultant data as being of 'high quality', although they were concerned about the reassurance of the public when the polluters were seen to carry out all their own monitoring. The smaller company generally felt more comfortable being policed by the regulator rather than conducting their own monitoring, although this may be, at least in part, a resource issue.

Operators and regulators explained that monitoring schemes had been modified in the light of continued experience as data had built up to show that, for example, a particular discharge point was 'not a problem'. Operators did carry out additional monitoring, that was not required by the regulators, in order to build their own data base. One operator explained: 'We want to know more than the Agency knows, so if anything comes up, we are able to answer'. In this way, the operator's own monitoring could provide an additional defence against possible enforcement action.

The regulators also carried out environmental monitoring which has, on a number of occasions, been successful in identifying previously unforeseen problems. One regulator described such a case involving the detection of methyl lindane in the Mersey, which was traced back to a particular operator with the result that the authorisation was changed. This was used by the regulator as an example where monitoring information had been successfully used to tighten up and improve authorisation conditions. With respect to toxicity testing and biomonitoring, there was a general consensus that, although this seemed to be a more logical method of identifying environmental problems, a lot of work needed to be done to derive tests that were both relevant to the environment and sufficiently scientifically robust. As one regulator explained: 'There may be a role for ecotox testing, but this needs to be carefully worked out. It could be included in future authorisations, but it would have to be carefully targeted'.

The discovery of hitherto unforeseen biological effects of discharged chemicals was viewed by operators and regulators as an issue which would eventually affect authorisation parameter limits. One operator
identified the regulation of endocrine disruptors and the introduction of direct toxicity consents as the two main pollution management issues currently facing industry: ‘...from an industry point of view, the two big issues for ourselves would be direct toxicity testing...the endocrine disruptors issue’.

**Structural**

The regulatory agencies both felt there had been some positive benefits in creating the integrated structures within which they now work. In SEPA, the multi-functional licensing teams were seen as being responsible for improving licences and harmonising authorisation conditions across Scotland. SEPA have used cross-disciplinary teams to tackle specific issues and they saw this as the way forward. In contrast, the operators thought there were significant organisational deficiencies within the agencies, as exemplified by one operator who said of the lack of perceived integration within the EA: ‘I'm still dealing with three groups of people who come together at a much too high a level’.

The lack of resources has also been highlighted as an impediment to efficient regulation and this was recognised by the operators, one of whom was doubtful about SEPAs ability to cope with the volume of work: ‘I think the resources are tight and they are short on the ground. They're probably getting a mountain of information; whether they can collate that efficiently, I don't know’.

A more fundamental question was raised by a regulator who advised that integration of the agency's functions necessitated a rationalisation and consolidation of the legislation which currently requires that different parts of the organisation work differently: ‘We're strapped by the law because we still have COPA and we still have Part I of the Environmental Protection Act 1990 and Part II and we still have the Radioactive Substances Act and these themselves are not integrated’.

With much of the regulatory practice deferred to the judgement of the individual Inspectors, the relationship between the Inspector and the operator is a key element in the process. The operators viewed the regulator's approach as being ‘very pragmatic' and valued their close working relationship, although they recognised this was criticised by the environmental groups as being too 'cosy'. One regulator said: ‘There have been the old chestnuts about the liaison with industry being too close. I don’t believe that’s the case because a lot of improvements have resulted from that close working, from the advice and cooperation of the close working relationship’.

The operators felt there were significant benefits with the development of a long-term working relationship with an individual Inspector and expressed concern at the possibility of their particular Inspector being replaced, through retirement or promotion, for example. All respondents felt that, to some degree, the scope for interpretation of the non-statutory guidance by the regulators generally resulted in some inconsistencies in the application of the legislation across the UK. There appeared to be a lack of reciprocal knowledge between SEPA and the EA concerning their respective approaches to IPC enforcement.

**Environmental groups**

Whilst the regulators and operators shared a common approach to the pollution management regime, the environmental groups represented an alternative view. Environmental protection is based on a system of risk assessment, as exemplified by the EQS approach, which the environmental groups saw as being flawed. They rejected the idea of assimilative capacity on which the current pollution licensing system is based: 'The whole infrastructure is set up around pipes, air emissions and waste dumps...they've always got their eyes on the end of the pipe and not what's causing the discharge'.

One group pointed to the paucity of information concerning industrial chemicals but which is required under a risk assessment scheme: 'The vast majority of chemicals have no toxicological or environmental fate data...'. As this data is a prerequisite for deriving an EQS comparatively few substances have an EQS defined. The growing issue of endocrine disruptors was seen by the environmental groups as a prime example of the problems associated with the lack of such data.

In the application of BATNEEC, industry was seen by the environmental groups as claiming that everything was too expensive,
driven by an interest in making money out of its older plants, with the regulator at a distinct disadvantage in what they saw as a secretive process. Indeed, they did not believe BAT to be environmentally sound as it failed to explore alternative substitution technologies.

The environmental groups interviewed said there was insufficient environmental monitoring and one group suspected that the regulators were worried about discovering new problems: 'Because so many environmental contaminants have been found by chance...it would be sensible to go out and say, “what’s there?” both in the environment and in food...but there is a real unwillingness to find problems'.

The regulators carry out their own monitoring programme, which was regarded by the environmental groups as predictable, and given their belief that the operators can control when they emit pollutants, one group suggested that: 'The company will know when they are coming and turn things down'.

The environmental groups raised concerns about the level of trust placed on industry by the regulator and were convinced that the relationship between the two was cosy. They particularly criticised the EA for being secretive on issues such as freemasons and access to Board meeting documents. SEPA was seen as more open, independent of government and more willing to make a fuss.

**Discussion**

The protection and enhancement of the environment is one of the key duties of the regulators. The environmental considerations in the pollution management process should therefore be at the heart of the authorisation. Indeed, there is a statutory duty to render harmless any discharge. Although there is great difficulty in defining harm, the system of EQSs is used as a basis for setting parameter limits for listed substances. This study has shown that operators and regulators firmly believed that meeting all defined EQSs would ensure that no environmental harm was caused. In addition, there appeared to be a consensus amongst the regulators and operators that COPA, together with the NSC reduction in PAkCGM pollutants, had effectively addressed the question of aqueous discharges prior to the introduction of IPC.

The environmental groups did not really address the same topics. Their concerns reflected the more fundamental environmental issues and they viewed the current pollution control system as having a narrow, bureaucratic focus. They criticised the current regime based on risk assessment and advocated the implementation of the precautionary principle. They highlighted the lack of toxicological and/or environmental fate data on a large number of chemicals, which are therefore included neither in the authorisation nor in the subsequent monitoring programme. The DETR are, at present, addressing some of the environmental groups’ concerns regarding current chemicals control policy by proposing a UK chemicals strategy. However, there is some concern that the Department of Trade and Industry have 'succeeded in turning the fairly forward-looking draft into a more timid consultation paper' (ENDS, 1997d).

Under the current risk assessment system, the listing of more substances as hazardous could improve environmental protection, but an expanded list would present obligations to the regulator which, given finite resource levels, it may not be able to meet. New research highlights an ever increasing number of organic chemicals, not regulated under the existing regime, that are cause for concern. Recent findings, for example, suggest that industrial chemicals may be the most significant environmental oestrogens in estuarine and coastal areas (ENDS, 1998d) and this was identified by the industrial operators and environmental groups as being one of the key future issues. This, according to the environmental groups, highlights the inadequacies of the current reliance on the use of lists. This view is shared by Johnston et al. (1991) who argued that the use of lists in themselves is unlikely to resolve aquatic environmental problems because the analytical difficulties inherent in identifying the components of complex industrial effluents creates serious problems with determination, control and enforcement.

The respondents indicated that the use of direct toxicity testing of complex effluents as a regulatory tool could be more meaningful than chemical analysis but they considered it fraught with difficulties. In particular,
they highlighted the inability of the current methodology to extrapolate the results of single species tests into reliably predictable ecosystem effects. This difficulty is also recognised by Elliot (1996) and Chapman (1997) but they, nevertheless, recommended the introduction of Ecological Quality Standards and Objectives into environmental management. The principle has been used with some measure of success by the United States Environmental Protection Agency (USEPA) (Fisher et al., 1998). There has also been some success in the application of Quantitative Structure Activity Relationship (QSAR) models in predicting joint toxicity of mixtures of organic chemicals to some microorganisms (Xu and Nirmalakhandan, 1998). In a recent study of estuarine and coastal water quality, Kirby et al. (1998) were unable to identify the cause of the majority of the toxic response of marine copepods to non-polar organic contaminants. They suggested there may be chronic biological effects that were not demonstrated by conventional bioassay-based monitoring. Goldberg (1998) proposed that more population studies, especially in areas where there are high inputs of industrial waste, should be carried out and this view was shared by the environmental groups. Furthermore, Goldberg argued that there were too many investigations on what appear to be benign contaminants, such as heavy metals and low molecular weight organic compounds simply because they are inexpensive and relatively easy assays.

The historical contamination of sediments in the proximity of industrial discharges is a potential source of future contamination of the water column. However, the issue of contaminated sediments has not yet been addressed by the regulators and was not raised by the respondents, but this could have a significant ecotoxicological impact in rivers and estuaries (Lang et al., 1998). Much work would be required before this could be incorporated into the regulatory regime. The USEPA has recently acknowledged that current scientific understanding does not support the setting of enforceable numerical standards for sediment quality (Renner, 1998).

During the period of application for an authorisation, the public and environmental groups have the opportunity to express their concerns regarding the impacts of the industrial operation on the environment. This consultation was viewed by the operators and regulators to have little influence on the final authorisation and they believed this was due to the public’s lack of scientific and technical understanding. The environmental groups believed the highly technical nature of the pollution control system, reflected in the contents of authorisations, was responsible for the low public response during the consultation process. Taylor (1997) highlighted this during a study of the chemical industry at Avonmouth and was critical of the information held in the public registers: ‘...all of the documents are highly technical and use jargon that would probably be unfathomable to anyone without experience of industrial processing or pollution matters’. She concluded that public registers alone are not providing the avenue for public involvement in pollution control. The lack of significant responses from the statutory consultees during the application process may be the result of lack of time or concern and this could be investigated more thoroughly to determine how well they are fulfilling their statutory duties. Despite the apparent lack of responses during the initial application, the lack of any requirement to seek consultation during the review process should be reviewed as this could strengthen public involvement.

Whilst both the regulators and the operators interviewed did not believe that the environmental groups have a significant influence on the regulation of industrial pollution, they agree that they have undoubtedly influenced policy-making. Operators and regulators recognized there was a link between policy initiatives, such as those following the NSC, and the derivation of parameter limits within their consents and authorisations. The most recent OSPAR Ministerial Meeting in July 1998 agreed a cessation of discharges of hazardous substances by the year 2020 (OSPAR, 1998). The list of priority substances has been expanded and OSPAR is to develop a mechanism for selection of others. Those respondents interviewed after the OSPAR meeting had not yet identified any detailed implications of this decision although it could result in a radical shift in policy.

In some cases parameter limits are technology-driven, rather than environmentally-led, as in the case of an operator installing
novel abatement equipment and the subsequent adjustment of limits to its proven capabilities. In this way the operator’s technology can therefore define BAT (or BATNEEC), not only for that site but for the industry sector or sectors as a whole. In some cases operators agree to install equipment which exceeds the current required performance standards. This is an area where further investigation should be carried out to determine how operators and regulators make these decisions. Such voluntary agreements can have a positive impact on environmental quality, but the widespread use of other voluntary agreements may be less beneficial (Segerson and Miceli, 1998). The regulators are not experts in all the process technologies they regulate and operators did not expect them to be. This is an area, therefore, where the operators are likely to possess superior knowledge. The concept of BAT was seen by the environmental groups as environmentally unsound. They did not believe that BAT can exist for what they considered inherently unsustainable industries, such as chlorine manufacturing. They also claimed that BAT precludes the consideration of product substitution leading to alternatives, such as cleaner technologies.

Developments in technology can also drive other parts of the regulatory process, such as the monitoring scheme. As improvements in detection limits are made and practical techniques are developed these can influence the authorisation limits through an iterative process.

One of the major factors to be taken into account in this technological development is economics. The use of BATNEEC arguments by the operators to justify their investments involves particularly difficult judgements by the regulators concerning their affordability, whilst at the same time balancing those costs against the perceived environmental benefit. This is an area where the regulators valued their ‘close working relationship’ with the operators and depended on them to provide accurate financial information. The lack of direct access to financial information was not seen as a problem by regulators, but the environmental groups believed this was an example of the power imbalance between the two. This confirms the view of the operator ‘holding the cards’ in the operator-regulator relationship (Smith, 1997). The regulators recognised that obvious improvements have been made since the introduction of IPC and that, if further improvements are to be made, then they will need more sophisticated information or guidance on what constitutes ‘excessive cost’. New draft guidance on the standards expected of organic chemicals processes have been issued by the EA but have already been widely criticised as offering little advance on the original guidance (ENDS, 1998e). A recent environmental-economic modelling exercise in the Forth Estuary, has attempted to address the issue of cost-benefit (Hanley et al., 1998). They looked at cost-effective ways of reducing Biological Oxygen Demand (BOD) loadings and found that a TFP scheme could control inputs more cheaply than the current regulatory regime.

The attitudes to compliance varied between the groups. Regulators and operators agreed that where the parameter limits are breached, this does not necessarily cause harm. Indeed they viewed a breach of parameter limits as a ‘minor offence’ similar to trivial speeding motoring offences, indicating a breakdown of the consensus regarding the application of the law. By contrast, the environmental groups argued that there was no point in having a limit, if it was constantly broken. Economic sanctions for breaches of authorization conditions were perceived as rare and the scale of the fines imposed were often viewed, by all parties, as being too low to be a deterrent, although this has recently been changing (ENDS, 1998a). In SEPA’s case, the lack of a mechanism to recover costs and the high proportion of cases rejected by the procurators-fiscal, are seen as further impediments to successful legal action (ENDS, 1997e).

Economic considerations also affect the resources available for the regulator to carry out its duties, including monitoring and inspections. Limited resources, recognised by all those interviewed, result in selective monitoring and therefore there is a risk that an unauthorised release will go undetected. The self-monitoring carried out by the operators is viewed by the operators as being a stringent activity and all but the small company would welcome an expansion of the self-regulation, a finding similar to that of Mehta and Hawkins (1998). Whilst the regulators considered the operator’s monitoring
data to be of high quality they also recognised that breaches could go undetected. This highlights an interesting ambiguity and does not help to allay scepticism about industry policing itself. A number of the operators carried out more monitoring than was required under their authorisation, not out of concern for the environment, nor in order to police their own discharges, but as a means of accumulating data which could be used as a defence against any proposed sanctioning by the regulator. This is a further example of the use of knowledge in the power relationship between the regulator and the operator. All respondents believed that the regulators should carry out some monitoring and recognise that this is a key role of the regulator. It has been shown by Nadeau (1997) that the monitoring and enforcement activity of a regulator has a direct and measurable effect in reducing the time that manufacturing plants spend in a state of non-compliance.

The organisational problems within the regulatory bodies were recognized by all respondents to create difficulties. For example, the operators did not perceive the regulator as the 'one-stop shop' (as opposed to the previous multi-agency approach), that was originally envisaged by the government when the Environment Agency was conceived. This is partly due to the problems involved in bringing together a large number of people from diverse backgrounds and partly because the regulators have to work with current legislation that is not itself integrated. This could change as the new Directive on Integrated Pollution Prevention and Control (EC, 1996) is likely to result in a more holistic site-based approach, as opposed to the current process-orientated scheme (ENDS, 1997f).

The DETR has recognised that there are structural problems and has recently issued a consultation paper reviewing the legislation relating to the EA and SEPA and aiming to identify any barriers preventing the Agencies from taking an integrated approach to the environment (DETR, 1998). The DETR has recognised that there are structural problems and has recently issued a consultation paper reviewing the legislation relating to the EA and SEPA and aiming to identify any barriers preventing the Agencies from taking an integrated approach to the environment (DETR, 1998). The DETR has recognised that there are structural problems and has recently issued a consultation paper reviewing the legislation relating to the EA and SEPA and aiming to identify any barriers preventing the Agencies from taking an integrated approach to the environment (DETR, 1998). The DETR has recognised that there are structural problems and has recently issued a consultation paper reviewing the legislation relating to the EA and SEPA and aiming to identify any barriers preventing the Agencies from taking an integrated approach to the environment (DETR, 1998). The DETR has recognised that there are structural problems and has recently issued a consultation paper reviewing the legislation relating to the EA and SEPA and aiming to identify any barriers preventing the Agencies from taking an integrated approach to the environment (DETR, 1998). The DETR has recognised that there are structural problems and has recently issued a consultation paper reviewing the legislation relating to the EA and SEPA and aiming to identify any barriers preventing the Agencies from taking an integrated approach to the environment (DETR, 1998).

Conclusion

The implementation of industrial pollution policy is, in practice, deferred to the individual IPC Inspectors who make their decisions taking into account such factors as environment, technology and economics, using extensive guidance. This study found the regulators and operators to share similar perceptions and interpretations of the pollution management process and confirms the 'informal persuasion' model of implementation identified by Brickman et al. (1985).

Environmental, technical and economic information is used in the regulation process, especially in the negotiation of BATNEEC. The study identified a perceived imbalance between the operators and regulators, with the operators having superior information and expertise, particularly in financial and technical areas. In some cases, the operators also possessed more comprehensive local environmental information, as a result of their own monitoring. This places the regulators at a significant disadvantage in the negotiation process and underlines their reliance on the operators to provide the relevant information. In the case of BATNEEC determinations, as further improvements are sought, there will be a particular need for more regulatory financial expertise and this issue should be addressed urgently. There should be a requirement for all the operator monitoring data to be available to the regulators and the public. The issue of information is also pertinent to the wider participation of the public and non-statutory bodies in the pollution regulation process. Effective participation is currently inhibited by the highly technical nature of the information available. Information should be made more accessible to these non-specialist groups by simplifying and removing jargon. This is the responsibility of the regulators.

The established system of EQSs and parameter limits within authorisations has, in most cases, successfully delivered the reduction in the PARCOM listed substances as required by the NSC. The system is viewed by the regulators and operators as effectively safeguarding the environment but there is little concern about the effects of substances which do not have an EQS. The emphasis is on the management of a bureaucratic
system, based on risk assessment, and not on the protection of the aqueous environment in the wider sense. One solution would be to expand the number of substances subject to an EQS. However as more becomes known about the possible biological effects of a growing number of industrial chemicals, the expanding requirement to control and monitor their releases and assess their environmental impact may create a huge burden on the available resources. The system could become unfeasible, from both the practical and cost point of view. Under the current regime, more local environmental monitoring should be carried out by the regulators in order to ensure better environmental protection. This should include, not only the assessment of water quality, but also sediment quality, together with ecological surveys and standards, should be developed for all these components. Given the limited resources and ever tightening budgets of the regulatory bodies, this would require operators to carry out more of the compliance monitoring themselves. Such an extension of self-regulation would need to be carefully managed using a robust audit system, together with a more strict enforcement regime than currently appears to be operating. The introduction of IPPC, with its site-based approach could provide operators with more flexibility to manage their own installations. However, this should be conditional on using tighter limits, set to achieve better environmental protection and coupled with stricter enforcement, as argued by Smith (1997, 223).

In the longer-term, the latest OSPAR agreement is likely have a major impact on the industrial operators and the regulators. It represents a shift to the more precautionary approach advocated by the environmental groups, away from risk assessment. The belief of operators, in particular, that the issue of aqueous discharges has effectively been dealt with will be challenged by this new initiative. In order to implement the new policy, it may require further legislation and the opportunity should be taken to fully integrate the relevant Acts, which comprise the current fragmented approach. The regulatory bodies will need to identify industries that are inherently unsustainable and manage the introduction of substitution products and technologies. The question will not be whether to make the necessary reductions in emissions using BATNEEC arguments, but how these reductions should be achieved. There will also be a requirement to define 'background' levels of contaminants and this must involve an assessment of sediment quality. New expertise will therefore be required, together with a more environmentally-led, less bureaucratic approach.

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