Environmental impact assessment for coal
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Tim Jones
IEA Coal Research

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Abstract

This report examines the process of environmental impact assessment (EIA) of coal-related projects from an international perspective. Current legislation in selected coal user and producer countries is reviewed, and the requirements for EIA of coal-related projects is determined. Key procedures in EIA are described and experience with EIA on coal-related projects is assessed. Potential effects of EIA requirements, such as costs, delays, modifications and benefits are examined and in conclusion the report suggests improvements to environmental impact assessment for coal. The EIA process up to the point of submission of the final environmental statement is studied. The report does not examine the other components of a planning application and it does not attempt to analyse the decision-making process or other matters such as a public inquiry.
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<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ABK</td>
<td>Algemene Beraadsgroep Koelwater (Dutch cooling water guidelines)</td>
</tr>
<tr>
<td>ACOE</td>
<td>Army Corps of Engineers (USA)</td>
</tr>
<tr>
<td>AONB</td>
<td>area of outstanding natural beauty (UK)</td>
</tr>
<tr>
<td>CCTDP</td>
<td>Clean Coal Technology Demonstration Program (USA)</td>
</tr>
<tr>
<td>CEC</td>
<td>Commission of the European Communities</td>
</tr>
<tr>
<td>CEGB</td>
<td>Central Electricity Generating Board (UK)</td>
</tr>
<tr>
<td>CEIA</td>
<td>Commission for Environmental Impact Assessment (The Netherlands)</td>
</tr>
<tr>
<td>CEQ</td>
<td>Council on Environmental Quality, Executive Office of the President (USA)</td>
</tr>
<tr>
<td>CFBC</td>
<td>circulating fluidised bed combustion</td>
</tr>
<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>DASETTE</td>
<td>Department of the Arts, Sport, the Environment, Tourism and Territories (Australia)</td>
</tr>
<tr>
<td>DEC</td>
<td>Department of Environmental Conservation (USA)</td>
</tr>
<tr>
<td>DEIS</td>
<td>draft environmental impact statement(s)</td>
</tr>
<tr>
<td>DF&amp;G</td>
<td>Department of Fish and Game (USA)</td>
</tr>
<tr>
<td>DNR</td>
<td>Department of Natural Resources (USA)</td>
</tr>
<tr>
<td>DoE</td>
<td>Department of the Environment</td>
</tr>
<tr>
<td>EA</td>
<td>Environmental assessment(s)</td>
</tr>
<tr>
<td>EC</td>
<td>European Community</td>
</tr>
<tr>
<td>EEC</td>
<td>European Economic Community</td>
</tr>
<tr>
<td>EES</td>
<td>environmental effects statement(s) (Victoria, Australia)</td>
</tr>
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<td>EIA</td>
<td>environmental impact assessment(s)</td>
</tr>
<tr>
<td>EID</td>
<td>environmental information document (USA)</td>
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<tr>
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<td>environmental impact statement(s)</td>
</tr>
<tr>
<td>EPA</td>
<td>Environment Protection Authority (Western Australia)</td>
</tr>
<tr>
<td>EPDCC</td>
<td>Electric Power Development Co-ordination Council (Japan)</td>
</tr>
<tr>
<td>ES</td>
<td>environmental statement(s)</td>
</tr>
<tr>
<td>ESP</td>
<td>electrostatic precipitator(s)</td>
</tr>
<tr>
<td>EZ</td>
<td>enterprise zone(s)</td>
</tr>
<tr>
<td>FEIS</td>
<td>final environmental impact statement(s)</td>
</tr>
<tr>
<td>FGD</td>
<td>flue gas desulphurisation</td>
</tr>
<tr>
<td>FONSI</td>
<td>finding of no significant impact (USA)</td>
</tr>
<tr>
<td>HMIP</td>
<td>Her Majesty's Inspectorate of Pollution (UK)</td>
</tr>
<tr>
<td>HMSG</td>
<td>Her Majesty's Stationery Office</td>
</tr>
<tr>
<td>IGCC</td>
<td>integrated gasification combined cycle</td>
</tr>
<tr>
<td>KEMA</td>
<td>NV Tot Keuring van Elektrotechnische Materialen (Dutch electric power research organisation)</td>
</tr>
<tr>
<td>LPA</td>
<td>local planning authority (UK)</td>
</tr>
<tr>
<td>MITI</td>
<td>Ministry of International Trade and Industry (Japan)</td>
</tr>
<tr>
<td>MWe</td>
<td>megawatt (electrical)</td>
</tr>
<tr>
<td>MWt</td>
<td>megawatt (thermal)</td>
</tr>
</tbody>
</table>
NEPA National Environmental Policy Act (USA)
NMFS National Marine Fisheries Service (USA)
NNR National Nature Reserve (UK)
NOI notice(s) of intention
NCC Nottinghamshire County Council (UK)
NOx nitrogen oxides
NPDES national pollutant discharge elimination system (USA)
NSW New South Wales
OMB Governor’s Office of Management and Budget
PEIS Programmatic environmental impact statement
PER public environment report(s) (Australia)
PSD prevention of significant deterioration (USA)
SEP Samenwerkende Electriciteits Produktiebedrijven (Dutch electricity generating board)
SHPO State Historic Preservation Office
SO2 sulphur dioxide
SPZ simplified planning zone(s) (UK)
SSSI Site of Special Scientific Interest (UK)
US DOE United States Department of Energy
US EPA United States Environmental Protection Agency
USFWS United States Fish and Wildlife Service

**Exchange rates** (Financial Times, 21 February 1992)

<table>
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<th></th>
<th>$</th>
<th>A$</th>
<th>NFL</th>
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</thead>
<tbody>
<tr>
<td>£1</td>
<td>1.747</td>
<td>2.321</td>
<td>3.245</td>
</tr>
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</table>
1 Introduction

Concern over the impact of human activity on the environment has been growing in recent years. In an attempt to regulate these effects, a number of countries have implemented legislation that requires proponents of certain new projects to assess the likely environmental impact of their activity. The information, submitted in the form of an environmental statement (ES), is considered during the permit decision-making process along with the other components of a planning application. The objective of environmental impact assessment (EIA) is to identify potential impacts on the environment in order to assess the consequences of a project proposal being permitted, or not. It should enable the best environmental option to be determined, necessary mitigating measures to be taken, or a proposal to be deemed unreasonable on environmental grounds. Requirements for EIA may be extended to policies, plans and programmes, as has been the case in the USA.

The terminology of environmental impact assessment varies from country to country. For example, the process is generally known as environmental impact assessment or environmental assessment (EA); these terms may, however, lead to some confusion, notably in the USA where an EA is a less elaborate process than the more comprehensive EIA, which results in an environmental impact statement (EIS).

Environmental considerations have long been a part of the planning process in many countries but the need for a formalised approach to the subject has given rise to new legislation specifying those projects requiring EIA, together with the information required. This ‘levelling of the table’ through national legislation is seen as a positive step towards sustainable development. Those industries operating on a global scale, however, are subject to a variety of EIA requirements specific to each country of operation. The possibility of further complications exists where differences occur between national, regional, and local requirements. This may be particularly relevant to larger countries such as the USA, and to Member States of the European Community (EC).

The coal industry operates on a global scale and is therefore subject to a variety of EIA requirements. This report attempts to determine a successful and efficient approach to EIA for coal-related projects by reviewing present practices. This may serve as a basis for member countries, if interested, to consider modifications of their own EIA procedures. An international perspective was necessary for the study and a selection of coal user and/or producer countries was chosen:

- Australia;
- Japan;
- Germany;
- The Netherlands;
- United Kingdom;
- Sweden;
- USA.

Each of these countries is a member of IEA Coal Research and each has a requirement for EIA. Although limited to seven countries, the scope of this study has included representatives from North America, Europe, Asia and Australasia. A broader analysis involving other countries is beyond the scope of this study. The report highlights good procedure and those aspects of EIA requiring further attention in order to benefit coal producers and users without causing adverse environmental consequences.

The USA is a major coal producer and user where assessments of major projects having a potentially significant impact on the environment, and involving a federal action, are made under the National Environmental Policy Act (NEPA) which came into force in 1970. Considerable experience of EIA will have been gained over the past twenty years or so in that country.

As Member States of the EC, Germany, The Netherlands,
and the United Kingdom, were each required to implement Directive 85/337/EEC, which deals with EIA, by July 1988. The extent to which this has been achieved will indicate the level of progress in introducing a uniform set of rules on an international scale. Sweden has long been associated with strict environmental standards and it is an example of a European country which is not subject to EC environmental legislation.

In another region of the world, Japan is a major coal user also having strict environmental standards to deal with its own specific environmental problems associated with a high population density and a large energy demand. To complete the global picture of the way in which EIA for coal has progressed in developed societies, this study includes one of the world’s major coal exporters, Australia, where in contrast to its Pacific Rim neighbour Japan, a low population density occurs coupled with a rich environmental heritage across the continent.

The EIA process up to the point of submission of the final environmental statement is studied. The report does not examine the other components of a planning application and it does not attempt to analyse the decision-making process or other matters such as a public inquiry.

This report begins by reviewing EIA legislation in the countries selected and determines the relevance to coal, thus identifying coal-related projects which are subject to EIA. Chapter 3 determines the requirements for EIA in each country and ends with a summary covering important points such as degree of detail, and whether a project proponent can be reasonably expected to meet the requirements. Procedures in EIA are expected to vary and this report attempts to identify strengths and weaknesses from country to country in Chapter 4, which includes a discussion of the more effective and efficient procedures.

Chapter 5 looks at the experience gained with EIA through chosen case studies of recent coal-related projects. A description of the project and the existing environment is presented, and the approach to the assessment is examined in addition to the assessment itself. The presentation of the environmental statement is an important matter which is described in each case. Permit decisions may be positive or negative, or, in the case of a programmatic EIA, not possible until project EIA are subsequently carried out.

The potential effects of EIA requirements are discussed in Chapter 6 with particular reference to costs, delays, modifications and benefits, and in conclusion the report summarises the findings of this study with suggestions for improvements to EIA for coal.
2 Environmental legislation in selected countries

Legislation for environmental impact assessment (EIA) in selected coal user and/or producer countries is reviewed in this chapter. The appropriate laws in each country are given and the relevance to coal is discussed. A summary of EIA legislation is shown in Table 1.

Table 1 National legislation for EIA in selected countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Law</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Environmental Protection (Impact of Proposals) Act 1974</td>
</tr>
<tr>
<td>Japan</td>
<td>Pollution Control Standard Law 1967</td>
</tr>
<tr>
<td>Germany</td>
<td>Federal Environmental Impact Assessment Act 1990</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>Environmental Protection (General Provisions) Act 1986</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Town and Country Planning (Assessment of Environmental Effects) Regulations 1988</td>
</tr>
<tr>
<td></td>
<td>Environmental Assessment (Scotland) Regulations 1988</td>
</tr>
<tr>
<td>Sweden</td>
<td>Environmental Protection Act 1969</td>
</tr>
<tr>
<td>USA</td>
<td>National Environmental Policy Act 1969</td>
</tr>
</tbody>
</table>

It should be noted that various state and local laws may also apply.

2.1 Australia

Responsibility for national legislation lies with the Commonwealth Government of Australia, as set out in the Constitution (Lootens and Kiernan, 1990). Australian constitutional arrangements vest ownership of on-shore minerals with State Governments. The States are therefore responsible for mineral resources legislation including allocation of exploration and minerals development rights, regulation of mining practices and environment and pollution control matters. The Commonwealth is responsible for overall national economic management and its powers include enforcement of environmental standards, particularly where industry is involved in international trade (Hearn, 1991a).

2.1.1 The law

Commonwealth provisions dealing with EIA are contained in the Environmental Protection (Impact of Proposals) Act 1974 and the Administrative Procedures made under that Act. Significant amendments to these came into effect on 1 June 1987. The Commonwealth Government has no direct powers under the Constitution to legislate in the environmental area and consequently the provisions have limited scope; only projects carried out by Commonwealth Government and Commonwealth public bodies or by private developers requiring Commonwealth approval, are affected (Lootens and Kiernan, 1990).

In relation to the States, coal mining proposals are assessed under relevant State legislation. Each State has legislated in a number of areas which impact on environmental consideration of new coal mining projects. The nature of the legal requirements and the environmental assessment process differs between each State and Territory (Hearn, 1991a).

In New South Wales major new coal mining proposals are subject to a Ministerial direction under Section 101 of the Environmental Planning and Assessment Act 1979, which came into operation on 1 September 1980, whereby the Minister for Planning determines the development application. Details of the Act are published in the Government Gazette. Concurrently with the development application, a new coal project requires a coal lease under the
Environmental legislation in selected countries

Coal Mining Act 1973. This lease particularly addresses coal resources utilisation and mining methods, rehabilitation and safety measures. An environmental impact statement is required before development of a new coal-using facility such as a power station, steelworks or industrial boiler, or for a significant change to an existing facility. Coal users are required to comply with the Clean Air Act 1961 and the Clean Waters Act 1970 (Hearn, 1991b).

The environmental aspects of coal mining in Queensland are regulated by the Mineral Resources Act 1989 (Hearn, 1991b).

In Victoria the Minister for Planning and Urban Growth may require an environmental effects statement under the Environmental Effects Act 1978.

In South Australia the Planning Act 1982 provides for the preparation of an environmental impact statement (EIS) from a proponent of a development or project which the Minister for Environment and Planning considers is of 'major social, economic or environmental importance'. An EIA, when given 'official recognition' by the Minister, must be taken into account by the relevant planning authority when making its decision on a planning application (Australian Environment Council, 1986).

EIA is required for new projects in the Northern Territory under the Environmental Assessment Act 1982 which provides for the assessment of the environmental effects of existing development, development proposals and for the protection of the environment (Australian Environment Council, 1986).

In Western Australia, the Environment Protection Act 1986 provides for EIA to be carried out.

The Environment Protection Act 1973 applies in Tasmania, and requires certain industries to be licensed. An EIA is carried out in the course of assessing a licence application.

2.1.2 The relevance to coal

Under the Commonwealth Environment Protection (Impact of Proposals) Act 1974, any proposal which affects the environment to a significant extent and which involves a Commonwealth decision is subject to Commonwealth environmental assessment. The grant of an export permit for the export of coal, or a coal mining development proposal requiring approval under the government’s foreign investment policy, are examples of projects subject to EIA.

2.2 Japan

Japanese government authorities have required EIA since 1972, and in 1984 formal guidelines were laid down to provide uniform rules governing large-scale projects involving the government (Nagaoka and others, 1989). A comprehensive review of environmental policy and impact assessment in Japan has been published recently (Barrett and Therivel, 1991).

2.2.1 The law

The environmental regulations in Japan are set out according to the legal system consisting of the Air Pollution Control Law 1968, Water Pollution Control Law 1970, Noise Regulation Law 1968, other individual laws and regulations established on the categories of environmental pollution based upon the Pollution Control Standard Law 1967. Part of the environmental regulations pertaining to the electric power industry are set out under the legal system of the Electric Power Industry Law 1964, regardless of the provisions in the individual environmental pollution control laws and regulations (Hirota, 1991).

Standard factors for pollution control (for example, dust and water) are specified by mine safety regulations legislated by the Government. EIA is performed by each coal mining company under these conditions and is authorised by the local government (Hirota, 1991).

2.2.2 The relevance to coal

There are no plans to develop a new coal mine in Japan at present.

The sector of most relevance to coal in Japan as far as EIA is concerned is coal-fired power station construction. Authorisation for new power station construction only occurs after the requirements of a number of laws and regulations have been met. The local government carries out an assessment of the project, with the participation of residents of the region (Hirota, 1991).

The Ministry of International Trade and Industry (MITI), the regulatory authority of the Japanese electric utility industry, defined in 1973 its policy for the EIA that would be required for the siting of a power station. On 26 June 1979, MITI’s Agency for Natural Resources and Energy produced a series of guidelines for:

- conducting EIA of power stations;
- public participation in environmental reviews;
- conducting environmental reviews;
- how to use other guidelines.

Projects which are of relevance to coal and subject to EIA include thermal power stations with a capacity of more than 150 MWe, and other types of power station (presumably smaller) with respect to which EIA is deemed expressly necessary for protecting the environment (Nagaoka and others, 1989). In those cases where both local regulations and MITI procedures apply, both are used (Barrett and Therivel, 1991). In the case of thermal power stations, where specified, local EIA ordinances require EIA for power stations of 150 MWe capacity or greater, with the exception of Hyogo local authority which requires EIA for power stations of 75 MWe capacity or greater.

Other projects of relevance to coal and subject to local EIA requirements include:

- roads;
Environmental legislation in selected countries

- railways;
- dumping sites;
- ports;
- waste treatment plants;
- activities affecting water supply.

Waste treatment plants and dumping sites may also be subject to national EIA requirements depending on size and location (Barrett and Therivel, 1991).

The following coal-related projects are not subject to EIA at present (Barrett and Therivel, 1991):

- open-cast mining;
- electricity transmission lines;
- waste storage sites.

2.3 European Economic Community


2.3.1 The relevance to coal

The Directive consists of fourteen Articles and three Annexes. Article 4 and the two Annexes referred to therein define the type of projects that are subject to assessment.

Projects listed in Annex I are subject to the full procedure unless exemption is granted (exemption is intended to apply only very occasionally and must be justified to the Commission, other Member States and the public). The list includes:

- thermal power stations;
- installations for conversion of coal at 500 t/d or more;
- integrated steel works;
- major roads;
- railways;
- port development.

Article 4(2) of the Directive refers to the assessment of Annex II projects as 'Where Member States consider their characteristics so require', thus allowing the national authorities to exercise their discretion. Annex II is a longer list with twelve categories of project, including:

- extraction of peat;
- extraction of coal and lignite by underground mining;
- extraction of coal and lignite by open-cast mining;
- surface industrial installations for the extraction of coal;
- coke ovens (dry coal distillation);
- industrial installations for the production of electricity, steam and hot water (unless included in Annex I);
- industrial installations for carrying gas, steam and hot water;
- transmission of electrical energy by overhead cables;
- surface storage of natural gas;
- underground storage of combustible gases;
- surface storage of fossil fuels;
- industrial briquetting of coal and lignite;
- iron and steelworks, including foundries, forges, drawing plants and rolling mills (unless included in Annex I);
- boilermaking;
- infrastructure projects including industrial estate development projects;
- construction of roads (projects not listed in Annex I);
- construction of harbours (projects not listed in Annex I);
- installations for the disposal of industrial waste (unless included in Annex I);
- waste-water treatment plants;
- modifications to development projects included in Annex I and projects in Annex I undertaken exclusively or mainly for the development and testing of new methods or products and not used for more than one year.

If the effects of an Annex II project are significant there is no discretion over the requirement for assessment (Tromans, 1990).

2.4 Germany

As a Member State of the EC, Germany was required to implement Directive 85/337/EEC.

2.4.1 The law

The adoption of the Directive was brought about in 1989 and 1990 through three federal acts, the most important of which is the Act to Implement the EC Directive on EIA of 12 February 1990. Provisions on EIA of mining projects are included in an amendment to the Federal Mining Act of 12 February 1990. An amended version of the federal Regional Planning Act as of 19 July 1990 contains framework rules on EIA at an early planning stage. Details of the acts may be found in the Federal Law Gazette (Bundesgesetzblatt). The Federal EIA Act came into effect on 1 August 1990 and its provisions may be extended by the Länder (Federal States). Additional EIA legislation is being developed at present (Bunge, 1990).

In order to facilitate EIA, Section 20 of the EIA Act authorises the federal government to issue administrative regulations on criteria and procedures for the identification, description and assessment of environmental impacts, principles for the scoping process, principles for the summary account and for the evaluation of environmental impacts. At present these regulations are being prepared (Bunge, 1990).

In community level the legal framework on EIA extends to some 120 towns where rules have been adopted for activities within their range of competence. The scope of these EIA provisions varies to a large extent but the fact that most of the towns and cities have included local development plans (zoning plans – Flächennutzungspläne, and building schemes – Bebauungspläne) in the range of activities for which EIA is mandatory, is of relevance to coal (Bunge, 1990).
2.4.2 The relevance to coal

The EIA Act of 12 February 1990 lists projects for which an EIA is mandatory in an annex to the Act. Forty types of project are included. Those relevant to coal are as follows:

- fossil fuel power stations;
- waste processing and disposal facilities;
- waste-water treatment plants;
- mining projects (specified in a separate regulation; Verordnung über die Umweltverträglichkeitsprüfung Bergbaulicher Vorhaben of 13 July 1990, Bundesesetzblatt I, p 1420);
- federal highways, waterways, and railways;
- dry distillation plants for hard coal and lignite (>500 t/d);
- installations for coal gasification or liquefaction (>500 t/d).

A statutory ordinance (Rechtsverordnung) has yet to be passed, however, for those projects listed in the Annex to the Appendix to Section 3 of the EIA Act, which includes power stations. Until such a statutory ordinance is passed no EIA according to the EIA Act has to be prepared for such projects (Wagner, 1991).

For mining projects the Federal Mining Act contains special EIA rules, and the EIA Act states expressly that its sections on EIA content and procedure do not apply in this case. The matter of EIA is addressed in the Federal Mining Act and the regulation mentioned in the list above (Bunge, 1990).

2.5 The Netherlands

As a Member State of the EC, The Netherlands was required to implement Directive 85/337/EEC.

2.5.1 The law

The EIA legislation in The Netherlands is incorporated in the Environmental Protection (General Provisions) Act of 23 April 1986 which requires the EIA procedure to be fully incorporated in the decision-making process, The EIA Decree of 20 May 1987 containing the implementation of the Environmental Protection (General Provisions) Act came into force in September 1987 as a General Administrative Order further detailing the section on EIA in the Act (Scholten, 1990).

2.5.2 The relevance to coal

The General Administrative Order Environmental Impact Assessment provides a list of activities and decisions with respect to which the making of an EIS is obligatory. Of relevance to coal are the following:

- construction of roads and railways;
- construction of or modifications to a navigable waterway;
- construction of a port for civil use;
- construction of a main transmission pipeline for carrying water;
- land development;
- construction of housing;
- construction of a dike;
- construction of a dam;
- construction of a storm-surge barrier;
- land reclamation, drainage or impoldering (over 200 ha);
- changing the level of water in certain bodies of water;
- expansion of the infrastructure for the drinking and industrial process water supply;
- construction of a water reservoir;
- production of coal and lignite;
- steelworks;
- erection of an installation for disposal of wastes on or in the soil, and for treating, processing and destruction of wastes with the exception of the processing of rubble;
- erection of an installation for the production of coke from coal;
- the application of fuels, fissile materials or of wind energy in existing or envisaged electric power stations and other installations for generating electricity;
- erection of an electric power station, other than a nuclear power station (where capacity is greater than 300 MWe);
- conversion of an electric power station (where capacity is greater than 300 MWe and aim is to achieve underfiring with coal);
- construction of an underground facility for storage of water or steam on behalf of electricity supply (greater than 1 million cubic metres);
- construction of a high voltage transmission line (with a voltage of 220 kV or more and planned with a length of 1 km, in either a large landscape unit, or in a protected nature reserve, a national nature reserve (NNR) designated as such pursuant to Section 7 or Section 21 of the Nature Conservation Act (Bulletin of Acts, Orders and Decrees 1967, 572), a national park, the Wadden area, a large unit of nature area and an area having nature as its main function, a foreshore belonging to the most valuable foreshores, and a brook valley belonging to the most valuable valleys of its kind);
- erection of an establishment for storage of coal and ores (greater than 50 ha);
- erection of an establishment for gasification or liquefaction of coal (250 kt capacity or greater);
- the activity on behalf of which the designation of a nature reserve or of a NNR is rescinded.

2.6 United Kingdom

A number of laws apply to EIA in the United Kingdom, the most significant being the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 No 1199.

Scotland has separate legislation from England and Wales.

2.6.1 The law

Under the European Communities Act of 1972 the United Kingdom was required to implement Directive 85/337/EEC.

England and Wales

The Directive is implemented in England and Wales by The Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 No 1199 which came into force on
15 July 1988. Environmental assessment is required for large-scale or environmentally sensitive projects which require planning permission under the Town and Country Planning Act 1971. Other projects are the subject of separate legislation.

The Town and Country Planning General Development Order 1988 No 1813 gives the Secretary of State powers to vary the conditions of the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988. The Secretary of State may exempt a particular development from environmental assessment, and may arbitrate as to whether or not a proposed development should come under the Regulations (Fortlage, 1990). Under the Planning and Compensation Act 1991, the Secretary of State is permitted to require EIA of projects not listed in the Regulations.

The Electricity and Pipe-line Works (Assessment of Environmental Effects) Regulations 1988 No 167 apply to the construction or extension of a generating station on any land under Section 2 of the Electric Lighting Act 1909 Clause 34, and to the placing of an electric line other than a service line above ground under Section 10(b) of the Schedule to the Electric Lighting (Clauses) Act 1899 Clause 19 (included in the Electricity Act 1947 Clause 54). The Regulations will apply if the construction or extension of a non-nuclear generating station is less than 300 MWe. It is noteworthy that the 1957 Electricity Act placed the CEGB under an obligation to consider environmental effects.

Almost any work to a watercourse, including works to control water, come under the Land Drainage Improvement Works (Assessment of Environmental Effects) Regulations 1988 No 1217.

The Highways (Assessment of Environmental Effects) Regulations 1988 No 1241 amend the Highways Act 1980 Clause 66 by requiring an environmental assessment to be made when certain new highways or major improvements to existing highways are proposed. The Secretary of State determines whether or not a highway project comes under Directive 85/337/EEC and whether or not an environmental statement is required.

Scotland
In Scotland the Regulations differ slightly from those for England and Wales in that one set of Regulations covers Town and Country Planning, Electricity, Roads and Bridges, Development by Planning Authorities, and Land Drainage. The same principles apply.


The Town and Country Planning (General Development) (Scotland) Amendment (No 2) Order 1988, SI 1988/1249 came into effect on 10 August 1988 and applies to Scotland only. This Order enables the Secretary of State to direct that development is exempt from the General Development Orders (1981 to 1988), in the case of development set out in the Environmental Assessment (Scotland) Regulations 1988 Schedules 1 and 2.

2.6.2 The relevance to coal

The Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 No 1199

As in the Directive, the Regulations divide new developments into two groups: those which are subject to mandatory EIA and those for which EIA is discretionary. Schedule 1 of the Regulations lists those projects for which an environmental assessment is mandatory. There are certain differences between the Directive list and the Regulations list, but these are not relevant to coal. The coal-related projects listed under Annex I of the Directive (see Section 2.3.1) are the same under Schedule 1 of the Regulations.

Schedule 2 of the Regulations lists those projects for which environmental assessment is discretionary, and the list closely parallels the Directive list. Only if a proposed project is likely to have significant effects does it require EIA. The decision is made by the local planning authority, or in certain cases the Secretary of State, and the developer is able to appeal against the decision. Guidelines have been published by the Department of the Environment (DoE) to assist local planning authorities when making the decision. Annex II projects of relevance to coal are listed in Section 2.3.1 of this report, and coal-related projects listed in Schedule 2 of the Regulations are the same. Where the Directive refers to Annex I projects, the Regulations refer similarly to Schedule 1 projects.

Guidelines for deciding whether a Schedule 2 project requires an environmental assessment are provided in DoE Circular 15/88 (Welsh Office Circular 23/88). The following points are of interest (Fortlage, 1990):

- extraction of peat
  - depends on location, size, duration of extraction, waste disposal, access, nature of plant and ancillary works, working methods, transport. Operations in an Area of Outstanding Natural Beauty (AONB) or a national park should merit an environmental assessment (EA);
- underground mining
  - new large deep mines may require EA;
  - open-cast mining
  - coal workings with sites over 50 ha and smaller ones if in a sensitive location, or are obtrusive, require EA;
- industrial plant for extraction of coal
  - product handling and site location may require EA. Extraction over 300 t/d, or where site is in a sensitive area, may merit EA;
- industrial installations for producing electricity, steam and hot water
  - no specific thresholds or criteria are set for developments in the energy industry category;
- installations for carrying gas, steam, hot water,
Ordinance (1989:364) applies to activities and measures covered by the Act, and it contains an Annex specifying whether an activity or action requires a permit or application according to the Act.

2.7.2 The relevance to coal

It is prohibited, without a permit, according to the Act, to erect a factory or any other establishment, to discharge waste-water, or to discharge or store solid waste or other solid material, if the action concerned is designated A or B in the Annex to the Ordinance. In the Annex an installation for gasification or combustion, for a power output of more than 200 MWe is designated A, and of more than 10 MWe but below 200 MWe is designated B. A mine installation comprising an installation for mining exploration is listed and designated B (Ministry of the Environment, 1990).

2.8 United States of America

The USA has had legislation requiring EIA since 1970.

2.8.1 The law

The relevant law is the National Environmental Policy Act (NEPA) which contains a specific requirement for US federal agencies to conduct assessments and file formal environmental impact statements (EIS) for 'major federal actions' which might have a 'significant environmental impact'. It became operative on 1 January 1970. Regulations containing government-wide requirements have been issued by the Council on Environmental Quality, Executive Office of the President (CEQ), and the individual federal agencies have supplementary regulations and technical guidelines that apply NEPA procedures to agency activities. Some States have adopted similar requirements for projects which they support or permit (Hanmer, 1990). The guidelines typically classify the types of agency actions that require the preparation of either an EA, a more detailed EIS, or neither (an exclusion supported by a mini EIS). For example, the US Department of Energy (US DOE) requires that any project actions during the NEPA assessment procedure for a proposed project be limited so as to avoid adverse environmental effects or limitation on alternative actions. Any other effort by the project is at risk. Hence, as a generalisation, it classifies conceptual design or feasibility studies as 'not normally requiring either an EA or an EIS'; detailed design, development and testing of an energy system prototype as 'normally requiring an EA, but not necessarily an EIS'; and actions resulting in construction and operation of a full-scale energy system project as 'normally requiring an EIS'.

Both the President's CEQ as the arbiter of NEPA, and the Environmental Protection Agency (US EPA) as reviewer, oversee implementation of the law (and the US EPA also writes EIS on some of its actions). The US EPA has a legal obligation, under Section 309 of the Clean Air Act as amended in 1971, to review EIS filed by all federal government agencies (Hanmer, 1990).

2.8.2 The relevance to coal

If a coal-related project falls within any of the definitions of 'major federal action' given in the regulations then it will be subject to NEPA. Such projects have included surface mining, construction of coal-fired power stations and the clean coal technology program, which required the preparation of an EIS.

Section 1508.18 Major Federal Action, of the CEQ Regulations for Implementing the Procedural Provisions of NEPA, July 1, 1986, defines 'Major Federal Action'. This 'includes actions with effects that may be major and which are potentially subject to federal control and responsibility'.

'Actions include new and continuing activities, including projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies; new or revised agency rules, regulations, plans, policies, or procedures; and legislative proposals.

'Federal actions tend to fall within one of the following categories:

- adoption of official policy, such as rules, regulations, and interpretations adopted pursuant to the Administrative Procedure Act, 5 U.S.C. 551 et seq.; treaties and international conventions or agreements; formal documents establishing an agency's policies which will result in or substantially alter agency programs;
- adoption of formal plans, such as official documents prepared or approved by federal agencies which guide or
prescribe alternative uses of federal resources, upon which future agency actions will be based;

- adoption of programs, such as a group of concerted actions to implement a specific policy or plan;
- systematic and connected agency decisions allocating agency resources to implement a specific statutory program or executive directive;
- approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities.

2.9 Commentary

The countries chosen for this study have each implemented legislation to evaluate and disclose the potential environmental impacts of development. While the legislation varies in detail and clarity, there is a common underlying theme: during the planning process, project proponents are required to assess the potentially significant impacts of their activity.

National legislation applies (except in Japan where local regulations are more important) to any coal-related project having a potentially significant effect on the environment. It is therefore unlikely that a proponent of a coal-related project will be exempt from carrying out an EIA.

In most cases a proposal will be subject to a number of laws requiring EIA. Where federal systems are in operation, as in Australia, the USA and Germany, federal, state and local laws may apply. In this situation, proponents will need to be more thorough in establishing their legal obligations from the outset, in order to avoid the possibility of misunderstandings and delay.

Where an attempt has been made to introduce uniform regulations on an international level the indications are that some nations are faster to act than others. In the case of EC statutory instruments, Directives must be implemented in the legislation of Member States within the agreed time limits (Simpson, 1990). This was not achieved in the case of Directive 85/337 EEC which deals with EIA. Furthermore, when the inclusion of certain projects is discretionary, the aim of achieving uniformity is all but lost.
3 Requirements for environmental impact assessment

The requirements for environmental impact assessment (EIA) have a common theme consisting of a description of the proposed project, the existing environment, the likely environmental impacts of the proposed project, mitigating measures, and consequences of not carrying out the proposal. While these points form the basis of EIA there are variations in the requirements on an international level. Such variations may occur in the detail necessary, the consideration of alternatives, scoping to determine relevant issues, or consultations made. In this chapter, the requirements for EIA in the selected countries are reviewed.

3.1 Australia

If a proposal affects the environment to a significant extent, the Commonwealth Environment Protection (Impact of Proposals) Act 1974, is applied. When applied, the level of assessment varies with the environmental significance of the proposal. A project may be examined by the Department of the Arts, Sport, the Environment, Tourism and Territories, without the preparation of more detailed environmental information. The Department may determine that a public environment report (PER) or an environmental impact statement (EIS) should be prepared (Hearn, 1991b).

In relation to the States, most coal mining proposals are assessed under relevant legislation by each State.

For New South Wales, major new coal mining proposals are subject to a Ministerial direction under Section 101 of the Environmental Planning and Assessment Act 1979 whereby the Minister for Planning determines the development application. This is lodged with and processed by the relevant local council and must be accompanied by a comprehensive EIS for the project. The contents of the EIS are specified but broadly include a detailed description of the project, the environmental impacts created by the project and the measures needed to minimise the environmental impact to acceptable levels (Hearn, 1991b).

Clause 34 of the Environmental Planning and Assessment Regulation 1980 gives the requirements for the contents of an EIS:

- a full description of the designated development proposed by the development application;
- a statement of the objectives of the proposed designated development;
- a full description of the existing environment likely to be affected by the proposed designated development, if carried out;
- identification and analysis of the likely environmental interactions between the proposed designated development and the environment;
- analysis of the likely environmental impacts or consequences of carrying out the proposed designated development (including implications for use and conservation of energy);
- justification of the proposed designated development in terms of environmental, economic and social considerations;
- details of energy requirements of the proposed development and measures to be taken to conserve energy;
- any feasible alternatives to the carrying out of the proposed designated development and reasons for choosing the latter;
- consequences of not carrying out the proposed designated development.

In New South Wales, an EIS is required before development of a new coal-using facility such as a power station, steelworks or industrial boiler, or for a significant change to an existing facility.

Environmental aspects of coal mining in Queensland are regulated by the Mineral Resources Act 1989. Applicants for a mining lease may be required to undertake a study into the environmental impact of the grant of a lease. Guidelines for
the study are formulated in consultation with other interested state and local government authorities (Hearn, 1991b).

In Victoria, Environmental Effects Statements (EES) may be required by the Minister for Planning and Urban Growth under the Environmental Effects Act 1978. When an EES is required statutory decisions under other Acts must await the Minister’s assessment of the EES.

In Western Australia the Environment Protection Authority (EPA) is an independent body with the dual role of providing independent advice to the government and the public on environmental protection, and for the implementation of government powers on pollution control. Other government departments have responsibilities for environmental management in their mandate, but decisions on environmental issues must be based on the policies or advice of the EPA. The EPA conducts Western Australia’s EIA procedures for site specific development proposals, the final decisions being made by the Environment Minister in consultation with other relevant Ministers and decision-making authorities. The assessment procedures are more publicly accessible than in other States, particularly at the lower levels of assessment. All the authorities’ advice on proposals, including informal advice, is publicly available. The appeals process is non-judicial so it is more accessible to the general public. The EPA also advises on development proposals, the re-zoning of land, and the formulation of government policy that has the potential to affect the environment significantly. The EPA operates under the Environment Protection Act 1986, which provides for the EPA to undertake EIA.

In Tasmania the Department of Environment and Planning is the primary agency responsible for environmental management and it administers the Environment Protection Act 1973. This Act requires certain industries (scheduled premises) to be licensed. EIA of proposals for scheduled premises is carried out by the Department of Environment and Planning in the course of assessing a licence application. There are statutory provisions for public input and third party appeals. It is government policy that other (non-scheduled) development with the potential for a significant environmental impact should be subject to environmental assessment. This is co-ordinated by the Department of Environment and Planning which produces an Assessment Report containing recommendations and advice for the relevant government decision-making authority. This authority is not, however, bound by this advice.

The Conservation Commission of the Northern Territory is responsible for the administration of the Environment Assessment Act 1982 under which major developments are subject to impact assessment.

### 3.2 Japan

Should the development of a new coal mine be proposed, the EIA is performed by each coal mining company under the conditions set out in the mine safety regulations, and is authorised by the local government (Hirota, 1991). Since there are no plans to develop a new coal mine at present, however, the requirements for EIA of coal-fired power stations are of greater relevance to this report.

According to the Ministry of International Trade and Industry (MITI) guidelines for conducting EIA, an electricity generating company should provide the following information in a proposed power station EIS:

- an outline plan of the power station;
- a description of the existing environment at the proposed site;
- proposed measures for environmental protection;
- an estimate and an assessment of potential environmental impacts;
- an evaluation of the development project.

Impacts considered in the national EIA procedures fall into two categories; pollution prevention and nature conservation. The first category includes air, water, and soil pollution, noise, vibration, subsidence, and offensive odour, while topography, geology, plants, animals, scenery, and outdoor recreation are regarded as nature conservation issues. A power station EIA is not required to include odours and recreation in its scope, but it must discuss the other potential impacts listed above, and also potential impacts on climate, sea floor topography, marine life, marine geology, and social, economic and cultural issues. Such detailed consideration of potential impacts on terrestrial and marine ecosystems, and on the marine and fishing industry is noteworthy.

The MITI guidelines for public participation in environmental reviews require the electricity generating company to release the EIS for public scrutiny for 20 days. During that period the company must distribute information about the proposed project and its potential environmental impacts, and must hold a public hearing. Public comment should be accepted for 30 days after release of the EIS, and the proponent is required to present pertinent comments and replies to MITI in its conservation plan.

The guidelines for environmental review specify that MITI must:

- review the project plan and existing environment;
- select items for examination;
- examine possible environmental protection measures;
- examine the EIS;
- assess the proposed environmental monitoring system;
- comprehensively assess the proposed project.

A draft environmental examination report is sent by MITI to the Electric Power Development Co-ordination Council which comments on the draft. The report is revised based on these comments, and the final environmental report is made public. Only after these EIA requirements have been met can the proponent apply to MITI for a permit to construct and operate a power station. Before making a decision MITI holds public hearings and consults other agencies.

One noteworthy aspect of EIA in Japan is that local authorities do not require project alternatives to be considered. This is thought to be for economic reasons (Barrett and Therivel, 1991).
3.3 European Economic Community

It is stated in Directive 85/337/EEC, Article 3, that the environmental assessment for a project should identify, describe and assess in an appropriate manner, the direct and indirect effects of a project on a number of issues, namely: human beings, fauna and flora, soil, water, air, climate and landscape. The interaction between these factors should also be considered as should material assets and the cultural heritage.

Article 5 sets out the information to be provided by the developer:

- description of the project comprising information on the site, design and size of the project;
- a description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects;
- the data required to identify and assess the main effects which the project is likely to have on the environment;
- a non-technical summary of the information mentioned in the preceding indents.

Annex III of the Directive further details the required information:

1) Description of the project, including in particular:
   - a description of the physical characteristics of the whole project and the land-use requirements during the construction and operational phases;
   - an estimate, by type and quantity, of expected residues and emissions (for example, water, air and soil pollution, noise, vibration, light, heat and radiation) resulting from the operation of the proposed project.

2) Where appropriate, an outline of the main alternatives studied by the developer and an indication of the main reasons for his choice, taking into account the environmental effects.

3) A description of the aspects of the environment likely to be affected significantly by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors.

4) A description of the likely significant effects of the proposed project on the environment resulting from:
   - the existence of the project;
   - the use of natural resources;
   - the emission of pollutants, the creation of nuisances and the elimination of waste; and the description by the developer of the forecasting methods used to assess the effects on the environment.

5) A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment. This description should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term permanent and temporary, positive and negative effects of the project.

6) A non-technical summary of the information provided under the above headings.

7) An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the developer in compiling the required information.

3.4 Germany

Provisions on the requirements for EIA are contained in the Environmental Impact Assessment Act, 1990. Section 6 of the Act deals with information required from the project proponent, who will have to provide the following, unless specific legislation states otherwise (Bunge, 1990):

- a description of the project including information on its location, type and size, and land-use requirements;
- a description of the type and quantity of emissions, waste, waste-water, etc, and other information necessary to determine and assess the project’s significant adverse impacts on the environment;
- a description of measures to prevent or reduce significant adverse impacts on the environment, or to compensate them as far as possible (this includes ‘substitute measures’ in cases of ecological and landscape damage that cannot be compensated adequately);
- a description of the significant impacts of the project on the environment.

In certain cases, if it was considered reasonable, the proponent will be required to submit further information on the following:

- a description of the environment as far as necessary to determine and assess all other effects of the project on the environment;
- an overview of the main alternatives studied by the proponent, and an indication of the principal reasons for his choice, taking into account, in particular, the environmental effects;
- an indication of any difficulties encountered by the proponent in compiling the required information (technical deficiencies or lack of know-how).

The information must also include a non-technical summary that is comprehensible to the average person.

The federal government is authorised, under Section 20 of the Act, to issue general administrative regulations in order to facilitate EIA. Such regulations would cover the following:

- criteria and procedures for the identification, description and assessment of environmental impacts;
- principles for the scoping process;
- principles for the summary account and for the evaluation of environmental impacts.
As mentioned earlier (Section 2.4.2), however, a statutory ordinance (Rechtsverordnung) has yet to be passed for those projects listed in the Annex to the Appendix to Section 3 of the EIA Act, which includes power stations. Until such a statutory ordinance is passed no EIA according to the EIA Act has to be prepared for such projects (Wagner, 1991).

3.5 The Netherlands

The Environmental Protection (General Provisions) Act 1986 details the requirements for EIA. For those projects requiring EIA an environmental impact statement must be prepared, either by the proponent or by a competent authority. Requirements for the minimum content of an EIS are as follows:

a) a description of what is envisaged with the proposed activity;

b) a description of the proposed activity and of the manner in which it will be carried out, as well as of the alternatives, which must reasonably be taken into consideration;

c) an indication of the decisions during the preparation of which the environmental impact statement shall be made, and a review of the decisions previously taken by government bodies, relating to the proposed activity and the alternatives described;

d) a description of the existing condition of the environment, in so far as the proposed activity or the alternatives described may have consequences for the condition, as well as the expected development of the environment in the event of neither the activity nor the alternatives being undertaken;

e) a description of the consequences which the proposed activity or the alternatives described may have for the environment, and the method used to determine the consequences;

f) a comparison of the expected development of the environment, as described in pursuance of indent d), with the described consequences of the proposed activity for the environment, as well as with the described consequences for the environment of each of the alternatives taken into consideration;

g) a review of the deficiencies in the descriptions referred to under d) and e) owing to lack of information;

h) a summary providing sufficient insight for the general public to be able to evaluate the environmental impact statement and the consequences for the environment described therein of the proposed activity and of the alternatives described.

The list of requirements in the Act go on to state that the alternatives to be described under b) shall in any case include the alternative in which the best available possibilities for protection of the environment are applied.

The Act also makes provisions for a change in the regulations to be made by General Administrative Order with respect to additional requirements and as to how further information shall be determined and described. Provision is also made for certain activities to be excluded from the Regulations, and for changes to the form of an EIS.

3.6 United Kingdom

In England and Wales, so far as projects requiring planning permission are concerned, Directive 85/337/EEC is implemented by the Town & Country Planning (Assessment of Environmental Effects) Regulations 1988 No 1199. The requirements of the Regulations closely follow those of the Directive. The same principles apply in Scotland, but under other regulations (see Section 2.6.1). Schedule 3 of the Regulations specifies the required information as set out in paragraph 2:

a) a description of the development proposed, comprising information about the site and the design and size or scale of the development;

b) the data necessary to identify and assess the main effects which that development is likely to have on the environment;

c) a description of the likely significant effects, direct and indirect, on the environment of the development, explained by reference to its possible impact on human beings, flora, fauna, soil, water, air, climate, the landscape, the interaction between any of the foregoing, material assets, and the cultural heritage;

d) where significant adverse effects are identified with respect to any of the foregoing, a description of the measures envisaged in order to avoid, reduce or remedy those effects;

e) a summary in non-technical language of the information specified above.

Paragraph 3 of Schedule 3 states that an environmental statement may include, by way of explanation or amplification of any specified information, further information on a number of matters:

a) the physical characteristics of the proposed development, and the land-use requirements during the construction and operational phases;

b) the main characteristics of the production processes proposed, including the nature and quality of materials to be used;

c) the estimated type and quantity of expected residues and emissions (including pollutants of water, air or soil, noise, vibration, light, heat and radiation) resulting from the proposed development when in operation;

d) (in outline) the main alternatives (if any) studied by the applicant, appellant or authority and an indication of the
main reasons for choosing the development proposed, taking into account the environmental effects;

e) the likely significant direct and indirect effects on the environment of the development proposed which may result from:
   i) the use of natural resources;
   ii) the emission of pollutants, the creation of nuisances, and the elimination of waste;

f) the forecasting methods used to assess any effects on the environment about which information is given under subparagraph e); and

g) any difficulties, such as technical deficiencies or lack of know-how, encountered in compiling any specified information.

In paragraph e) 'effects' includes secondary, cumulative, short, medium and long-term, permanent, temporary, positive and negative effects.

Any further information pursuant to paragraph 3 requires a non-technical summary, as stated in Schedule 3 paragraph 4.

3.7 Sweden

The Environment Protection Act (1969:387) Section 13 provides details of the requirements for EIS, as follows:

Permit applications shall be in writing, and contain:

1) the particulars, drawings and technical descriptions required for an assessment of the nature and extent of the environmentally hazardous activity;

2) an EIA that makes possible a concise assessment of the impact of a planned construction, activity or measure on the environment, health and management of natural resources (amendment of 1 July 1991);

3) proposals for the protective action or other precautionary measures required to prevent or remedy detrimental effects of the activity, and proposals as to how the activity should be inspected;

4) an account of the consultations that have taken place in accordance with Section 12a (see below), and the outcome of such consultations.

The Environmental Protection Act (1969:387), Section 12a, states that 'anyone intending to perform an environmentally hazardous activity for which a permit is required according to the directives issued pursuant to this Act shall, before applying for a permit, consult any central and local authorities, organisations and individuals who may have an interest in the matter, to a reasonable extent and in an appropriate manner.'

Failure by the applicant to meet the requirements may result in delay or a fine.

3.8 United States of America

Environmental managers should consult federal, state and local agencies on the exact requirements applicable to their proposal. While not all major projects in the USA require an EIS, all do require discharge permits. The provisions of the Clean Air Act call for analysis, a prevention of significant deterioration (PSD) permit, and an approval to construct.

The National Environment Policy Act (NEPA) Section 102 requires federal agencies to incorporate environmental considerations in their planning and decision-making through a systematic interdisciplinary approach. All federal agencies are required to prepare detailed statements assessing the environmental impact of, and alternatives to, proposed major federal actions significantly affecting the environment, including the issuance of discharge permits. In the USA such statements are referred to as environmental impact statements (EIS). Section 102 also requires federal agencies to lend appropriate support to initiatives and programmes designed to anticipate and prevent a decline in the quality of mankind's world environment (US EPA, 1989a).

Title II of NEPA established the Council on Environmental Quality, Executive Office of the President (CEQ) and requires the President to transmit to Congress, with the assistance of CEQ, an annual Environmental Quality Report on the state of the environment. In 1978 the CEQ promulgated regulations implementing NEPA, which are binding on all federal agencies. Among the various guides published by CEQ is 'Guidance Regarding NEPA Regulations'. Most federal agencies have promulgated their own regulations and guidance which, although based on CEQ procedures, are specific to their particular function.

In the NEPA process the effects of a proposed federal undertaking and its alternatives are evaluated. Three levels of analysis are possible:

1) exemption;

2) preparation of an environmental assessment/finding of no significant impact (EA/FONSI);

3) preparation of an environmental impact statement (EIS).

At level 1 a proposal may be categorically excluded from a detailed environmental analysis if it meets certain criteria which have previously been determined by a federal agency as having no significant environmental impact. Lists of actions which are normally excluded from environmental evaluation are available from a number of agencies.

A level 2 analysis consists of the preparation of a written environmental assessment by a federal agency in order to determine whether or not a federal undertaking would affect the environment significantly.

If the finding was of no significant impact, the federal agency issues a FONSI (finding of no significant impact). The FONSI may address measures which an agency will take
to reduce potentially significant impacts (known as a FONSI with mitigation).

If, however, the EA finds potentially significant impacts a more detailed evaluation of the action and alternatives is made; the environmental impact statement (level 3). Other federal agencies, members of the public, and third parties are invited to provide input to the preparation of an EIS and then comment on the draft EIS when it is complete. The EIS process also includes preparation of a final EIS, and the decision process.

An EA is described in Section 1508.9 of the Council’s NEPA regulations, and it generally consists of brief discussions of the following:

1) the need for the proposal;
2) alternatives (when there is an unresolved conflict concerning alternative uses of available resources);
3) the environmental impacts of the proposed action and alternatives;
4) a listing of agencies and persons consulted.

An EIS, which is described in Part 1502 of the regulations, is prepared by the relevant federal agency based on inputs from the applicant, and should include discussions of:

1) the purpose of and need for the proposed action;
2) alternatives, including no action;
3) the affected environment;
4) the environmental consequences of the proposed action;
5) irretrievable and irreversible use of resources; and
6) lists of preparers, agencies, organisations and persons to whom the statement is sent;
7) an index;
8) appendices if/as appropriate.

3.9 Commentary

The majority of countries studied here have clear EIA requirements which can be determined from the various official guidelines. Determination of exact requirements is a more convoluted process in the USA, Germany and Australia, where the three levels of government each have specific requirements. Even so, a proponent should encounter little difficulty in determining his exact requirements at the initiation stage, by consulting the competent authorities.

The EIA process can be improved where an external body exists to advise on requirements. The US Environmental Protection Agency (US EPA) and the Commission for Environmental Impact Assessment (CEIA) in The Netherlands perform this task. Although non-statutory, the Institute of Environmental Assessment has been set up in the United Kingdom to perform a similar role.

While the requirements for EIA can, in general, be considered reasonable, the use of specialist consultants would normally be required for coal-related projects. In the case of the competent authority directing an extensive assessment, perhaps involving elaborate mathematical modelling, costs are likely to be substantial. Under these circumstances a proponent may consider the requirements to be unreasonable from an economic standpoint. Potentially lengthy time requirements may be involved; baseline data acquisition could require a year (to capture all of the seasons).
4 Procedures in environmental impact assessment

The procedures for environmental impact assessment (EIA) vary from country to country. This chapter examines such procedures in order to identify strengths and weaknesses so that suggestions for improvements may be made.

4.1 Australia

If a proposal is likely to have a significant effect on the environment and there is a need for a decision or action by the Commonwealth, then the proposal falls within the scope of the Environment Protection (Impact of Proposals) Act 1974 (Department of Arts, Heritage and Environment, 1987). The main steps involved in project assessment are shown in Figure 1.

Following initiation of the proposal a proponent is designated by the Action Minister (the Commonwealth Minister with portfolio responsibility for the industry) or by the Action Minister’s Department on his behalf. The proponent can be either a Commonwealth department or authority if the proposal is a Commonwealth development, or a private company if the proposal is a private sector development requiring Commonwealth approval.

The proponent is required to provide preliminary information which briefly describes the proposal. This information is presented to the Department of the Arts, Sport, the Environment, Tourism and Territories (DASETT) in the form of a document known as a ‘Notice of Intention’ (NOI), which contains a description of the proposal, the environment likely to be affected, the expected beneficial and adverse impacts, any alternatives to the project, and proposed environment protection measures. The information is assessed by DASETT which administers the Act. Following assessment of the NOI:

a) the Department may determine that neither a public environment report (PER) nor an environmental impact statement (EIS) is required provided that particular environmental conditions are met;

b) the Minister may direct that a PER should be prepared;

c) the Minister may direct that an EIS is advertised in the Commonwealth of Australia Gazette.

Amendments to the Act which came into force on 1 June 1987 introduced the PER to overcome the problem of preparing an EIS in cases where only one or two issues of environmental significance were involved (Department of Arts, Sport, the Environment, Tourism and Territories, 1987). The EIS, a comprehensive document requiring considerable time and resources to prepare in draft and final form, is not always required. The PER provides an intermediate level of assessment, below that of an EIS, which allows for public comment on the environmental aspects of proposals. Where the Minister considers that the public should be made aware of the environmental impacts of a proposal, and of the measures which will be taken to protect the environment, but where the impacts are expected to be few or focused on a small number of specific issues, he will usually direct a PER because an EIS is not warranted. A PER is a report prepared by the proponent; it is a simpler and more flexible document than the EIS and it is designed to be effective in communicating information and obtaining responses from interested parties.

Should the Minister direct that an EIS be prepared, the Department consults with proponents on the content and coverage of the draft EIS (or PER) and provides guidelines for their preparation. The Department many consult with other individuals, experts or organisations in preparing guidelines. The Department also consults with proponents during the preparation of the draft EIS or PER to ensure that the documents are suitable for public review.

When accepted, the EIS or PER is made available for public review and comment. In rare cases there may be a need to retain confidentiality for commercial or national security or other reasons. The release of a draft EIS or PER is
announced in the Commonwealth of Australia Gazette, and in advertisements in national, state or even local newspapers. Such advertisements include a brief summary of the proposal, details of where the document can be purchased or read, an address to which comments can be forwarded and the closing date for receipt of comments which is a minimum of 28 days from the date of announcement. The review period for a draft EIS is often extended following agreement between the proponent and the Department, or at the discretion of the Minister. The Minister may also direct the Department to hold 'round table' discussions with the proponent and members of the public following the public review of a draft EIS or a PER.

Comments by Government departments and agencies, together with all public comments are sent to the proponent who is required to revise the draft EIS accordingly. The revised document is known as a final EIS and it may comprise either a revised draft EIS or the draft EIS with a supplement which responds to the comments received during public review. The final EIS is submitted to the Department for assessment. The proponent also provides copies to persons who have submitted public comments on the draft EIS, and copies are also made available to the public by sale or otherwise.

The final EIS is examined by the Department:
Procedures in environmental impact assessment

- to ensure that the object of the Act has been met with regard to the proposal;
- to determine whether further environmental information is required, including data to be obtained from monitoring before the project commences or during construction or operation of the project;
- to formulate any recommendations or suggestions on the environmental aspects of the proposal, which may be applied in association with approval of the proposal.

The results of this examination, including any recommendations or suggestions, are set out in an Environmental Assessment Report to the Minister. In the case of a PER, the Department makes its assessment in the light of comments submitted during the public review period and it prepares an assessment report, which includes recommendations or suggestions, for the Minister. The proponent is not required to prepare a revised or final PER. During this phase the Minister may direct the Department to hold 'round table' discussions with particular interested groups or individuals. The assessment report is made available to the public on request, with the exception of those containing material of commercial confidence, or having security implications.

The Minister may make comments, suggestions or recommendations to the Action Minister on the environmental aspects of a proposal, and the Action Minister is required to take into account such comments, suggestions or recommendations in making a decision on the proposal.

To avoid duplication of actions, arrangements have been made with the States to facilitate joint assessments of proposals involving both State and Commonwealth decisions. In deciding whether a Commonwealth EIS or PER is required, consideration is given to any environmental assessment undertaken, or required to be undertaken, to meet State requirements.

The Minister has the discretion to direct the preparation and submission of an EIS to achieve the object of the Act even though a PER has already been prepared. Under Section 11 of the Act, the Minister may direct an inquiry at any stage of the assessment process, whether or not an EIS or a PER has been prepared. The Administrative Procedures require the Minister to consult with the Action Minister before directing an inquiry. Under the 1987 amendments to the Act, the Minister may specify a date by which a Commission of Inquiry should report its findings.

New South Wales has specific legislation on EIA and guidelines on the procedures for coal mining are available.

4.2 Japan

The extraction of coal in Japan is not a significant issue and the most relevant projects related to coal are proposals for construction of power stations. Such proposals require an EIA to be carried out by the procedure shown in Figure 2.

The process begins with the proponent carrying out a preparatory investigation into the potential environmental impacts of the proposal, in parallel with the process of site selection and procurement of land. Members of the local fishing industry may require compensation. Having completed the preliminary stage the Ministry of International Trade and Industry (MITI) guidelines for conducting EIA are followed by the proponent in preparing the draft EIS. The completed draft EIS is made available to the public according to the MITI guidelines for public participation. The period of public scrutiny is 20 days, but local residents are given 30 days in which to comment. A public hearing is also held.

Following the public review of the draft EIS the proponent provides MITI with the local residents' comments and its response. An environmental review is carried out by MITI according to its own guidelines, and comments are invited from advisors in the review process. The local authority submits its comments also, after which the concerned ministries discuss the proposal. Approval of an electric power development plan is made by the Electric Power Development Co-ordination Council (EPDCC) and, based on the comments of the EPDCC, MITI publishes the final environmental review report. The views of the public are
considered during the last stage of the EIA process when the final EIS is produced.

After completing the EIA, the proponent may apply to MITI for a permit to construct and operate the power station. In considering the permit application MITI consults other relevant agencies and local residents. Construction may begin following the issuance of a permit by MITI.

4.3 Germany

A specific licensing procedure has existed for some time in Germany and the Federal EIA Act 1990 basically retains the legislation governing those procedures (Bunge, 1990). A new concept to the system is the scoping process which is dealt with in Section 5 of the Act. Figure 3 shows the EIA process under the Federal EIA Act.

![Diagram of the German EIA process under the Federal EIA Act 1990]

There are five steps in the EIA procedure beginning with the scoping process. This process is aimed at determining what information is required from the proponent, which methods for predicting environmental impacts should be used, and which other details are required.

The second step involves collection of the required information and preparation of the EIS by the proponent. The EIS is submitted to the competent authority which then contacts other parties, in the third step. Such parties include domestic authorities, the public, and authorities of other states concerned about the project. They receive the information submitted by the proponent and are able to comment on the proposal. In the case of the public, however, most special legislation only allows comments by individuals concerned with the project. External experts may be involved by the competent authority if they are deemed necessary, and information may be sought from European Community member countries and other neighbouring countries likely to be concerned by the project.

In the fourth step the competent authority prepares an objective view of the project taking into account the information received in the earlier stages, and the results of further investigations if necessary. A summary account of the likely environmental impacts of the project is prepared.

An evaluation of the impacts prior to the decision constitutes the fifth step, and in making the decision the results of the evaluation must be taken into account. The decision is made available to those persons concerned by the project and to those involved in the EIA process.

Where a project requires several licences, provisions exist in the Act for a co-ordinated approach. In such cases a lead agency is appointed to carry out the scoping process and to prepare the summary account of the environmental impacts. All competent licensing authorities are required to evaluate the impacts collectively.

Provisions also exist for the planning of some projects in a two- or three-tier process in order to co-ordinate the EIA procedure at each stage and to avoid duplication of work.

4.4 The Netherlands

The EIA process in The Netherlands involves a number of participants: the proponent, the competent authority, the public, advisors and the Commission for Environmental Impact Assessment (CEIA) (Ministry of Housing, Physical Planning and Environment, 1989).

The formal procedure is shown in Figure 4. The proponent starts the procedure by issuing a 'notice of intent' which details the plans. Formal preparations for the environmental impact statement (EIS) begin after publication of the notice by the competent authority. A preliminary stage is the scoping process in which the content of the EIS is decided through discussions between the proponent, competent authority (including advisors in the field of environmental protection and nature conservation) and the CEIA.

The role of the competent authority is one of decision-maker regarding the proposal. The public are able to make remarks and suggestions as to the implementation of the proposed activity and can appeal against the decision. Individuals with relevant expertise act as advisors to the competent authority about the nature and conditions involved in implementing the project, and the CEIA provides independent expertise to the competent authority. Any other interested party may also comment during the scoping process.

Following the scoping process the competent authority must issue guidelines on the content of the EIS with specific reference to project alternatives and key environmental impacts. A period of three months is allowed for the
Procedures in environmental impact assessment

Figure 4 The EIA procedure in The Netherlands

preliminary phase of scoping and guidance, which may extend to five months if the proponent is also the competent authority.

The proponent is responsible for the content and preparation of the EIS and has no time limit on the process which may involve the use of consultants, a research institute, a university or any other contributor. After submission to the competent authority, the EIS (together with the licence request or draft-plan) is checked for accuracy and completeness. If the EIS is found to be inadequate in any way the proponent is informed and this finding is made public. In the case of the competent authority being the proponent it is the government agency who must rectify the problem. A period of at least six weeks is allowed for determining the acceptability of the EIS and if no refusal is forthcoming after that the proponent may assume that his commitments have been met. A favourable finding on the statement must be publicised by the competent authority, and the draft plan, the project document or the licence application is published.

The public review process begins with the notification of the EIS, and a minimum of one month is permitted in which to comment on the EIS. A public hearing is compulsory by law but comments may also be submitted in writing. Advisors to the competent authority play an active part in the public review process and must provide advice on the EIS to the competent authority before the end of the review period. Such advisors include those agencies or authorities designated to provide recommendations in the course of the decision-making process. The Regional Inspector for Environmental Protection and the Director for Agriculture, Nature Conservation and Outdoor Recreation are always given the opportunity to comment. If the competent authority is part of central government, recommendations are made by civil servants appointed for this purpose by the Minister of Housing, Physical Planning and Environment and the Minister of Agriculture, Nature Management and Fisheries.

The competent authority adds the results of the public review and advice to the EIS. These results are also used by the CEIA in checking the statement.

The CEIA receives a copy of the EIS upon its submission and it checks the report against legislation, implementary regulations and the guidelines given in the preliminary phase to see whether it is complete and correct. The CEIA also involves the results of the public review and advice in its deliberations, and the outcome is a recommendation to the competent authority, within one month of the public review period. It should be noted that the CEIA presents a recommendation on the adequacy of the environmental assessment and does not comment on the environmental acceptability of the project. The competent authority makes the decision on the acceptability of the project.

In its discussion the competent authority must include the impact described in the EIS, the result of the public enquiry, the advice given, and the CEIA’s comments. In the decision it must clearly indicate the reasons for the decision and how a balance was struck between environmental interests and other interests, and what consideration was given to alternatives. If an alternative which was not the most environmentally acceptable was chosen, the competent authority will give an explanation why. The decision and the reasons for it must be made public.

There is the possibility of appeal against the decision. While it is not possible to appeal against the EIS itself, a poor EIS may be a reason for appealing against the decision for which the EIS was drawn up. This usually involves an appeal to the Crown or an appeal under the Administrative Jurisdiction (Government Orders) Act. In some cases it may be possible to institute proceedings before the civil courts. For those decisions which are specific to the legislative arrangements for EIA, there are other appeal opportunities. Designation of a case of urgency, exemption, and application of the co-ordination arrangement are examples of this category.
Provisions have been made for post-project evaluation which may lead to possible mitigating measures in the years following completion of the project.

### 4.5 United Kingdom

Formal guidance on the EIA procedures, directed principally at local planning authorities, is given in the Department of the Environment (DoE) Circular 15/88 (Welsh Office Circular 23/88). Flow charts illustrating the main procedural stages of EA are given in Figures 5, 6 and 7 (DoE/Welsh Office, 1990).

The first step is to decide whether a coal related project requires EIA. As discussed earlier (Chapter 2) all 'Schedule 1 projects' require EIA but those included under Schedule 2 will require EIA only if they are judged likely to give rise to significant environmental effects; a point which will need clarification. Rulings may be obtained from the local planning authority or the Secretary of State on whether EA is required in particular cases. The proponent has two options, either to decide for himself that the project falls within the scope of the Regulations, or to provide basic project information to the planning authority for an opinion. Such information must include a site plan, a description of

![Flow Chart](image-url)
Procedures in environmental impact assessment

the nature and purpose, and possible environmental effects of the project. An approach to the planning authority prior to the planning application stage is possible but is voluntary, and the authority must give an opinion within three weeks unless the proponent agrees to a longer period. A written statement giving clear and precise reasons is required if the authority decides that EA is necessary, and this statement is made available for public inspection together with the application. A proponent who is dissatisfied with the planning authority’s opinion may refer the matter to the Secretary of State, who will normally give his direction within three weeks. If EA is necessary no action will be taken on a planning application until the proponent has prepared his ES and submitted it to the planning authority. Once a decision has been reached as to the need for EA it is still possible for that decision to be reversed.

Special considerations apply to projects proposed for simplified planning zones (SPZ) and enterprise zones (EZ), although all Schedule 1 projects are excluded from the scope of SPZ. Proponents must notify the planning authority where they intend to undertake Schedule 2 projects, if the terms of SPZ schemes would permit such projects to be undertaken without specific planning permission. The planning authority, or the Secretary of State, may determine that EA is required if the proposal is likely to have significant environmental effects.

Enterprise zones which were designated before July 1988 are not affected by the provisions for EA. In the case of EZ designated after July 1988, if the planning scheme allows for Schedule 1 projects, EA must be carried out. As regards Schedule 2 projects, the same procedures apply as those for SPZs.

The proponent is responsible for preparing the ES he must submit with his planning application and he may engage

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**Figure 6** Application to UK Secretary of State for Direction where developer disagrees with Local Planning Authority’s opinion (DoE/Welsh Office, 1990)
consultants for all or part of the work. There is no prescribed form of statement; it is sufficient that the requirements of the Regulations (Schedule 3, paragraph 2) are met (see Section 3.6). Discussions involving the local planning authority, statutory consultees and other bodies are advised but not mandatory.

Having established the need for EA the local planning authority is required to inform the relevant public bodies who will then have an obligation to provide any relevant information to the proponent for the preparation of the ES, should he request it. The local authority sends a list of all bodies contacted to the proponent. The following is a list of the public bodies concerned:

1) the bodies who would be statutory consultees under Article 15 of the General Development Order for any planning application for the prospective development;

2) any principal council for the area in which the land is situated other than the local planning authority;

3) the Nature Conservancy Council and the Countryside Commission, in all cases;

4) HM Inspectorate of Pollution in respect of development involving mining, manufacturing industry or waste disposal which in the local planning authority’s opinion is likely either to give rise to radioactive wastes, or to discharges (other than of domestic sewage) which are controlled waste or special waste or which are likely to require the licence or consent of a water authority; or to

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Figure 7 Submission of environmental statement to UK Local Planning Authority in conjunction with planning application (DoE/Welsh Office, 1990)
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involve works specified in Schedule 1 to the Health and Safety (Emissions to the Atmosphere) Regulations 1983 (SI 1983 No 943).

Local planning authorities should also provide information which they have within their departments. There is, however, no obligation on public bodies to undertake research or otherwise to take steps to obtain information which they do not already have, and neither are they obliged to disclose confidential information. They may make a reasonable charge for their services.

The timing of informal consultations is at the proponent’s discretion and he can request confidentiality at the preliminary stage.

The DoE/Welsh Office Guide to the EA Procedures provides a checklist as a practical guide to the scoping of an ES. This is to facilitate discussions between the proponent and the local authority with the aim of ensuring that the key issues are addressed in greater detail in the ES. Although the planning authority may express views about the information that should be included in an ES, the proponent is responsible for the content of the statement he finally submits. It is in his interest to submit an ES of a high standard if only to avoid delays resulting from the planning authority exercising its power to call for additional information. In the event of a disagreement between the proponent and the planning authority over the content of an ES, there is no provision for referral to the Secretary of State, except through normal planning appeal procedures.

Original scientific research will not normally be necessary to prepare an ES and where there is uncertainty in the prediction of environmental effects it is to be explicitly recognised.

A planning application should be submitted in the normal way, accompanied by the completed ES. Since this is the case the proponent will need to work out his proposals in considerable detail in order to assess adequately the potential impacts. The proponent will also need to publicise the availability for inspection of the ES stating where and when this may be done. A notice in a local newspaper and notices on the site will be needed, and the place for inspection should be in the locality of the project, open at reasonable hours. Statutory consultees must be provided with a copy of a complete ES, or, if the consultee agrees, a part of it. The proponent is required to provide the ES either directly or through the planning authority. Copies of the ES should be available for sale at a reasonable price to members of the public.

The planning authority places the planning application on Part 1 of the Planning Register, together with the ES. In order to encourage comment on the ES further publicity may be considered, and statutory consultees are invited to comment also. Consultees must be allowed 14 days in which to comment before a decision can be taken by the planning authority and that decision must be taken within 16 weeks unless a written agreement between the authority and the proponent is made to the contrary. If after the 16-week period or any agreed extension, no decision has been made, the proponent may appeal to the Secretary of State against non-determination.

When the planning authority has determined the planning application it is required to notify the Secretary of State. The proponent is notified as are those public bodies involved in the procedures, and a copy of the decision, including any conditions imposed, is placed on Part II of the planning register (which will meet the requirements to inform the public in Article 9 of Directive 85/337/EEC). Proponents have the normal right of appeal against refusal of planning permission following consideration of environmental information or against any conditions. A copy of the ES must be sent to the Secretary of State with the notice of appeal.

4.6 Sweden

The EIA process according to the Environmental Protection Act 1969 is shown in Figure 8.

When considering the application for a permit the project proponent must consult any central and local authorities, organisations and individuals who may have an interest in the matter. The primary step is a form of scoping process intended to determine what issues need to be addressed. The proponent then prepares the written application which will include the details described in Section 3.7 of this report. The requisite number of copies of the application are submitted to the National Licensing Board for Environment Protection who undertake an evaluation of the application. The Board may request further information at this stage or may reject the application if it is found to be unacceptable.

The Board is responsible for a complete investigation of any case that is subject to examination by the Board.

The Board makes a public announcement of the application in a newspaper or other suitable medium in order to give those potentially affected by the project an opportunity to comment on the matter. The announcement must contain information concerning:

1) the location of the project and a brief description of what the application contains concerning the nature, extent and environmental effects of the activity;

2) the place where the documents concerning the proposal are available for inspection;

3) the period within which statements concerning the application shall be submitted.

The Board also consults central and local authorities that have substantial interests regarding the proposal to consider the matter. A meeting of the parties concerned is held and if necessary an on-site inspection is made. The Board informs anyone who submitted an application or lodged an objection concerning aspects of a case introduced by some other party, and may give them an opportunity to comment. The Board may also appoint an expert to perform any special investigation necessary.
If the Board finds that the proposal 'entails a substantial deterioration in the living conditions of a large number of persons, a significant loss from the viewpoint of nature conservation or considerable damage to a similar public interest' it may refer the matter to the Government for a decision, with its own statement. The Government can issue a permit under the Environmental Protection Act 'if the project is of particular importance to the economy or local community or otherwise serves public interest'.

The final step in the procedure is the permit decision which includes specific details of the activity and the conditions to apply. The proponent must initiate the project within a specified period which will have a maximum of 10 years. If the permit is granted by the Government the Licensing Board or Country Administrative Board may be appointed to define detailed conditions for the permit. If the Licensing Board grants a permit, a relevant public authority may be appointed to define conditions of minor importance. Where there is insufficient experience of the impacts of certain projects the imposition of conditions may be delayed until such time as information is available.

Decisions taken under the Act may be appealed against:

1) to the County Administrative Board if the decision was announced by the Municipal Environment and Health Protection Committee;

2) to the Licensing Board if the decision was announced by the National Environment Protection Board or County Administrative Board;

3) to the Government if the decision was announced by the Licensing Board.

Some restrictions and other procedures for appeal are detailed in the Act, Section 48.

4.7 United States of America

Procedures for EIA in the USA are shown in Figure 9.

Due to the federal nature of the USA any given project may be subject to a number of local, state and federal laws, regulations and standards. Federal laws and regulations apply throughout the country, but state and local laws vary with location. Even federal laws tend to be administered differently from state to state depending on whether the law is administered directly by the responsible federal agency or by a state agency with delegated authority (Walden, 1990).

After the adoption of the National Environmental Policy Act (NEPA), which applies only to federal actions, a number of states passed laws which incorporate consideration of environmental effects into state actions. Many of the state NEPAs are modelled on the federal NEPA. According to the US EPA a total of 11 states have passed laws with comprehensive environmental review requirements and 14 states have limited environmental review requirements established by executive order or other administrative directives (US EPA, 1989a).

For the project proponent the first step of the EIA procedure is to determine the exact requirements applicable by consultation with local, state and federal agencies. The majority of coal-related projects will require environmental permitting under federal and state laws. As an illustration, environmental permitting of a proposed 200 MWe coal-fired power station in New York State required a Certificate of Environmental Compatibility and Public Need pursuant to Article VIII of the New York State Public Service Law. A US Army Corps of Engineers (ACOE) permit authorising construction in navigable waters (Rivers and Harbours Act) and dredging and filling in wetlands (Clean Water Act) was required, together with a Prevention of Significant Deterioration (PSD) permit (Clean Air Act) issued by the US EPA (Walden, 1990). Other permits and certificates were required but the key point here was the proposed issue of a permit by a federal agency and this federal involvement subjected the proposal to the NEPA process. The US Courts,
Procedures in environmental impact assessment

The procedures for EIA in the USA

- project proposed
  - federal government involved only if federal action is proposed
    - consultation with local, state and federal agencies to determine environmental requirements
      - proponent prepares environmental information document (EID)
        - submission of EID with application to competent authority
          - if potentially significant impacts, EID used as input for environmental assessment (EA)
            - decision
              - public record of decision
                - environmental impact statement (EIS) required
                  - discussion with local, state and federal agencies, public, interested parties, to determine scope
                    - draft EIS prepared by proponent or agency
                      - public review of draft EIS
                        - preparation of final EIS by proponent or agency

- finding of no significant impact (FONSI)

- categorial exclusion from NEPA review possible if clearly no impacts

Where there is federal involvement in a proposal the requirements of NEPA must be met. The effects of the federal undertaking and its alternatives are evaluated and fall into one of three categories. The proposal may be exempted from an environmental analysis if certain criteria are met, or the preparation of written environmental assessment (EA) may be required. The federal agency will base its decision on the environmental information supplied by the proponent. If, on the basis of the EA, the agency determines that the proposal has no significant impact it issues a finding of no significant impact (FONSI). If, however, the proposal is likely to have significant environmental impacts an EIS is prepared.

In certain cases the federal agency itself will prepare the EIS. A federal agency’s role in the NEPA process depends on the agency’s expertise and relationship to the proposal. The US EPA prepares and reviews NEPA documents, as do other federal agencies. The US EPA, however, has a unique responsibility in the NEPA review process in that under Section 309 of the Clean Air Act it is required to review and publicly comment on the environmental impacts of major federal actions including actions which are the subject of EIS. If the US EPA determines that the action is environmentally unsatisfactory it is required by Section 309 to refer the matter to the Council on Environmental Quality (CEQ).

Federal agencies must, as far as possible, integrate the NEPA review with the analytical and consultation requirements of other environmental laws such as the Endangered Species Act and the National Historic Preservation Act. The NEPA review also takes into consideration whether a federal undertaking is in compliance with statutes such as the Clean Water Act and the Clean Air Act.

The CEQ NEPA regulations require federal agencies to make the environmental review documents and any comments and responses a part of the record in formal rulemaking and adjudicatory proceedings. These documents must also accompany the proposal through the federal agency’s review process. In making its decision on a proposal, an agency must consider a full range of alternatives including ones evaluated in the NEPA review.

A federal agency may choose to prepare an EIS without having first to prepare an EA if it anticipates a significant impact, or controversy over a proposal. On completion of a final EIS and at the time of its decision a federal agency prepares a public record of its decision addressing how the findings of the EIS, including consideration of alternatives, were incorporated into the agency’s decision-making process.

4.8 Commentary

Although the requirements for EIA have a common theme from country to country, as described in Chapter 3, the procedures involved in project assessment tend to vary. This
variation not only occurs between countries but often within the countries themselves as a result of how the relevant legislation is administered. A proponent may be involved in consultations with local authorities, state governments, and national or federal government in order to meet the environmental requirements of the project. The involvement of the general public occurs to varying degrees and at different stages of the EIA process, and the process may or may not be monitored by an independent body.

Weak procedures would be those involving a high degree of complexity. A convoluted approach that may involve referring back to participants on numerous occasions, and one that involves public participation at a late stage is inefficient. Procedures that do not allow for the public review of a draft ES may result in the process being considered incomplete and therefore ineffective.

Simplicity is desirable for an efficient and effective EIA procedure. Incorporation of a scoping stage early in the process, which involves effective publicity and full public participation is a key step in an effective process. Public outcry at a relatively late stage is counter-productive. An EIA procedure that involves the participation of an independent competent body to advise on, and monitor the procedures would be superior to one which does not. In The Netherlands the involvement of the CEIA is seen as a significant benefit in performing efficient and effective assessments where costs and delays may be kept to a minimum.
A number of environmental impact assessments (EIA) of recent coal-related projects have been studied in an attempt to establish what experience has been gained in the subject. The first case study report deals with an open-cast mine proposal in the USA, examining the nature of the project and the existing environment, before analysing the approach to the assessment in addition to the assessment itself. The presentation of the environmental impact statement (EIS) is also described in terms of effectively communicating the findings. Further case study reports are presented in a similar vein, covering a large coal-fired power station proposal, an integrated gasification combined cycle (IGCC) demonstration plant proposal, a circulating fluidised bed combustion (CFBC) power station proposal, and as an example of a programmatic EIA, the Clean Coal Technology Demonstration Program (CCTDP). The costs involved in these assessments are dealt with in Section 6.1.

5.1 Case study report: open-cast mine EIA

General
Following initiation of an open-cast mining project in the USA an EIA was carried out (US EPA, 1989a). Sponsored by Diamond Alaska Coal Company, the Diamond Chuitna development would consist of a 10.9 Mt/y coal mine in the Beluga region of upper Cook Inlet, some 45 miles west of Anchorage, Alaska. The development would involve an open pit mine and associated coal transport and port facilities, service facilities and housing. A map indicating the project location is given in Figure 10.

The final environmental impact statement (FEIS) was prepared by the United States Environmental Protection Agency (US EPA) pursuant to Section 102 (2) (c) of the National Environmental Policy Act (NEPA) of 1969 and was published in February 1990. The FEIS is in two volumes totalling 435 pages plus six appendices.

Diamond Alaska Coal Company in association with Granite Point Coal Port Inc and Tidewater Services Corporation applied to the US EPA for National Pollutant Discharge Elimination System (NPDES) permits to discharge pollutants from the mine, port and housing facilities to navigable waters pursuant to the Clean Water Act. These facilities were determined to be New Sources under Section 306 of the Clean Water Act and, according to Section 511 (c) (1) of the Clean Water Act, are subject to the provisions of NEPA. Draft NPDES permits were released for public review concurrently with the draft environmental impact statement (DEIS) on 15 July 1988, and public comments on the draft NPDES permits are included in the FEIS (Appendix D).

The US Department of the Army, Corps of Engineers (ACOE) and the State of Alaska Department of Natural Resources (DNR) were co-operating agencies for the EIS. The ACOE, under the authority of Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act, were to evaluate proposed project-related activities in waters of the USA. A complete description of the proposed activities requiring ACOE authorisation is contained in Appendix C of the FEIS. The DNR is authorised to review, pursuant to the Alaska Surface Coal Mining Control and Reclamation Act (AS27.21, 11 AAC Ch.90), Diamond Alaska Coal Company’s detailed application for a permit to conduct surface mining. This permit application was the subject of a separate state review and approval process, which was completed on 21 August 1987.

The actions to be considered in the FEIS were the approvals of federal NPDES, wetlands, and dredge-and-fill permits for the proposed Diamond Chuitna Coal Project which would consist of a surface coal mine, a haul road, a method of transporting coal to a port facility on Cook Inlet, dock facilities and other ancillary facilities. Figure 11 shows the project area and the location of project options are shown in Figure 12. Three action alternatives and a no-action alternative are discussed in detail. A rationale for eliminating
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Figure 10 Diamond Chuitna project location (US EPA, 1989a)

various options is given. The preferred alternative would include construction of a port site at Ladd, an eastern transport corridor, development of a housing site at Lone Creek and a conveyor system which would run in parallel to the haul road and transport coal to the port site. The impacts of the proposed project are considered in terms of vegetation, fish, wildlife, wetlands, water quality and hydrology (both surface and subsurface), physical and chemical oceanography, air quality, visual resources, cultural resources, subsistence, socio-economics, recreation, technical feasibility and future uses of facilities.

The FEIS consists of 13 chapters and begins with a summary of the purpose of and the need for action, project description, existing environment, scoping, options screening process, identification and description of alternatives, comparison of alternatives, identification of preferred alternative, and environmental consequences of the preferred alternative.

5.1.1 The proposed project

The Diamond Chuitna Coal Project, if fully developed, would involve a 10.9 M/t/y surface coal mine in the Beluga area approximately 72 km west of Anchorage (Figure 10). The coal is subbituminous, low sulphur, low ash, high moisture steam coal with an average of 4250 kcal/kg (7650 Btu/lb). During the projected 34-year life of the project, the area to be mined would be approximately 2029 ha with a maximum of 182 ha of pit being open at any one time.

Mining methods would use shovels, draglines, hydraulic backhoes, front-end loaders and haul trucks. Coal would be initially crushed at the mine and carried to a 22 ha mine service area by conveyor for further crushing and weighing. A port site on Cook Inlet (Figure 11), either at Granite Point south of the mine or at Ladd east of the mine, would receive the coal via a 17.6 km long single-span, 1.2 m wide conventional conveyor. Provisions would be made to prevent spillage at stream crossings and to allow human and large mammal passage across the corridor. The conveyor would be paralleled by a light duty maintenance road and an all-weather gravel/access haul road.

About 104 ha on the bluff above Cook Inlet, at either Granite Point or Ladd, would be occupied by the onshore port facilities. No one would be housed there. A stockpile of up to 1.1 Mt of coal would await shipment at the port. At full production, the offshore port facility would consist of an elevated trestle up to 3810 m long, depending on the port site, which would support twin conveyors for loading coal ships. At maximum length, the trestle would have a berthing
5.1.2 Existing environment

The project proposal is for an area which is largely undeveloped. As a result of past oil, logging and coal exploration activities a system of roadways exists there. The project area, including the Diamond Chuitna coal lease area, is largely state land as is the Trading Bay State Game Refuge to the south (Figure 11). To the east of the project area most of the land is owned or selected by the Tyonek Native Corporation. The majority of the remaining land to the northeast, north and west is owned by Cook Inlet Region, Inc. The Kenai Peninsula Borough has either selected or received selection approval to land at or near both potential port sites.

The project area consists mainly of a broad, gently sloping plateau characterised by irregular ridges and depressions. The southern edge of the plateau ends at a coastal bluff that rises from the gravel beaches of Cook Inlet. Much of the area has poor drainage and contains bogs and ponds. Vegetation consists primarily of spruce-birch forest intermixed with open, muskeg terrain.

A large portion of the project area provides moderate to high quality habitat for moose, brown bear and black bear. Part of a moose rutting concentration area is located within the northern half of the mine site; moose spend the winter in a narrow zone along the coast. Birds occupying the project area include bald eagles, as well as small numbers of trumpeter swans and sandhill cranes.

The Chuitna River originates in the Alaska Range and enters Cook Inlet north of Tyonek village. It bisects the project area and is the major drainage system within it. Several major tributaries are within or next to the proposed mine area and ground water originating within shallow aquifers in the mine area contributes significantly to the flow of streams. Tyonek and Old Tyonek Creeks are separate systems that drain the southern part of the project area. Water resources are unpolluted and water quality is high.

The Chuitna River has important fish resources including rainbow trout, and chinook, coho, pink and chum salmon. The river supports a small but high quality sport fishery and provides salmon to commercial and subsistence fisheries within Cook Inlet. Characteristics of Cook Inlet next to the project area include high tides, strong currents and high turbidity. A number of important species of marine life inhabit the coastal area including Belukha whales and the five species of eastern Pacific salmon.

Air quality within the project area is high and noise pollution is low.

The village of Tyonek, situated 17.6 km southeast of the mine area, is the nearest development to the project area. About 270 people live there and some 95% are Alaska natives. There are no road links with the more populated areas of south-central Alaska; the village is therefore accessible only by air or by sea. Subsistence hunting and fishing are important to the economic, cultural, social and nutritional well-being of most of the permanent residents of the area.

Figure 11 Diamond Chuitna project area (US EPA, 1989a)
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5.1.3 The approach to the EIA

An important chapter is included in the FEIS describing the consultation and co-ordination process involved in the assessment. Throughout development of the EIS the US EPA conducted a broad public and inter-agency consultation and co-ordination programme and the resulting input is incorporated in the FEIS.

The scale and nature of the Diamond Chuitna Coal Project necessitated the involvement of several federal, state and municipal agencies in the EIS process.

Federal agencies

US Environmental Protection Agency
The US EPA is the lead federal agency responsible for preparation of an EIS that meets NEPA requirements, and for issuing NPDES permits for waste-water discharge. The US EPA must also concur on issuance of a Section 404 permit.

US Army Corps of Engineers
The ACOE is a co-operating agency for the EIS. It is responsible for issuing Section 404 wetlands and Section 10 navigable waters dredge and fill permits.
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US Fish and Wildlife Service
The USFWS is responsible for certain threatened and endangered species. It has advised and consulted with other federal and state agencies on fish and wildlife issues.

National Marine Fisheries Service
The NMFS is also responsible for certain threatened and endangered species. It has advised and consulted with other federal and state agencies on anadromous, marine, and intertidal fish and marine mammal issues.

State agencies

Department of Natural Resources
The DNR is responsible for issuing the Surface Mining Permit under authority of the Alaska Surface Coal Mining Control and Reclamation Act. The DNR also is responsible for issuing right-of-way permits across state land, tidelands permits and leases, water rights permits, gravel source permits, permits to construct and modify a dam, and burning permits.

Department of Fish and Game
The Alaska DF&G is responsible for issuing Title 16 permits for any actions in streams in which fish ascend from the sea to spawn (anadromous fish) or which might obstruct fish passage.

Department of Environmental Conservation
The DEC is responsible for issuing a Certificate of Reasonable Assurance that states the proposed project would meet state water quality standards. It must also authorise plans, specifications and proposed methods of operation to assess air quality emission standards and to assure proper disposal of solid wastes. The DEC also reviews oil spill contingency plans.

State Historic Preservation Office
The SHPO is responsible for issuing a clearance for construction following adequate archaeological surveys.

Governor’s Office of Management and Budget
The OMB must concur with the applicant’s coastal zone management consistency determination that, to the extent practicable, the project would be consistent with the approved state coastal zone management plan.

Local government

Kenai Peninsula Borough
The Borough has local government responsibilities for planning, zoning and solid waste disposal permitting and, as a landowner, must issue a right-of-way for the transport corridor across borough lands.

The agencies met for the first time to discuss the project on a formal basis in Anchorage on 11 December 1984. Agency involvement continued in a number of ways:
- a review of a preliminary draft of the DEIS;
- a meeting on 25 July 1985 to discuss the preliminary draft;
- informal telephone calls among US EPA, EIS team members and agency personnel.

The ACOE and the DNR are formal co-operating agencies for the EIS, as provided for in the Council on Environmental Quality regulations governing preparation of an EIS. They provided technical assistance in their areas of expertise and in matters relating to permits within their jurisdictions.

Prior to the formal scoping meetings two pre-scoping meetings were held to provide information about the project and to solicit questions and comments (Table 2).

Table 2 Pre-scoping meetings (US EPA, 1989a)

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Attendance</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Dec 1984</td>
<td>Anchorage</td>
<td>16</td>
<td>State &amp; federal agencies</td>
</tr>
<tr>
<td>12 Dec 1984</td>
<td>Anchorage</td>
<td>2</td>
<td>Alaska Centre for the Environment; Trustees for Alaska</td>
</tr>
</tbody>
</table>

In the early stages a number of scoping meetings were held (Table 3) with the main objectives being:
- to present an overview of the proposed Diamond Chuitna Coal Project;
- to identify the major environmental issues to be addressed in the EIS;
- to identify areas where additional information was needed;
- to receive comments and questions regarding environmental impact concerns;
- to incorporate those comments and questions into the EIS planning process.

Table 3 Scoping meetings (US EPA, 1989a)

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Attendance</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Jan 1985</td>
<td>Anchorage</td>
<td>17</td>
<td>State &amp; federal agencies</td>
</tr>
<tr>
<td>8 Jan 1985</td>
<td>Anchorage</td>
<td>80</td>
<td>Public meeting</td>
</tr>
<tr>
<td>9 Jan 1985</td>
<td>Soldotna</td>
<td>20</td>
<td>Public meeting</td>
</tr>
<tr>
<td>10 Jan 1985</td>
<td>Tyonek</td>
<td>27</td>
<td>Public meeting</td>
</tr>
</tbody>
</table>

Oral and written comments and questions received during and following the scoping meetings were documented in a Responsiveness Summary. The purpose of the Summary was to provide a public record of the issues and concerns raised, to provide a response to those issues and concerns, and to serve as a blueprint for the EIS process to follow. The FEIS contains a table which summarises the comments received.

Public involvement

As part of the scoping process, a meeting was held with
environmental groups in Anchorage on 12 December 1984 and public meetings were held on 8-10 January 1985. The Responsiveness Summary documents and addresses the oral and written comments received from the general public and these groups. A preliminary draft of the DEIS was reviewed by environmental groups in Anchorage and a meeting to discuss the draft with them was held on 26 July 1985. The Native Village of Tyonek and the Tyonek Native Corporation also reviewed a preliminary draft of the DEIS and a meeting was held with representatives from each organisation on 26 July 1985.

The public may informally submit questions and requests for information or express concern at any time. There are further opportunities for the public to participate in the EIS process and these include:

- the formal 60-day period for public review and written comment following publication of the DEIS;
- public hearings during the DEIS review period to discuss updated project status, answer questions, and receive comments on the DEIS. All written comments received during the DEIS review period will be individually addressed in the EIS;
- a formal review comment period following publication of the FEIS;
- public hearings on the DEIS were held during August 1988 in Anchorage, Tyonek and Soldotna. The FEIS contains a chapter describing the public comments and responses to the DEIS.

5.1.4 The assessment

The ‘scoping’ process is the first step of the EIS in the USA. This process is intended to provide an opportunity for the public, interested parties and agencies to assist in defining the significant environmental issues relating to a project. Having been identified, these issues are described in a document called the Responsiveness Summary which is distributed to all interested parties and agencies. The range of alternatives considered in the EIS is determined using these issues as a primary basis.

The scoping process involved the full participation of Diamond Alaska, the public, special interest groups and agencies involved in the EIS process. Ten issues were identified as being of major concern if the project was developed.

A desire to maintain the integrity of the Chuitna River Watershed by minimising impacts to water quality and maintaining proper flows was expressed, as was a desire to maintain the quality of fish habitats in the Chuitna River system and minimise impacts on resident and anadromous fish. Disruption of wildlife and wildlife habitats, including important seasonal use and migration areas is to be minimised.

Substantial areas of vegetated terrain and existing stream courses would be temporarily disturbed by development of the project. Returning these disturbed areas to a biologically productive condition is a significant concern, and it would be necessary to give assurance of successful reclamation of project components.

Impacts to the commercial set net fishery and marine life movements near the port trestle are to be minimised in addition to impacts to subsistence resources, including access to those resources, as traditionally used by local residents. The social, cultural, and economic impacts on local residents are to be minimised.

A regional perspective is to be maintained in order to minimise the cumulative impacts of this and other potential development projects and the chances of system failure are to be minimised by incorporating technically feasible component siting, design and mitigation features. Such component siting, design and mitigation features should be cost-effective.

The ten issues identified as being of major concern in development of the project were addressed following a process of options screening. Here, 31 options for the twelve project components were identified. A two-step options screening process was conducted to determine reasonable options.

The first step involved a review of all options in order to eliminate those which were unreasonable or not feasible primarily for environmental or technical reasons. Nine options were eliminated.

The second step involved the individual evaluation of each remaining option. All options in the applicant’s proposed project were considered to be environmentally and technically reasonable and feasible, so the proposed project was retained to be considered in the analysis of alternatives. For each component where at least one option other than the applicant’s choices remained, options were individually evaluated from the perspective of each resource or technical discipline (water quality, subsistence, technical feasibility). In the event that one of the other options equalled, or bettered an option of the applicant on an overall basis or if it addressed one or more of the ten scoping issues in a significantly more favourable manner, that option was retained for the analysis of alternatives.

In this case the best options for all but two of the project components were relatively easy to identify. Two components, transport corridor/ port site location and housing site location, had three options each that adequately addressed one or more of the ten issues. These options were retained and along with the other nine options were used to form the alternatives (Table 4).

Three action alternatives were identified for the Diamond Chuitna Coal Project. A no-action alternative was also considered. The process of identifying the action alternatives was, in this case, relatively straightforward because only three alternatives (combinations of options) were necessary to address the issues raised by the two components with more than one option remaining (transport/port site location and housing site location). The applicant wishes to retain two transport corridor/port site options (southern/Granite Point...
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Table 4  Diamond Chuitna project action alternatives  (US EPA, 1989a)

<table>
<thead>
<tr>
<th>Project components and options</th>
<th>Action alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Southern/Granite Point</td>
</tr>
<tr>
<td>Mine location* – fixed</td>
<td>✓</td>
</tr>
<tr>
<td>Overburden stockpile location* – southeast</td>
<td>✓</td>
</tr>
<tr>
<td>Mine service area* – south of mining limit</td>
<td>✓</td>
</tr>
<tr>
<td>Transport</td>
<td>a) Corridor/portsite</td>
</tr>
<tr>
<td></td>
<td>1 Southern/Granite Point</td>
</tr>
<tr>
<td></td>
<td>2 Northern/Ladd</td>
</tr>
<tr>
<td></td>
<td>3 Eastern/Ladd</td>
</tr>
<tr>
<td></td>
<td>b) Mode* – conveyor</td>
</tr>
<tr>
<td>Loading facility* – trestle</td>
<td>✓</td>
</tr>
<tr>
<td>Worker housing</td>
<td>a) Location</td>
</tr>
<tr>
<td></td>
<td>1 Lone Creek</td>
</tr>
<tr>
<td></td>
<td>2 Congahbuna</td>
</tr>
<tr>
<td></td>
<td>3 Threemile</td>
</tr>
<tr>
<td></td>
<td>b) Type * – single status</td>
</tr>
<tr>
<td>Airstrip* – new construction</td>
<td>✓</td>
</tr>
<tr>
<td>Water supply* – wells</td>
<td>✓</td>
</tr>
<tr>
<td>Power generation* – purchase gas</td>
<td>✓</td>
</tr>
</tbody>
</table>

* components with only one option

and northern/Ladd) (Figure 12). Two alternatives using these options were identified as the applicant’s proposed project. Development of only one of these transport corridors is proposed by the applicant and the haul road and conveyor would both be built in the same corridor leading to the port site (either Ladd or Granite Point). The third alternative would involve use of the eastern/Ladd option. The three action alternatives and the no-action alternative are described as follows:

**Southern/Granite Point alternative**
In this alternative there would be the fixed mine site and mine service area locations with the overburden stockpile southeast of the mining limit. The conveyor system would be in the southern transport corridor to the port site at Granite Point, where the coal-loading facility would be an elevated trestle. A single-status housing facility with a new airstrip would be at the Lone Creek site. Water would be supplied by wells to all facilities and electric power would be bought from the Chugach Electric Association gas-fired power station at Beluga.

**Northern/Ladd alternative**
This alternative is the same as alternative 1 except the northern transport corridor to a port site at Ladd would be used.

**Eastern/Ladd alternative**
In this case an eastern transport corridor to a port site at Ladd would be used. All other components would be the same as those for the northern/Ladd alternative.

**No-action alternative**
This alternative means that the Diamond Chuitna project would not occur. This would result from denial of one or more of the federal or state permits necessary for project development or from a decision by the applicant not to undertake the project.

**Comparison of alternatives**
Ten issue criteria were identified during the scoping process and the impacts of each of the three action alternatives were compared against those criteria. In order to identify the preferred alternative, the impacts of each alternative were compared relative to one another. Three options remained for the housing/airstrip site, Congahbuna, Threemile and Lone Creek. These were compared to decide whether the Lone Creek option could be substituted by another option in one or more of the alternatives.

**Identification of preferred alternatives**
The eastern/Ladd alternative, using the Lone Creek housing site, had the least overall relative total impact value and was identified as the preferred alternative. Since the eastern corridor would cross private land owned by Tyonek Native Corporation it is not certain whether the applicant could develop such a corridor. At the time of publishing the FEIS the applicant had been unable to negotiate a right-of-way across that land.
Environmental consequences of the preferred alternative

It was found that overall environmental consequences of the entire project would be similar regardless of which corridor alternative were developed. About 2029 ha of vegetated terrain would be disturbed by project components at maximum mine extent. The actual unvegetated surface area at any one time in the life of the mine would be substantially less because of the on-going reclamation of mined-out areas. An important point is that about 24% of the area to be disturbed is classified as wetland.

Impacts on wildlife would include loss of habitat during the life of the mine and for some time after. Moose, brown bear, black bear and small mammals and birds would be affected. Among the more important impacts would be the loss of moose winter range at the proposed port site and a part of a rutting area in the vicinity of the mine. Movement of large mammals would be partially impeded by the conveyor system, although the wildlife crossing areas would allow access across the transport corridor. Wildlife values in the long term are expected to return to the pre-mining condition, following reclamation of disturbed terrain.

Water quality and hydrology of tributaries of the Chuitna River in and next to the mine site would be altered significantly during mine operation and for a long time after. This may extend over the long term depending on post-mining hydrological characteristics and on the success of stream reclamation. Impacts would include increased suspended solids concentrations, higher turbidity and reduced flow in some stream segments. A substantial part of one tributary would be mined through, causing direct loss of habitat.

During mine operation and for some time after there would be a loss of fish productivity including key species such as chinook and coho salmon. Fish productivity loss could be a long-term impact because returning mined-through streams to pre-mining productivity is questionable. It was determined that loss in productivity would have a small adverse impact on the Chuitna River sport fishery and a very small effect on commercial subsistence fisheries in the marine environment.

There would be only local degradation of air quality with no significant impact to populated areas.

Socio-economic impacts to the Anchorage and Kenai Peninsula population centres would be minor or insignificant. There would be both beneficial and adverse impacts to the residents of Tyonek Village; potential benefits would include an increase in employment opportunities and in village income. Increased development and human intrusion into the area would probably cause disruption to traditional native lifestyles and loss of subsistence hunting and fishing opportunities.

5.1.5 Presentation of the EIS

NEPA regulations prescribe the basic format for an EIS and these were followed in presenting the statement which has the following structure:

Cover letter and cover sheet
Table of contents
Summary
1 Purpose of and need for action
2 The proposed project
3 Alternatives including the proposed action
4 Affected environment
5 Environmental consequences
6 Mitigation, reclamation and monitoring
7 Consultation and co-ordination
8 List of preparers
9 EIS distribution list
10 Public response to DEIS
References
Glossary of technical terms, acronyms, abbreviations and measurement equivalents
Index
Appendices

The cover letter at the beginning of the FEIS briefly describes the reasons why the document was prepared, and the cover sheet provides an abstract and remarks on the public review process. In addition, important points of contact are given. The summary stresses major conclusions, areas of controversy, and issues to be resolved.

In Chapter 1 the underlying purpose of the action for which the EIS is being written and why the action is needed is discussed. Chapter 2 describes the individual components of the project as proposed by the applicant and the specific options being considered for each component. A description of how the project will be developed is given together with the mitigation plan included in the project proposal for all project components.

Alternatives including the proposed action constitute Chapter 3 which is described as the heart of the EIS. The initial options that were considered for the project, reasons for the elimination of many and the selection of the final options and alternatives (set of options comprising a total project) are described. Based on information and analysis presented in subsequent chapters (Affected Environment and Environmental Consequences) the environmental impacts of the proposed project alternatives are presented in comparative form to give a clear definition of the issues and to provide a basis for choice by the decision-makers and the public. The preferred alternative is identified and described.

Chapter 4 contains a concise description of the existing environment which would be affected by the development of the project, and in Chapter 5 the potential environmental impacts which could be expected for each alternative are detailed, together with a description of unavoidable impacts, any irreversible or irretrievable commitments of resources and the relationship between short- and long-term productivity. The comparison of alternatives given in Chapter 3 is based on the scientific and analytical data given in this chapter.

Chapter 6 summarises the detailed mitigation and reclamation requirements imposed by the State of Alaska through the Alaska Surface Coal Mining Program and the
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other state permitting programmes, requirements of federal and local permitting programmes, and other measures which could be considered by the permitting agencies. In Chapter 7 the process for soliciting input from agencies and the public, and how the process is co-ordinated with the agencies' permitting processes is described. Chapters 8 and 9 present a list of preparers and the EIS distribution lists, respectively.

Responses to comments received during the DEIS review, both written comments and oral remarks made at public hearings, are given in Chapter 10. The responses indicate how the final document was changed or why no changes were made. The closing chapters contain the list of references, a glossary of technical terms, acronyms, abbreviations and measurement equivalents, and an index. Important supplementary material prepared in connection with the EIS is presented in the six appendices.

Project information centres
The FEIS contains addresses at which project information and related documents, including the baseline studies, Responsiveness Summary, Table of Contents for the detailed Permit Application to Conduct Surface Mining and the DEIS, may be reviewed during normal business hours. Addresses at which sets of the detailed 27-volume Permit Application to Conduct Surface Coal Mining are stored, are also given in the FEIS.

Agency contacts
The FEIS contains addresses of the EIS Project Officer and an EIS Consultant who should be contacted for additional information or submittal of questions and concerns relating to the proposed Diamond Chuitna Coal Project or the US EPA's EIS.

5.1.6 The decision
A permit was granted shortly after publication of the FEIS (Seabourne, 1991).

5.2 Case study report: large coal-fired power station EIA

General
A proposal to build a large coal-fired power station in southern England resulted in an EIA (Central Electricity Generating Board, 1988). The ES was prepared by the Central Electricity Generating Board (CEGB) (now National Power and PowerGen) to accompany its application to the Secretary of State for Energy for consent, under Section 2 of the Electric Lighting Act 1909, to build a coal-fired power station next to the existing oil-fired power station at Fawley in Hampshire, UK. Although this EIA was carried out prior to the operative date of The Town and Country Planning (Assessment of Environmental Effects) Regulations 1988, the CEGB decided to act as if the provisions of Directive 85/337/EEC were already in force. The new power station would be known as Fawley 'B'. The ES which has a length of 139 pages was published in February 1988.

Development of the project would involve construction of the 1800 MWe coal-fired power station and associated systems including a flue gas desulphurisation (FGD) plant, re-routing of existing overhead transmission lines, and construction of a jetty.

5.2.1 The proposed project
The Fawley power station site is located on the west bank of Southampton Water some 11 km south east of Southampton (Figure 13). The site for the Fawley 'B' power station would be adjacent to the existing oil-fired Fawley 'A' power station.

Figure 13 Fawley power station location
The existing power station occupies a part of the 122 ha of land owned by the CEGB. The development would occupy an area of about 80 ha to the south west of the 'A' station and outside of the CEGB's current land holdings, with further land required for the rail link (Figure 14). Temporary use of land would be required during construction. On-site landscaping proposals would require additional land to that required for the power station. This also applies to proposals for off-site landscaping. There is a road link to the 'A' station, but the existing railway line to the north would have to be extended. The existing cooling water intake channel provides facilities for receiving heavy loads by sea. No jetty facilities for berthing tankers exist. Two 400 kV transmission lines run from the 'A' station.

The plant involves a 2 x 900 MWe system incorporating FGD equipment. The station would have a 40-year design life with a lifetime load factor of 76%. For at least the first 10 years the station is expected to operate at 100% output 24 hours a day except for shut down for various reasons such as maintenance.
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A two shift system would operate during the latter part of its life. The unit size proposed for Fawley 'B' is larger than that in current use.

The 'B' station would be located parallel to the 'A' station. An independent jetty would be provided and a new railway line would be constructed from the north of the site. A new pump-house would be built and the new intake would be designed for the docking of roll-on-roll-off ships. A new indoor 400 kV substation would be built to the south west of the larger existing 400 kV substation. The coal stock would be located to the north of the 'B' station away from the foreshore.

The two 900 MWe subcritical pressure boiler and turbine generator units would produce a station electrical output of 1800 MWe. Each boiler and its associated mill bay would be housed in a building approximately 95 m high, 76 m wide and 92 m long. The turbine hall would be approximately 39 m high, 35 m wide and 225 m long. The height of the chimney would be determined by Her Majesty's Inspectorate of Pollution (HMIP) and would probably be about 230 m. The FGD plant would use the limestone/gypsum process. The possibility of supplying heat under a combined heat and power scheme would remain an option and the plant could be modified if required.

The coal stock would occupy an area of 15 ha having a capacity of 1.25 Mt with a height of 15 m. There would be two coal stacker/reclaimers and mobile plant. At full load the power station would require 5 Mt/y of coal which would be carried to the mill bunker bay via an enclosed conveyor system. Low NO x burners would be used in the furnace. A direct pipeline from the nearby Esso oil refinery would supply fuel oil for operating auxiliary boilers and for start-up of the main boilers. Superheated steam from the boilers would then drive the turbines, and cooling water from Southampton Water would be pumped through the condenser tubes.

Flue gases leaving the boiler would pass through the electrostatic precipitators designed to have a 99.7% particulate removal efficiency. Particulate emissions would be less than 85 mg/m 3 (at standard 15°C, 1 bar, 6% oxygen and dry conditions). The fly ash would be pumped to storage silos to await removal from the site. Bottom ash would be removed by a chain conveyor submerged in water, transferred to a conventional belt conveyor system and carried to a 1 kt capacity silo to await sale or disposal. Flue gases would enter the FGD system where SO 2 is removed using a limestone slurry; gypsum of commercial quality being produced as a by-product.

Figure 14 Fawley 'B' site (Central Electricity Generating Board, 1988)
Experience with environmental impact assessment

There would be two main elements to the FGD plant: plant for each boiler/turbine unit, and common services plant incorporating facilities for the import, export, handling, storage, preparation and treatment of the raw materials and products. During base load operation the plant would use about 300 kt of limestone a year, producing about 500 kt of gypsum. Dewatered gypsum would be stored temporarily in a covered storage building and it would then be transferred by covered conveyors to loading facilities for removal from site by road, rail or sea. About 21 kt/y of sludge would be produced and would require disposal. Treated waste-water would be discharged through the cooling water outfall into Stanswood Bay.

A marine terminal consisting of a jetty head and shorearm would be built. The jetty head would be about 650 m long and about 55 m wide in its widest place. The jetty would be designed to cater for the import of coal and limestone and the export of ash and gypsum. Five unloaders would be located on the jetty and a hopper would also be provided. The shorearm would extend from the jetty head to the coal stock area and would be of a trestle type construction consisting of concrete beams supported by tubular steel piles. It would be about 18 m wide and would carry a 6 m wide roadway for two-way traffic, and an enclosed conveyor system.

A rail link to the north would be situated mostly in a cutting, with a short section of tunnel where it intersects a road.

Water treatment plant would be provided to supply high quality water for use in the steam cycle. It may be possible to use treated sewage effluent as process water for the FGD plant. Up to 300 m$^3$/d of domestic (potable) water would be required for general station use. A new cooling water pump-house would be located to the south of the existing 'A' station pumphouse, and it would draw water from the same dredged channel. The cooling water flow rate for the 'B' station would be 50 m$^3$/s with a temperature rise through the condensers of 11°C. The water would discharge via a tunnel into Stanswood Bay. A new outfall located further offshore than the existing 'A' station outfall would be built to ensure maximum dilution and dispersion of the warmed water by stronger currents in deeper water.

Underground cables would carry the electric power to a new 'B' station 400 kV substation fitted with metal clad, gas insulated switchgear, located to the south west of the existing 'A' station 400 kV substation. The new substation would be connected to the existing substation by two new 400 kV cables. Diversion of existing overhead lines would be necessary as would duplication of existing lines in the 3 m diameter tunnel under Southampton Water. No new transmission lines are proposed.

The total duration of project construction works would be seven years. A plan illustrating the construction programme is given in Figure 15.

5.2.2 Existing environment

The project site is within Fawley Parish, the New Forest District and the County of Hampshire. Considerable industrial, housing and leisure development has taken place on the west bank of Southampton Water. There are a number of villages in the immediate locality and the boundary with the New Forest is 3 km to the west. Two Sites of Special Scientific Interest (SSSI) exist adjacent to the project site and the South Hampshire Coast is designated as an Area of Outstanding Natural Beauty (AONB). The Beaulieu Estuary is a National Nature Reserve (NNR), and the Calshot Marshes Local Nature Reserve is incorporated into one of the SSSI's. Two areas near the site have also been designated as County Heritage Sites.

Fawley 'B' will be located in the Hampshire Basin on the western bank of Southampton Water. The Hampshire Basin forms a distinct physiographic unit dominated by Southampton Water and the Solent. It is bordered by the chalk uplands of Salisbury Plain and the Hampshire Downs to the north.

The site is located immediately inland of the existing 'A' station (Figure 14). The saltmarsh and mudflats of the coastal zone are bordered to the east by the deep water channel of Southampton Water. Plateau Gravel extends over much of the site area.

All of the saltmarsh within the study area has been designated as the Hythe and Calshot Marshes SSSI while the southern saltmarsh (Calshot Marsh) located between the existing cooling water intake channel for the Fawley 'A' station and Calshot Spit, has been declared a Local Nature Reserve. In addition, this latter area and the reclaimed Tom Tiddler's Land immediately to the west are part of an AONB. The saltmarsh is fronted, both along the margins of the drainage system and along its seaward edge, by low (0.5 m) cliffs that mark the lateral extent of various grasses that have colonised the saltmarsh. Various annuals and perennials are among the present inhabitants.

The Hythe-Calshot Marshes SSSI is the most extensive mudflat on Southampton Water. Stretching from Calshot to Hythe the site is breached by the development of Fawley Esso refinery which splits the site in two. The site is important nationally for migratory and other wintering birds as well as a range of eel-grasses. The North Solent SSSI extends westwards along the intertidal zone from Calshot Spit and it also supports a wide range of eel-grasses. The designated area also includes valuable riverine habitats. A wide range of wetland habitats is found in two marshy valleys which extend northward from the shore in the NNR which is within the North Solent SSSI.

The South Hampshire coast AONB includes Calshot Spit, Calshot Village, and the Calshot Marshes Nature Reserve. The boundary of the AONB passes within 100 m of the 'A' station and includes the hamlet of Ower. The area continues south west in a narrow band along the coast to the Beaulieu Valley and New Forest.

The area around Southampton Water and the Solent has had human settlements since mesolithic times and it offers a rich archaeological heritage. There are also several listed buildings in the area around the power station site.
Experience with environmental impact assessment

Most of the farmland around the area, including that within the proposed 'B' station site, is managed for arable or livestock purposes. In places where the soils have been disturbed during mineral workings, such as Badminton Common, an impoverished heath vegetation is becoming established. This habitat is more typical of the New Forest a few kilometres to the west. A rich grassland sward exists on common land at Ashlett which may also have been disturbed.

There is a wide range of woodland types, the most characteristic being a mixed woodland where oak, birch and scots pine are frequent. The belt of woodland along the west side of the 'A' station is of this type. Parts of the common land and the 'A' station construction area of Ashlett and the landward edge of Tom Tiddler's Land have been colonised by scrub woodland. Tom Tiddler's Land is a mosaic of marshes and grasslands important for roosting birds and is of interest and potential for nature conservation. Other wetland areas include small reedbeds along the 'A' station's western boundary and herb-rich meadows and reedbeds with the North Solent NNR area.

On a regional air quality basis the Fawley area and surrounding areas of South Hampshire lie between the less polluted South West and the more polluted Midlands, North West and the rural fringes of the south east conurbation. It has been, and continues to be, subject to influence from local industrial and urban developments as well as more distant sources. Rural parts of the area including the New Forest are subject to so-called 'background' levels which are fairly uniform throughout the region. Since 1961 smoke and SO₂ have been monitored in the United Kingdom as part of a national survey. The levels in South Hampshire have shown a downward trend since about 1970. Monitoring in South Hampshire suggests that rural annual average values have decreased from about 45 mg/m³ SO₂ around 1970 to about 25 mg/m³ SO₂ at the time of the assessment.

Water quality is addressed in the ES solely in relation to waste-water discharges from the power station into the Solent. A table is given indicating environmental quality standards for the Solent and current concentrations of selected elements. From the figures shown it would appear that the quality of water in the Solent is well within the required standards. No consideration is given in the ES to other water courses such as streams and ponds.

Terrestrial habitat types have been classified as belonging to

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**Figure 15** Fawley 'B' construction programme (Central Electricity Generating Board, 1988)
Experience with environmental impact assessment

one of twelve major types, which are described with an assessment of their wildlife value in a table given in the ES.

Southampton Water is industrialised with numerous sewage and trade outfalls. The ES states that unlike the terrestrial ecology study, there can be no simple geographical limits circumscribing the marine assessment study area, because areas for a particular organism are determined by its habits and the type of impact considered to be critical for it.

The major commercial fishing activity in the Solent is for native oysters; the Solent is the largest native oyster fishery in Europe and one of the few sustained by natural recruitment. Five areas, including the whole of Stanswood Bay, have been designated European Economic Community Shellfish Waters under Directive 79/923/EEC.

The commercial fishery for the American hard shell clam does not extend to the Fawley area. Prawns were once caught by hand net along the shore of Stanswood Bay, but have not been taken in commercial quantities since the 1950s. Ragworms, catworms and lugworms are dug for angling bait at Ower lake, Calshot and at Lope where commercial quantities are removed. There are no major fishing ports within the Solent area and the area is of low importance; the angling catch is as great as the commercial catch. The species taken commercially include mackerel, mullet, Dover sole, plaice, flounder and thornback ray. Rod and line catches of bass are important. A large proportion of the subtidal Solent was surveyed in 1971 with a more restricted survey in 1986. Typical fauna and flora were found to exist in the three types of community recognised.

A number of areas of high landscape value exist in the surrounding area.

The Fawley site is close to major road, rail and shipping networks. A seasonal 24-hour background noise survey is summarised in the ES. Environmental noise criterion would be established by taking measurements at a specific location.

Socio-economic conditions existing in the area of the project are not specified in the ES, but the socio-economic effects of development are discussed. The human environment appears to vary from affluent rural areas to less affluent urban areas.

5.2.3 The approach to the EIA

Issues of potential environmental significance were determined through a series of consultations with the local authorities in Hampshire, and other statutory bodies. The proponent, the CEGB, states its appreciation of the desire of local authorities to be advised, at first hand, of its proposals and their potential effects. Informal meetings taking the form of presentations and discussions were held with officers and members of New Forest District and Hampshire County Councils during the development of proposals for the present application, beginning in November 1986. Such meetings helped to clarify local conditions, potential significant effects and the concerns of local people.

A number of adjoining local authorities and other statutory bodies which may be affected, either directly or indirectly, by the project have been involved in discussions. HMIP was consulted on matters of atmospheric pollution and other environmental matters. Southern Water Authority was consulted on matters of water abstraction and discharges.

The proponent, CEGB, appointed consultants to consider and advise on product sale or disposal arrangements and transport matters, who prepared reports following discussions with local authorities. Formulation of the proposals contained in the ES also took into consideration the views of a number of other statutory and non-statutory bodies and individuals. CEGB policy was to continue such a consultative process as described above should it receive a Consent in respect of the application.

5.2.4 The assessment

The environmental effects of the project are described under the relevant chapters of the ES.

As far as land use requirements are concerned, the project would need about 80 ha of land outside CEGB ownership. The land includes farmland and a number of residential and commercial properties including some grade II listed buildings.

The effects of construction of Fawley ‘B’ are described in the ES in terms of geology, topography and soils. The effects would be to impact on groundwater and to create spoils of sand and gravel. According to the ES no geological changes are expected following construction. This raises the question of how geology might be affected at all.

Impacts to coastal physiography are rather inconclusive. If appropriate measures were taken the project may have little significant impact on the overall stability of the saltmarsh.

Air quality impacts were assessed as follows: Modelling experiments suggest that the annual average ground level concentration of sulphur dioxide would increase by up to 1 µg/m³ or about 3% along the prevailing downwind direction. The maximum is predicted to occur in the region of Fareham, east of Southampton Water. The maximum annual average concentration in the New Forest due to Fawley ‘B’ is predicted to be about 0.2 µg/m³ which is less than a 1% increase. Preliminary modelling predicted that persistence of visible plumes of length greater than 2 km from the chimney is estimated to occur about 2% of the time. Significant loss of sunlight at a fixed position, however, would be unlikely. No significant impacts from particulate emissions are predicted because suitable mitigating measures will be taken. The operation of Fawley ‘B’ is predicted to increase annual average ground level concentration of NOx by about 1.5 µg/m³ in the region of Fareham, and by about 0.3 µg/m³ in the New Forest. The extra contribution could at most increase the annual average concentration from 30 to 32 µg/m³ NO2 in the area of Southampton Water, with an estimated 1.5% increase in the New Forest. No health or crop damage is expected, even when taken in combination with SO2 concentrations. It is not expected that emissions from
the new power station would have a significant adverse
(presumably increasing) effect on atmospheric ozone
concentration in the locality. The ES states that the release of
carbon dioxide cannot be controlled by any means currently
available and no adverse effects on vegetation are known; the
emission was expected to have no local effect.

Impacts on water quality were considered mainly in relation
to waste-water from the FGD plant, using a mathematical
model. Calculations indicated that FGD plant effluent would
be acceptable for discharge to the Solent following water
treatment.

Construction of Fawley 'B' and associated projects would
mean the loss of some habitat types of value.

No significant adverse effects on the marine environment
were anticipated as a result of the construction and operation
of Fawley 'B'.

The substantial mass of the civil engineering and building
work of the proposed power station would have a significant
visual impact on the local scene, particularly in close views.

Effects due to production of solid by-products (ash, gypsum
and sludges) would be related to their disposal. In the locality
of the project, transport impacts would be most significant,
and for those solid products not having commercial uses,
disposal sites would be required.

The additional road traffic generated during construction of
the power station was expected to compound the problems of
road congestion already experienced in the area. Road
improvements would be required. About 14 rail movements
per day would be expected during the operational phase of
the project. This was not expected to have a significant
impact on road users at level crossings. Recreational sailing
would be affected by the new jetty but this was not expected
to affect commercial shipping.

Impacts due to noise during the construction and operational
phases were not expected to be significant.

The construction of Fawley 'B' was expected to generate
local employment opportunities, and to have a number of
indirect effects on the Hampshire economy. During operation
the project was also expected to have local economic impact,
particularly through retail expenditure.

5.2.5 Presentation of the EIS

The ES is in three parts. Part 1 is an introduction outlining
the purpose of the ES, describing the CEGB and its system
and the statutory background to the consent application.
The need for new generating capacity is explained and alternative
options to building a coal-fired power station at Fawley are
discussed.

Part 2 is the project description, covering the Fawley site,
the proposed plant, land requirements, construction
activities, the operational process, and expected residues and
emissions.

The environmental analysis constitutes Part 3 of the ES. In
this section, the main environmental effects of the proposed
project are described as well as the measures aimed at
avoiding, reducing and remediying such effects. The analysis
focuses on the following: land use and quality; geology,
topography and soils; coastal physiography; terrestrial and
marine ecology; air and water quality; landscape and
architecture; transport; noise, and socio-economic effects.

Every effort is said to have been made to consider the most
up-to-date information available as at 31 December 1987.
Provisions for a supplementary ES were made. A
non-technical summary of the ES was also produced. Copies
of the documents were made available to members of the
public at locations in London, Winchester, Lyndhurst and
Southampton as well as at main libraries in the New Forest
District Council area and at Calshot Craft Centre.

The ES has the following structure:

1  Introduction
2  The CEGB and its system
3  Statutory background
4  The need for new generating capacity
5  Project description
6  The site
7  The plant and its operation
8  Land use and quality
9  Geology, topography and soils
10  Coastal physiography
11  Air quality
12  Water quality
13  Terrestrial ecology
14  Marine ecology
15  Landscape and architecture
16  Solid products
17  Transport
18  Noise (and vibration)
19  Socio-economic effects

The introduction provides background information to the
project and the reasons for producing the ES. The
consultative process is briefly described. Chapter 2 gives a
description of the electricity supply industry and the role of
the CEGB, and Chapter 3 provides an overview of the
statutory requirements for building a coal-fired power station
and its associated projects. Reasons for the proposed project
are discussed in Chapter 4. Electricity supply options and site
options are addressed. Details of the site for the proposed
power station are given in Chapter 5, and Chapter 6
describes the components of the power station, covering coal
handling equipment, boiler house, turbine house, ash
handling equipment and the FGD plant. The marine terminal,
rail connection, transmission connections and water
requirements are also discussed.

Chapter 7 addresses the issues involved in construction of the
power station, including project management, site
preparation, buildings construction and installation of the
plant. Construction materials, traffic and the workforce are
also discussed. The implications of land use plans for the
Fawley 'B' project are considered in Chapter 8 together with
the extent and agricultural quality of land which would be required. An overview of the geology of the area is followed by a description of the site topography and soils in Chapter 9. Effects of construction of the Fawley 'A' power station are described and the corresponding expected effects of the Fawley 'B' project during and after construction are discussed.

The broad effects of the project on the coastline of the local area are discussed in Chapter 10. Main areas of concern are the jetty and cooling water requirements. Chapter 11 considers the potential effects of the power station on air quality in this area. Existing conditions are described and impacts due to sulphur dioxide, particulates and nitrogen oxide emissions are discussed. The significant water quality issues associated with the operation of the power station are addressed in Chapter 12. Particular attention is given to waste-water from the FGD plant. Chapter 13 aims to identify and assess the potential impacts of the proposal on terrestrial ecology in the immediate vicinity of the site. Ameliorative measures are suggested.

In Chapter 14 attempts were made to assess the potential impacts of the proposal on the marine ecology. The scope of effects could not be limited to the local area because of the movements of certain marine organisms. The ES examines economic resources such as fisheries, and also the subtidal ecology. Potential effects are discussed drawing on experience gained during construction and operation of the Fawley 'A' power station. Chapter 15 describes the architectural design of the power station, and the associated projects. The existing landscape is described as is the potential visual impact of the project. Ameliorative measures are described.

Three main types of solid by-product would be produced by the power station; ash from the combustion process, gypsum from the FGD plant, and sludges from treatment of FGD waste-water. Chapter 16 examines the nature of the solids and the marketing and disposal options available for the materials. The potential effects of the additional use of road, rail and sea transport which would arise from the construction and operation of the proposed project are discussed in Chapter 17 and Chapter 18 addresses the issue of noise and vibration effects of the project. Existing background noise is determined and expected noise levels during construction and operation are assessed. Vibration is also considered. Chapter 19 summarises the results of studies of the effects of the project on employment, accommodation and local services, together with the wider economic consequences. Both construction and operational phases are considered.

5.3.1 The proposed project

East Midlands Electricity have entered into a joint venture with British Coal to develop a coal-fired power station on a colliery site. Having considered a number of possible sites, taking into account such factors as fuel quality, life of the colliery, reliability of supply, access to a 132 kV transmission line, the availability of a suitable area on the colliery site, and the environmental acceptability of the location, Bilsthorpe was regarded as the preferred location. The proposed power station layout is shown in Figure 17.

The plant will have a single boiler operating with a CFBC system, and it will include either electrostatic precipitators or bag filters for particulate removal. It will be fully instrumented for remote start-up, operation and monitoring, and as a precaution against malfunction the necessary safety interlocks and trips will be included. Water chemistry will be maintained by chemical dosing and on-site purification of make-up water. Air fans will be housed in an adjacent, acoustically insulated building while the boiler house will be clad for suitable aesthetic appearance and weather-proofing.

A reheate condensing type steam turbine giving an output of 150 MWe at the generator terminals will be used. The steam cycle will include a regenerative feed heating system. Depending on electricity demand plant output will be controlled by the turbine governor valve. The turbine governor system will provide for safe automatic shutdown under abnormal conditions and it will be matched to the requirements of the grid system. The plant is intended for continuous base load operation but it will be capable of load following.

A generator of the cylindrical rotor hydrogen- or air-filled type will be used and it will be cooled by water from the

Experience with environmental impact assessment

power station at Bilsthorpe, Nottinghamshire, UK. A map of the project location is given in Figure 16. The power station will employ CFBC technology. In accordance with The Town and Country Planning (Assessment of Environmental Effects) Regulations 1988, an assessment of the environmental impact of the proposed power station was carried out as part of the application for planning consent (Ove Arup, 1989). The ES was published in July 1989 and it has a length of 103 pages plus nine appendices. In addition other consents will be required from HMIP, the Severn Trent Water Authority, and the Mines and Quarries Inspectorate.

Principal concerns of the proposal relate to the visual impact and the potential impacts of waste disposal activities. Associated activities may cause concern over their visual impact; the power line must be routed such that it is visually acceptable, and should the Secretary of State for Energy require a strategic coal stockpile, visual screening measures will be necessary. The ES does not address the long-term waste disposal requirements of the power station and the associated coal mine. Chemical and physical characterisation of waste products of combustion had not been carried out for the ES and therefore appropriate waste handling and deposition techniques, the implications for leachate generation, as well as final restoration of the wastes could not be addressed (see Section 5.3.6).

5.2.6 The decision

The project proposal met with much local opposition but did not result in a public inquiry. The CEGB withdrew the application.

5.3 Case study report: small CFBC power station EIA

General

It is proposed to build a 150 MWe (400 MWt) coal-fired

power station at Bilsthorpe, Nottinghamshire, UK. A map of the project location is given in Figure 16. The power station will employ CFBC technology. In accordance with The Town and Country Planning (Assessment of Environmental Effects) Regulations 1988, an assessment of the environmental impact of the proposed power station was carried out as part of the application for planning consent (Ove Arup, 1989). The ES was published in July 1989 and it has a length of 103 pages plus nine appendices. In addition other consents will be required from HMIP, the Severn Trent Water Authority, and the Mines and Quarries Inspectorate.

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General

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Experience with environmental impact assessment

Figure 16 Bilthorpe site location
Experience with environmental impact assessment

closed circuit auxiliary cooling system. Static excitation will be supplied with an automatic voltage regulator to maintain the generator terminal voltage within defined limits, and both generator and excitation system will be suitable for running in parallel with the grid.

Steam from the turbine will be condensed in a direct air-cooled condenser. This system results in a small penalty in plant thermal efficiency compared with an evaporative wet cooling tower, but was chosen after consideration of the following factors:

- reduced visual impact (low height, no plume of water vapour);
- no large requirement for make-up water;
- no environmental effects of cooling water discharge;
- no wayleaves required for water supply and return pipelines;
- no significant overall economic penalty with regard to site location being some considerable distance from a suitable water supply.

A number of electrically driven fans will force air upwards past a series of ‘A’ frame finned-tube heat exchangers in the condenser. Small proprietary packaged evaporative cooling units drawing make-up water from an existing licensed borehole on the colliery site will meet the auxiliary cooling water requirements of the plant.

A conveyor system from the colliery will supply coal directly to the power station crushing facility where a small stockpile will be established. Another conveyor will supply coal from the crusher house to the bunker of the boiler house. In accordance with the Secretary of State for Energy’s directives for strategic stocking for security purposes, a separate stockpile of coal will be established near the power station.

About 300 m³ of diesel oil for start-up purposes will be stored in a single cylindrical steel storage tank located in a bunded area for safety reasons and to avoid pollution.

The plant will be connected to the 132 kV system by a 132 kV substation comprising three circuit breaker bays feeding via a double circuit overhead line to the existing 132 kV line.

A number of associated projects and activities will be required for the construction and operation of the power station, as follows:

- a 132 kV power line;
- the disposal of power station ash;
- construction of a coal conveyor;
- a strategic coal stockpile;
- short-term coal reclaim area;
- an electrical switchyard;

Figure 17 Aerial photograph of Bilsthorpe power station layout (Ove Arup and partners, 1989)
Experience with environmental impact assessment

- car parking and setting down area;
- limestone crushing plant at the source quarries.

The boiler house will be about 60 m tall and the height of the stack may have to extend to 120 m. The power station will burn about 700 kt of coal at an 85% load factor and it will use about 55 kt of limestone annually. Blending of coal will take place within the coal preparation plant. Limestone will be supplied from several existing quarries in Derbyshire and will arrive by road. Each truck will have an on-board pneumatic delivery system to feed the pre-crushed limestone to the main storage silo.

The time from placing a contract to entering commercial operation is expected to be three years.

5.3.2 Existing environment

The site covers 89.5 ha and is surrounded either by spoil heaps from the colliery or by colliery buildings (Figure 17). It is presently used for coal stocking and a number of settling ponds are already there. The only built structures on site are an explosives magazine and a sewage pumping works. The site is described as made-up ground from earlier colliery spoil disposal operations; colliery buildings and railway sidings previously being situated on the site. Colliery spoil restricts views into the site in all directions except the west where the colliery itself obscures the view. A revegetated spoil bank lies to the west of the colliery.

The surrounding area is predominantly undulating farmland, large fields and isolated woodland. The village of Bilthorpe is situated 1–2 km to the south west of the project site, and the Bilthorpe area forms part of the catchment for watercourses draining into the lake at Rufford Park. The area slopes generally to the north with drainage ultimately being into the River Maun. Agricultural land in Nottinghamshire is predominantly Grade 3, as classified by the Ministry of Agriculture, Fisheries and Food (Table 5) and it is frequently found to the east of the coal measures of the area. The county also has Grade 2 land which is used to grow a variety of agricultural and horticultural crops. In the immediate vicinity of the colliery spoil disposal site, the land is Grade 2 with some verging on Grade 1, and it is mostly under arable crops. To the west, north and south of Bilthorpe there is Grade 3 land which may be used for growing a variety of crops. Several major areas of woodland are situated to the west and north of Bilthorpe, with numerous smaller woods located to the east. Some 15,000 ha of the county is woodland, of which 3600 ha is ancient woodland. The Sherwood area is a candidate for the new Midland Forest being promoted by the Countryside Commission.

In the immediate vicinity of the project site, the human environment consists of the villages of Bilthorpe (population 3145 (1987)) and Eakring, and various places of employment. Several egg and poultry producers are situated to the south of Bilthorpe and a large grain store and complex is situated at Bell Eau Park. Rufford Country Park and the remains of Rufford Abbey lie about 3.5 km to the north of the project site. Center Parcs Holiday Village at Pittance Park lies to the north northwest with the remains of King John’s Palace being in the north western corner of Clipstone Forest. Sherwood Forest’s famous tree, Major Oak, is situated about 7 km to the north west of the site.

Existing air quality is affected by concentrations of sulphur dioxide in the region of 40 μg/m³.

Ambient noise levels were measured on 2 and 3 May 1989.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Potential use</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Land with no or very minor limitations to agricultural use</td>
<td>Excellent quality</td>
</tr>
<tr>
<td>2</td>
<td>Land with minor limitations which affect crop yield, cultivations or harvesting</td>
<td>Very good quality</td>
</tr>
<tr>
<td>3</td>
<td>Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield</td>
<td>Good to moderate quality</td>
</tr>
<tr>
<td>Subgrade 3a</td>
<td>Land capable of consistently producing moderate to high yields of a narrow range of arable crops or moderate yields of a wide range of crops</td>
<td>Good quality</td>
</tr>
<tr>
<td>Subgrade 3b</td>
<td>Land capable of producing moderate yields of a narrow range of crops, lower yields of a wider range of crops or high yields of grass</td>
<td>Moderate quality</td>
</tr>
<tr>
<td>4</td>
<td>Land with severe limitations which significantly restrict the range of crops and/or level of yields</td>
<td>Poor quality</td>
</tr>
<tr>
<td>5</td>
<td>Land with very severe limitations which restrict use to permanent pasture or rough grazing</td>
<td>Poor quality</td>
</tr>
</tbody>
</table>

Table 5 United Kingdom agricultural land classification (Ministry of Agriculture, Fisheries and Food, 1988)
Experience with environmental impact assessment

Table 6  United Kingdom river water classification (HMSO, 1986)

<table>
<thead>
<tr>
<th>Class</th>
<th>Current potential use</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Water of high quality for potable supply abstractions, game or other high class fisheries; high amenity value</td>
<td></td>
</tr>
<tr>
<td>1b</td>
<td>Water of less high quality than Class 1A but usable for substantially the same purposes</td>
<td>Good quality</td>
</tr>
<tr>
<td>2</td>
<td>Waters suitable for potable supply after advanced treatment, supporting reasonably good coarse fisheries; moderate amenity value</td>
<td>Fair quality</td>
</tr>
<tr>
<td>3</td>
<td>Waters which are polluted to an extent that fish are absent or only sporadically present; may be used for low grade industrial abstraction purposes; considerable potential for further use if cleaned up</td>
<td>Poor quality</td>
</tr>
<tr>
<td>4</td>
<td>Waters which are grossly polluted and are likely to cause nuisance</td>
<td>Bad quality</td>
</tr>
</tbody>
</table>

and it was found that the main source of noise in the area is Bilsthorpe Colliery. There have, however, been no records of any complaints concerning noise from rail, road or the mine.

Three watercourses, Bilsthorpe Brook, Rainworth Water and a tributary of Gallows Hole Dyke exist in the immediate locality. Gallows Hole Dyke is a Class Ib watercourse (Table 6) but Rainworth Water is only a Class 3 river due to poorly controlled sewage works discharges. The project site is within an aquifer protection zone as designated by Severn Trent Water Authority.

Within an approximate 10 km radius of the proposed power station several localities have been designated as SSSIs. These are detailed in Appendix 7 of the ES. Details concerning sites of local ecological importance were not available for the ES.

Although over 140 ancient monuments and 6000 known archaeological sites exist in Nottinghamshire, there is little prospect of archaeological remains within such a disturbed site as the colliery. There are several areas of landscape and ecological significance of national and regional importance within the county, including Sherwood Forest and parts of the Trent Wetlands. Part of Sherwood Forest has been designated by the County Council as a Heritage Area.

Newark and Sherwood District Council has designated an area on each side of the A614(T) road from Bilsthorpe to the south of Warren Hill as a Landscape Enhancement Area, and other nearby areas are similarly defined.

Existing landscape quality is described in the ES and by Newark and Sherwood District Council in the Sherwood Forest Plan as not being of high quality, with the urban form clearly reflecting its strong inter-relationships with the colliery.

Two 132 kV overhead power-lines are located in the Bilsthorpe area; one to the east passing close to Eakring, the other to the south and west of Bilsthorpe which connects the Mansfield, Clipstone and Staythorpe 132 kV substations.

5.3.3 The approach to the EIA

Appendix 1 of the ES discusses the preparation of the ES which was carried out following the requirements as detailed in the Town and Country Planning (Assessment of Environmental Effects) Regulations (SI 1988/1199) and in the Department of the Environment Circular 15/88. Identification of potential environmental impacts was achieved by a method employing a checklist procedure adapted from that presented in the DoE Circular 'Environmental Assessment' and in the 'Manual for the Assessment of Major Developments', published by Her Majesty's Stationery Office (HMSO). The ability to perform a detailed assessment of potential environmental impacts was limited by a lack of detailed information on certain aspects of plant operation and waste disposal. The approach was one of addressing potential impacts of a worst case scenario.

During the course of this assessment a total of 22 organisations were consulted. The ES contains an appendix (2) which lists them:

- Biological Records Centre, Nottingham
- British Coal Corporation
- Council for the Protection of Rural England – Sheffield and Peak District Branch
- Countryside Commission
- Department of the Environment
- Emerson and Renwick Limited
- Forestry Commission
- Health and Safety Executive
- HMIP
- Mansfield District Council
- Meteorological Office
- Ministry of Agriculture, Fisheries and Food
- National Trust
- Nature Conservancy Council

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The project site is situated entirely on 89.5 ha of British Coal land at Bilsthorpe Colliery.

According to the ES impacts on air quality due to annual average emissions of $\text{SO}_2$ and $\text{NO}_x$ are expected to be within the EC limits in Bilsthorpe and the surrounding areas. The extra contribution of $\text{SO}_2$ is expected to be small; 0.36 µg/m$^3$ with a 120 m stack, or 0.57 µg/m$^3$ with a 90 m stack, against a background level of 40 µg/m$^3$. Visual impacts of gaseous emissions are considered not to be significant, and neither are impacts of particulate emissions.

Noise effects during construction and operation of the power station are not expected to be significant. During operation an increase of 2 dB(A) is expected at the nearest houses to the site. Impacts on water quality in the area are inconclusive due to lack of data on CFBC ash, and boiler properties. Mitigating measures would be taken to reduce any likely effects.

The ES concludes that the project is not likely to have significant ecological impacts because the site is considered to be of limited ecological value. Landscaping measures are designed to have a positive impact in providing new habitat.

The visual impact of the buildings and stack on local residents is expected to be relatively low because of their acceptance of the existing colliery landscape. Mitigating measures such as tree planting to screen the power station would be taken to reduce more distant visual impacts.

Mitigating measures with regard to hazard and risk assessment would be taken in consultation with the appropriate authority.

The project is expected to increase car traffic on local access roads by 7% and lorry traffic by 8%. A decrease in lorry traffic might occur if coal presently going off-site by road were to be used at the power station.

The power station would add significantly to the quantities of solid waste generated at the site. The present waste disposal site would have a life of four years from commencement of operation. Grade 2 agricultural land would eventually be lost and long-term waste disposal strategies had yet to be considered.

The coal stockpile would have a significant visual impact but it would be screened by a 90 m bank planted with trees.

Impacts of the power-line corridor could not be considered until a viable corridor was available.

Socio-economic impacts would include employment opportunities during construction with a need for about 100 accommodation units. Impacts on accommodation, medical, education or recreation services due to immigration of workers are not likely to be significant. According to the ES the local economy is likely to experience a positive impact, with some employment possibilities arising during operation.

Details of the existing natural and human environment are given in separate chapters of the ES. Chapter 3 describes the project site and its environs. The main areas of environmental interest are addressed chapter by chapter, considering the potential consequences of the proposed project. A brief assessment of the environmental effects is presented at the end of relevant chapters. The document has the following structure:

Executive summary
1 Introduction
2 Outline of the proposed development
3 The site and its environs
4 Air quality considerations
5 Noise
6 Water requirements and aqueous discharges
7 Ecological, archaeological and historic interest
8 Landscape quality
9 Hazard and risk assessment
10 Traffic generation
11 Materials handling and solid waste disposal
12 Connection to the East Midlands Electricity distribution system
13 Human environment

References
Appendices (9)

The ES begins with a four-page executive summary which introduces the proposed project, the technology employed and its location. The method of preparation of the ES is described before discussing the findings on environmental impacts and socio-economic effects of the project.

The one-page introduction briefly describes the proposed project. Chapter 2 describes the reasons for the development and why this site was chosen. Details of the technology involved and project components are then presented. An explanation of CFBC is given, followed by a description of site layout, visual design and operational characteristics. The chapter concludes with sections describing the fuel and limestone requirement, construction characteristics and timescale, and associated projects. Chapter 3 provides a detailed description of the project site and the surrounding area discussing geology and topography. Soils, agriculture and forestry in the area are described followed by use of neighbouring land. Existing utilities and site development are briefly covered before an extensive account of the Planning Policy Framework and its relationship to the proposed project is given.

The issue of gaseous emissions to the atmosphere is
Experience with environmental impact assessment

addressed in Chapter 4. Meteorological characteristics, existing air quality and expected flue gas emissions are discussed. It is expected that Air Quality Standards will be met. Atmospheric dispersion theory is discussed in the context of this project followed by the method of determining stack height. Sulphur dioxide deposition over the area of interest is discussed and the issue of NO₂ and CO₂ emissions is also addressed along with water vapour and particulate emissions. Mitigation and monitoring plans are described and the chapter concludes with a summary of the overall air quality effects of the project.

In Chapter 5 the issue of noise generation during construction and operation of the power station is addressed. Ambient noise levels are discussed followed by expected noise during construction and operation. Noise control measures are listed and the chapter concludes with a summary of the overall noise effects of the project. The water requirements and discharged water quality are discussed in Chapter 6. Existing drainage from the site, water supply and proposals for effluent discharge are covered. The necessary precautions to protect the aquatic environment during the construction and operational phases are discussed, and the chapter concludes with a summary of the expected overall effects of the project.

A number of SSSI exist within a 10 km radius of the proposed power station; they are listed in Chapter 7. Details of sites of local ecological importance had not been obtained for this ES. The low numbers of lichen species in the area is commented on and is said to be due to the history of high SO₂ in this area. Impacts due to raw material inputs to the power station and those arising from the discharge of atmospheric and aqueous wastes were found to be the only ones of ecological interest. No physical disturbance to natural ecological areas will arise. The ecological consequences of the power station are described in just over one page. Sites of archaeological and historic interest are described and the chapter concludes with a summary of the overall ecological consequences and the possibility of the power-line corridor having an impact on hitherto unknown historic sites.

The visual impact of the project on the surrounding landscape is described in Chapter 8, with an emphasis on viewpoints on local roads. Mitigation measures are heavily reliant on existing visual intrusions (coal mine). Landscape enhancement measures are discussed and the chapter concludes with a summary of the overall effects of the project on the landscape.

Chapter 9 discusses the potential for the project to result in contamination of land. Potential hazards and safety precautions are described.

A detailed account of the expected impact of traffic related to the project during construction and operation is given in Chapter 10, and Chapter 11 describes the delivery mechanisms for the power station coal and limestone supplies, as well as the disposal and possible re-use of gypsum and ash wastes. Environmental impacts arising from these activities are considered in relation to existing arrangements for stockpiling of coal and for spoil disposal at the mine.

A description of the power-line requirements and the potential environmental impacts is given in Chapter 12. Three route options were considered. An assessment of the effects on landscape quality could not be made until a viable corridor is available. In Chapter 13 the existing demographic and socio-economic situation in the project area is described and the employment opportunities during construction and operation are discussed.

5.3.6 The decision

After submission of the ES, a number of modifications were made to the proposed project (Waldron, 1991a). The efficiency of the plant was boosted to reduce the cost of electricity in order to be competitive with electricity pool prices. A 38.4 MWe Gas Turbine exhausting through a waste heat boiler and air preheaters, was added. Cycle efficiency was improved by 2% and the plant cost per kW was reduced. The output was increased from 150 MWe to 210 MWe. This change was not considered to be a major alteration as far as the overall plant was concerned, and the local authority, Nottinghamshire County Council (NCC), was prepared to accept this as an amendment to the planning application.

Further studies were made of the properties of the combined power station ash (with limestone) and colliery discard. This work was expedited using CFB ash obtained from plants operating in the USA and Europe. The proponent intends to carry out a test burn with Bilsthorpe coal and Wirksworth limestone on the 5 MW Lurgi test facility in Frankfurt, Germany. Confirmation of the findings already made are anticipated from this test. A study carried out by the Coal Research Establishment in Cheltenham, UK, assessed leachates, permeability, run off and all other relevant factors to the satisfaction of the National Rivers Authority and NCC.

With regard to ash disposal, the ES and the consequent planning application addressed only the change of usage on the existing tip consent from colliery waste to combined colliery and power station waste. A separate ES (and planning application) is required for additional tipping consents. These were originally scheduled around a 40-year tipping life but due to subsequent changes in available land were reduced to 30 years.

The proposed project is currently on hold pending either a funding from the Government, or a rise in electricity pool prices.

5.4 Case study report: IGCC demonstration plant EIA

General

With the exception of Section 5.4.8, this case study is based on the information published by NV Tot Keuring van Electrotechnische Materialen (KEMA) in the environmental impact statement in July 1989 (Demkolec, 1989). Further research and development will have occurred since that time. Because the EIS was published before the final decision on the choice of gasification and gas cleaning processes was made, it covered the data of each of the candidate processes. The final decision and permit values may therefore differ.
Experience with environmental impact assessment

Regional location

FRANCE

UNITED KINGDOM

NETHERLANDS

Belgium

Germany

Antwerp

London

Rotterdam

Essen

Brussels

Luxembourg

Paris

Regional location

Amsterdam

Nijmegen

Roermond

River Maas

Rhine

Figure 18 Demo IGCC project location

from the data in the EIS. More recent data may be made available to the reader by contacting the organisations involved in this project.

Demkoiec BV was set up by the Dutch utilities' parent organisation Samenwerkende Electriciteits Produktiebedijven (SEP) to undertake an IGCC project in The Netherlands. The plant is to be erected at the Buggenum site near Roermond in the province of Limburg (Figure 18) and is scheduled to go on-line in September 1993. The power plant will have a gross output of approximately 285 MWe, burning clean syngas produced by the coal gasifier. It will be the largest IGCC power plant in the world. It is thought highly likely that coal gasification will be employed increasingly in coal-fired power generation because of the better environmental performance and higher efficiency of coal gasification combined with improvements in gas turbine application. For these and other reasons there is considerable interest in this project which is known as Demo IGCC.

The project proposal required the necessary permits under various Dutch environmental laws (Air Pollution Act, Noise Act, Public Nuisance Act, Water Pollution Act) and an EIA was also required. For this project, permit applications were considered by the Province of Limburg Rijkswaterstaat Office, Limburg (Ministry of Traffic and Waterways, administering the Water Pollution Act). The type of EIS produced is known as an 'installation EIS' – an EIS that is based on a specific location and choice of fuel, on a given size of unit and commissioning date, and on the environmental effects of the proposed activity and its alternatives. Guidelines were provided by the Competent Authorities who received advice from the Commission for Environmental Impact Assessment (CEIA). There were provisions for public participation in the process.

The EIS consists of eight chapters and is 292 pages in length. It begins with a summary of the purpose of the project followed by summaries of each chapter. These deal with the project background and EIA process, a definition of the challenges and goal, the proposed project and its alternatives, the decision-making process, existing environment, environmental effects of the proposed project and its alternatives, a comparison of the environmental effects of the proposed project and its alternatives, and issues on which there is a lack of data.

5.4.1 The proposed project

The Demo IGCC project would involve the construction and
Experience with environmental impact assessment

Figure 19 Demo IGCC project site (photograph courtesy of Demkolec)

operation of an IGCC power station. The plant would be built on an area of land situated south of the Maas power station in Buggenum (Figure 19). The installation would comprise a number of components, including facilities for coal supply, for gasification and gas cooling, for gas cleaning and sulphur recovery, the steam and gas turbines, waste-water treatment plant, air separation systems, and cooling water systems. Coal would be supplied from the existing stockyard at the Maas power station. The EIS contains a schematic diagram of the IGCC process to be employed. Coal gasification for IGCC power generation has been the subject of a recent report from IEA Coal Research (Takekatsu and Maude, 1991).

During the coal gasification process the carbon is converted to carbon monoxide by reacting with added oxygen. Hydrogen is also formed. In comparing various methods of coal gasification it was concluded that the 'entrained flow gasifier' with dry or wet feedstocks would be preferable to the 'moving bed gasifier'. Oxygen would be used as gasification medium. Coal transport would be by conveyor which would be partly underground with the remainder totally enclosed. Impurities are removed from the coal gas during the gas cleaning process. Such impurities include particulates, and gaseous components H2S, COS, NH3, HCN, HCl, and HF. Gas cleaning is a two-stage process in which the non-sulphur compounds and particulates are first removed. Stage 2 concentrates the sulphur compounds to 20 ppm (yearly average) from which solid sulphur is obtained by a two-step process. Any remaining sulphur compounds are emitted as SO2 following combustion. Using coal with 1% S content, the annual average removal efficiency at Demo IGCC is expected to be 98%. The clean syngas is burned to power a gas turbine which in turn drives an electricity generator.

NOx production occurs mainly in the gas turbine and is minimised by saturation of the syngas with water. In addition, special burners would be used and measures to give a short residence time and thorough pre-mixing would be taken. Some NOx production also occurs during sulphur recovery.

A waste heat boiler uses the energy of the spent flue gases to produce steam. Additional steam is produced during the syngas cooling process, and both steam flows are fed to a steam turbine which in turn drives an electricity generator. The spent vapour is condensed and the condensate is used to produce steam in the waste heat boiler and syngas cooling process.

Particulate emissions in this process are low, and emission data for SO2 and NOx via the sulphur recovery plant stack and the waste heat boiler are 10 g/s and 46.3 g/s respectively (see Table 7).

During start-up and shut-down, and emergencies, a flare system will be necessary. Emissions of SO2 and NOx related to start-up and shut-down are 6.7 t/y and 1.2 t/y respectively.

Provisions described in the EIS as ‘best technical means’ will
Experience with environmental impact assessment

Table 7  Emissions data for Demo IGCC (annual average with 1% sulphur coal) (Demkolec, 1989)

<table>
<thead>
<tr>
<th>Sulphur recovery plant</th>
<th>Waste heat boiler</th>
<th>Total, g/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack height, m</td>
<td>Emissions, g/s</td>
<td>Emissions, g/s</td>
</tr>
<tr>
<td>75</td>
<td>SO₂</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>NOₓ</td>
<td>1.3</td>
</tr>
<tr>
<td>Particulates</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

be incorporated to reduce the noise level to the requirements for the Maas power station area.

Cooling water discharge will be in accord with guidelines issued by the Algemene Beraadsgroep Koelwater (ABK). Maximum expected heat output would be 250–285 MWt. Anti-fouling measures would be taken to protect this system. Scrubbing water from the gas cleaning process (20–50 m³/h) would enter the waste-water treatment plant from which it would be evaporated. Data on the various waste-water streams are given in the EIS.

Facilities for temporary storage of slag would use rainwater to reduce dust emissions, and no contamination of groundwater is expected due to the low leachability of the slag. The EIS states that Demo IGCC would produce 32–64 kt/y of slag which would be marketed for subsequent use. Management of by-products from IGCC power generation has been the subject of a recent report from IEA Coal Research (Clarke, 1991).

Coal gasification fly ash production would be 0–32 kt/y according to the EIS. Part of the fly ash would be separated in dry form, depending on the coal gasification process to be supplied, and would be stored in a silo of 2 weeks capacity. The remainder would be wetted and stored temporarily in an impermeable containment area to prevent soil contamination through leaching.

Liquid sulphur would be stored in buffer tanks of about 270 t capacity (2 weeks production at full rate), prior to delivery by road tanker to customers. Sufficient demand for sulphur to guarantee sales was expected.

Water evaporation residue (about 1500 t/y) may contain heavy metal concentrations exceeding the legal limit. When the EIA was carried out it was expected that such residue would either be stored on site in a silo of 750 t capacity, or preferably sold or disposed of by a licensed chemical waste facility.

At the time of publication of the EIS (July 1989) research into applications for coal gasification slag were ongoing. Sales to the existing market for bottom ash (road construction) looked feasible, and other sales possibilities were envisaged. The pulverised coal fly ash market was expected to be a target for coal gasification fly ash. The evaporation residue was even expected to have a niche in the de-icers market on account of its sodium chloride content.

5.4.2 Project alternatives

An important aspect of Dutch EIA requirements is the need to consider the alternatives in relation to the proposed project. This involves the no-action alternative, the project alternatives and the most environmentally acceptable alternative.

In this case, the no-action alternative consists of three scenarios:

1) present situation with units 4, 5 and 6 of the Maas power station in operation;
2) unit 6 in operation only;
3) the situation after the year 2000 when unit 6 is decommissioned and Demo IGCC had not been built (not to be regarded as feasible based on the Electricity Plan 1989-1998 of SEP).

The project alternatives considered were:

- increased sulphur removal efficiency of 99.5%;
- improved gas turbine NOₓ emission control to an average of 50 g/GJ (future alternative);
- application of a cooling tower for the entire Demo IGCC;
- sealed storage for slag and fly ash in silos and sheds.

The most environmentally acceptable alternative comprises the proposed project combined with the project alternatives listed above. Those alternatives, however, could equally be classed as mitigating measures or modifications. This is an indication of the benefit of considering alternatives during, as well as before the EIA process rather than after (could result in significant delays and additional costs).

There are a number of possibilities in relation to the gas scrubbing and sulphur recovery processes. An annual average sulphur removal efficiency of 98% (=10 g/s SO₂) based on 1% S content of coal, is possible. An efficiency of 99.5% (=2.5 g/s SO₂) is possible with an option that is very unattractive in energy terms. Wet scrubber processes could attain 99% (=5 g/s SO₂) efficiency, but these have the disadvantage of additional waste-water streams and lower quality sulphur product.

A number of measures for NOₓ emission reduction are under development, and concern improved combustion chamber
construction for natural gas firing. These so-called ‘dry techniques’ involve:

- adjustment of combustion chambers;
- premixing and lean mix;
- catalytic combustion chambers;
- hybrid combustion chambers;
- internal recirculation.

If these techniques were successfully developed NO\textsubscript{x} emissions could be reduced to 50 g/GJ or less. With this possibility in mind, the combination of such measures with the proposed project was determined to be the most environmentally acceptable alternative. The EIS stresses, however, that this value is a future possibility.

The most suitable cooling tower would be a wet system with natural draught, located north west of the power plant. The dimensions would be approximately 65 m diameter at the base, 60 m diameter at the level of the packs, and 80 m high.

The EIS states that sheds would be used as alternative storage in the case of coal gasification fly ash scrubbing. The same would apply to coal gasification slag which is liberated in wet form in all cases. If coal gasification fly ash were produced in dry form three silos of 11 kt capacity would be a storage alternative.

Various scenarios are described in the EIS regarding the disposal of coal gasification fly ash and coal gasification slag for useful purposes. Three scenarios for electricity production are assumed:

- the nuclear power scenario;
- the pulverised coal scenario;
- the IGCC scenario.

From the analysis it appears that:

- Demo IGCC will result in a slight annual surplus of fly ash until the year 2000;
- in the nuclear power scenario, after 2000 the coal gasification slag and fly ash could find useful application;
- in the IGCC scenario, after 2000 the 1989 situation for sales of fly ash would be maintained (no or small surplus of fly ash);
- in the pulverised coal scenario coal gasification slag is expected to be sold until 2000;
- after 2000 the Demo IGCC slag would contribute to the surplus of bottom ash/slag.

A steering group for long-term storage of coal residues (LOKO) was set up to work towards a long-term storage facility.

5.4.3 Existing environment

The existing environment of the Maas power station is described in terms of soil use and nature values, air quality, water quality, deposition, noise levels, and landscape. Two situations are considered; units 4, 5 and 6 in operation (reference year 1987) and unit 6 only in operation (reference year 1992).

Soil use and nature values

Within an area of The Netherlands (about 1400 km\textsuperscript{2}) around the site, high or very high nature values are given to the environment. The woodland of Limburg was categorised as 56.6\% essential, with less essential woodland occurring in the Peel area and in the Maas valley.

Air quality

Annual average ground level concentrations (\SI{}{\mu g/m^3}) of SO\textsubscript{2}, NO\textsubscript{x} and particulates in the Buggenum area are:

<table>
<thead>
<tr>
<th>Substance</th>
<th>28-35</th>
<th>31-37</th>
<th>45-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO\textsubscript{2}</td>
<td>\textit{(P50 13-18)}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO\textsubscript{x}</td>
<td>\textit{(P50 25-33)}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The SO\textsubscript{2} and NO\textsubscript{x} values are below the human health safety threshold, and the SO\textsubscript{2} value is also below the plant health safety threshold. For the higher percentiles the SO\textsubscript{2} and NO\textsubscript{x} target levels are exceeded. Ambient concentrations of SO\textsubscript{2} and NO\textsubscript{x} in the area are largely due to remote sources, and this is also true for trace elements and hydrocarbons.

According to the EIS the forecast annual contributions of the existing Maas power station to the existing concentrations (\SI{}{\mu g/m^3}) of SO\textsubscript{2}, NO\textsubscript{x} and particulates are:

<table>
<thead>
<tr>
<th>Substance</th>
<th>4.2</th>
<th>1.0</th>
<th>0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO\textsubscript{2}</td>
<td></td>
<td>\textit{(P50 25-33)}</td>
<td>\textit{(P50 25-33)}</td>
</tr>
<tr>
<td>NO\textsubscript{x}</td>
<td>\textit{(P50 25-33)}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After decommissioning of units 4 and 5 the concentrations (\SI{}{\mu g/m^3}) are forecast as:

<table>
<thead>
<tr>
<th>Substance</th>
<th>1.9</th>
<th>0.3</th>
<th>&lt;0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO\textsubscript{2}</td>
<td></td>
<td>\textit{(P50 25-33)}</td>
<td>\textit{(P50 25-33)}</td>
</tr>
<tr>
<td>NO\textsubscript{x}</td>
<td>\textit{(P50 25-33)}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Water quality and availability

There is a considerable flow range in the River Maas, in which the water quality standards are met most of the time, but are sometimes exceeded. About 32 species of fish occur in the Maas area, including members of the salmon family. The waters of the area are generally well buffered and insensitive to acidic deposition. Certain small bodies of nutrient-poor waters occurring on chalk or sandy soils are, however, sensitive to acidic deposition.

The Maas enters The Netherlands at Eysden. Thermal discharge into the Maas upstream of Eysden results in an average water temperature increase of 2.6°C at Eysden, with a maximum of 4°C. The maximum was not expected to increase because of the introduction of 1990 quality standards in Belgium, but the average is expected to increase.

Deposition

The average total acid deposition in Central and North Limburg is 6100 mol H\textsuperscript{+}/ha y, largely due to sources in other countries. The maximum contribution of the Maas power station is 579 mol H\textsuperscript{+}/ha y and is expected to fall to 255 mol H\textsuperscript{+}/ha y after decommissioning unit 6 in the year 2000.
Experience with environmental impact assessment

<table>
<thead>
<tr>
<th>Period</th>
<th>Proponent action</th>
<th>Authority action</th>
<th>Others</th>
<th>Proponent action</th>
<th>Authority action</th>
<th>Others</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>notice of proposal</td>
<td>announcement</td>
<td></td>
<td>participation and advice</td>
<td>guidelines</td>
<td>CEIA</td>
<td></td>
</tr>
<tr>
<td>2 months</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>discussion</td>
<td>guidelines</td>
<td></td>
<td>preparation of EIS</td>
<td>submit EIS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 weeks or 2 months</td>
<td>decision on acceptability of EIS</td>
<td>announcement</td>
<td>2 months or 6 weeks + 1 month</td>
<td>participation and advice</td>
<td>advice CEIA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 month</td>
<td>evaluation of environmental effect</td>
<td></td>
<td>6 months</td>
<td>decision on suitability of applicant</td>
<td>announcement</td>
<td>objections, advice</td>
<td>1 month</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 - 2 months</td>
<td>preparation of draft decision</td>
<td>objections, advice</td>
<td>decision</td>
<td>2 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 month</td>
<td>appeal</td>
<td>appeal</td>
<td>1 month</td>
<td></td>
</tr>
</tbody>
</table>

Figure 20  The EIA process for Demo IGCC (Demkolec, 1989)

Noise
Noise zones for Demo IGCC were established in draft on the basis of the noise levels from the Maas power station. Noise load in the direction of Buggenum is expected to decrease after decommissioning of units 4 and 5.

Landscape
The EIS states that beyond 2 km from the Maas power station its only influence on the landscape is as an orientation point. Within a 2 km radius the effect is greater.

5.4.4 The approach to the EIA

The Electricity Plan 1989-1998 is based on government policy for electricity generation aimed at fuel diversification and an internationally competitive electricity price. Within the framework of the Plan decisions were made with regard to Demo IGCC concerning its location, commissioning date, unit size and fuel. The final location was based on the electricity supply structure scheme. Prior to commencement of construction, permit decisions were required under the Air
Experience with environmental impact assessment

Pollution Act (Wet inzake de Luchtverontreiniging (WLV)), the Public Nuisance Act (Hinderwet (HW)), the Noise Act (Wet Geluidhinder (WGH)), and the Water Pollution Act (Wet Verontreiniging Oppervlaktewateren (WVO)). The EIA process ran in parallel with the permit requests, as shown in Figure 20.

Requirements specific to Demo IGCC are given in a number of documents:

- Energy Policy Part 2/coal (1989);
- Electricity Supply in the Nineties (government viewpoint on the national energy policy debate, 1985);
- Electricity Supply Structure Scheme (part e, text after parliamentary discussions);
- Electricity Plan 1989-1998;
- Environmental Programme 1988-1991 (Dutch House of Commons 1987) and National Environmental Policy Plan (Dutch House of Commons 1989);
- Combustion Facilities Emission Standards Decree WLV (1987);
- The Indicative Water Plan 1985-1989 (1985);
- State Waters Quality Plan (1987) including temporary guidelines for cooling water discharge (Appendix 3);
- Domestic Water in The Netherlands (1984);
- Regional Plan for North and Central Limburg (1982);
- Province of Limburg Environmental Paper (1985);
- Dust, $SO_2$ and Particulate Abatement Programme 1987-1988 (1987);
- Sound Zoning of Maas Power Station (1987) (draft);

5.4.5 The assessment of the proposed project and alternatives

Air quality

Annual average expected environmental concentration of $SO_2$, $NO_2$ and particulates for the proposed project and its alternatives are given in Table 8.

Fly ash emissions of 10 t/y are expected to give a maximum annual average concentration of <$15 \mu g/m^3$. The expected overall contribution of major elements is <$10 \mu g/m^3$, and of minor and trace elements is <$0.15 \mu g/m^3$. The estimated annual average contribution of gaseous elements to concentration is largest for fluorine at $6 \mu g/m^3$.

During start-up and shut-down, and plant failures the maximum 30-minute average $SO_2$ and $NO_2$ concentrations are expected to be 200 $\mu g/m^3$ and 20 $\mu g/m^3$ respectively.

Mist formation is theoretically possible whether a cooling tower is incorporated or not, but is more likely with once-through cooling than with a cooling tower. During operation of the Maas power station, however, mist formation has never occurred according to the EIS.

Water quality and availability

Cooling water from Demo IGCC would be discharged into the River Maas. The ABK guidelines apply and allow a

Table 8 Expected environmental concentrations for the proposed project and its alternatives (annual average) (Demkolec, 1989)

<table>
<thead>
<tr>
<th>Situation</th>
<th>Environmental concentration, $\mu g/m^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$SO_2$</td>
</tr>
<tr>
<td>Proposed project (Demo IGCC)</td>
<td>1.2</td>
</tr>
<tr>
<td>99.5% sulphur recovery alternative</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Future alternative for gas turbine $NO_x$ emissions of 50 g/GJ</td>
<td>1.2</td>
</tr>
<tr>
<td>Limits</td>
<td>75</td>
</tr>
<tr>
<td>Target values</td>
<td>30</td>
</tr>
</tbody>
</table>

warming of the River Maas of 3°C above background level ($T_x$). A table is given in the EIS indicating the results of the analysis for the Maas at Buggenum and concludes that incorporation of a cooling tower would greatly reduce thermal discharge.

Water quality standards for oxygen content specify a minimum level of 5 $g/l$, and water discharged from the proposed project or its alternatives would meet this standard. It is likely to meet the standard of 6 $g/l$ for fishing waters, and incorporation of a cooling tower would be a further improvement. The EIS states that the fish population of the River Maas is unlikely to be affected by fish deaths caused by the cooling water intake.

Intermittent dosing of cooling water with NaOCl and the eventual continuous chlorination during three weeks per year are expected to have minimal effect on fish. Although chlorinated organics are formed as a result, their concentration is expected to remain below 1% of the total chloride concentration. Furthermore, the input of chlorine is expected to have no effect on the increasing salmon population of the Border Maas.

The low concentrations of $FeSO_4$ (for corrosion prevention) in the cooling water are not expected to have any effect on the fish, and the chlorides and ammonium contained in the waste-water from the neutralisation pit would cause an increase in background concentration of <$1\%$.

Deposition and soil contamination

Acidic deposition would be as follows:

<table>
<thead>
<tr>
<th>Situation</th>
<th>Acidic deposition, mol $H^+/ha$ y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demo IGCC</td>
<td>126</td>
</tr>
<tr>
<td>99.5% S removal alternative</td>
<td>22</td>
</tr>
<tr>
<td>Future gas turbine technology with 50 g/GJ $NO_x$ emission</td>
<td>124</td>
</tr>
</tbody>
</table>
Experience with environmental impact assessment

The maximum contribution of Demo IGCC to background acidic deposition is expected to be low for the proposed project (2.1%), and the alternatives considered above (0.4% and 2.0% respectively).

Wetting of the coal gasification slag and fly ash would reduce dust emissions to below 1 g/m² per month, and the low leachability of the slag is not expected to result in soil contamination. An impermeable lining would be applied to the fly ash storage facility to prevent leaching. The alternative of using sealed slag and fly ash storage facilities would eliminate the possibility of dust emission and soil contamination.

Noise
After commissioning of Demo IGCC, noise levels would increase in every direction, mainly to the south towards the River Maas. When unit 6 is decommissioned the noise levels in the northerly direction towards Buggenum, and in the westerly direction towards Haelensche Broek will be lower than in the existing situation.

Safety
The presence of CO and H₂S in the coal gas constitutes a toxic hazard, and although the plant would be constructed to a standard above that required by the regulations, the possibility of leakage cannot be discounted. Two scenarios were considered in which a 50 mm diameter hole occurs, and in which complete line failure occurs (although this scenario is not considered to be realistic). The worst case scenario would result in limited effects to humans at a distance of 1 km; headaches, nausea and dizziness would occur due to CO, and slight irritation would result from H₂S which also causes a bad smell nuisance. There would be no danger of fire or explosion outside the plant area, and the EIS states that there is none in the existing situation. There would be no significant cooling effect on the surrounding area in the event of total failure of liquid oxygen storage facilities.

Landscape
The visual impact of the Maas power station is expected to decrease after commissioning of Demo IGCC according to the EIS. This is due to the lower height of the new buildings (75 m maximum), and the chemical plant character of the project which appears to be more visually acceptable. Incorporation of a cooling tower would increase the visual impact.

Effects of air contaminants
Existing levels of SO₂ and NO₂ are below the safety threshold for human life but above the target levels. Retardation of plant growth is possible. The maximum contribution to background levels by Demo IGCC would amount to 5% of the permitted level of 2400 mol/ha y stated in the National Environmental Policy Plan, and is considered too low to cause local effects. It is also considered unlikely that trace element emissions would have any effect on flora, fauna and soil.

Comparison of environmental effects of the proposed project and its alternatives
The comparison was based on the potential environmental effects and the current standards and guidelines.
Experience with environmental impact assessment

Table 9  Comparison of air quality and acidic deposition impacts of the proposed project and its alternatives, in relation to government policy (Demkolec, 1989)

<table>
<thead>
<tr>
<th>Situation</th>
<th>Environmental concentrations, μg/m³</th>
<th>Acidic deposition, mol H⁺/ha y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SO₂</td>
<td>NO₂</td>
</tr>
<tr>
<td>Background level, annual average</td>
<td>28–35</td>
<td>31–37</td>
</tr>
<tr>
<td>50 percentile, (P50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4.2</td>
<td>1.0</td>
</tr>
<tr>
<td>B</td>
<td>1.9</td>
<td>0.3</td>
</tr>
<tr>
<td>C</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>D</td>
<td>1.2</td>
<td>0.1</td>
</tr>
<tr>
<td>E</td>
<td>&lt;0.05</td>
<td>0.1</td>
</tr>
<tr>
<td>H</td>
<td>1.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Limits (P50)</td>
<td>75</td>
<td>50†</td>
</tr>
<tr>
<td>Target levels (P50)</td>
<td>30</td>
<td>25</td>
</tr>
</tbody>
</table>

* ≤ 10 μm  
† VROM estimate  
‡ desired level  
§ VROM proposal  
¶ VROM proposal for year 2000  
VROM = Ministry of the Environment

According to the EIS a decrease in noise levels is expected after decommissioning of units 4 and 5 (situation B) relative to situation A. In the northerly direction the decrease is expected to be 1–2 dB(A), 1 dB(A) in the westerly direction, and 5 dB(A) in the southerly direction. The increase in noise levels expected after commissioning of Demo IGCC (situation C) will be greatest in the southerly direction (5–6 dB(A)). An increase of 0.5–1.0 dB(A) is expected to the north and west, while the east would receive an increase of about 3 dB(A). Situation D with Demo IGCC only in operation would cause a decrease of 2 dB(A) to the north and west; lower than the present level. The decrease to the south would be 1 dB(A).

The limits specified in the draft of the noise zone scheme for the Maas power station would be met in situations A–D. Incorporation of a cooling tower (situation F), however, is expected to result in the limits being breached.

By-products from the existing Maas power station amount to 127 kt/y of fly ash and 17.3 kt/y of bottom ash, reducing by 50% after decommissioning of units 4 and 5 (situation B). Commissioning of Demo IGCC would not result in by-products of greater quantities than are produced at present (situation A), but there would be more diverse by-products: coal gasification slag, coal gasification fly ash, bottom ash, fly ash, sulphur and evaporation residue. In every situation useful applications for by-products would be sought.

In the present situation (A and B) there is negligible risk of injury to local inhabitants due to an accident occurring at the Maas power station. The risk would increase somewhat after commissioning of Demo IGCC (C and D).

After commissioning of Demo IGCC the visual impact of the plant is expected to decrease relative to the present situation (A), with the new plant having the appearance of a chemical plant. Incorporation of a cooling tower, however, would increase the visual impact.

Table 10 summarises the most important environmental effects of the proposed project and its alternatives.

5.4.6 Uncertainties

The EIS addresses the areas where data are lacking.

The NOₓ reduction technology developed for natural gas-fired turbines had not been assessed for coal gas-fired turbines.

Further research into the applications for coal gasification slag and coal gasification fly ash, and evaporation residue is necessary.

The possibility of reducing CO₂ emissions is a challenging area of research with high costs associated with currently postulated solutions. An increase of >65% would be expected in generating costs.

At the time of publication of the EIS the relationship between coal composition and ash composition at IGCC plants was not fully understood.

Long-term exposure to air pollutants is being investigated by various institutions, for example, KEMA in The Netherlands. Additional work is required to determine the effects of washing out the various components of flue gas plumes.
Experience with environmental impact assessment

Table 10 Overview of the most important environmental effects of the proposed project and its alternatives (Demkolec, 1989)

<table>
<thead>
<tr>
<th>Situation</th>
<th>Air</th>
<th>Water</th>
<th>Soil</th>
<th>Noise</th>
<th>By-products</th>
<th>Safety</th>
<th>Landscape</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Existing situation, zero option</td>
<td>16.93 kt SO₂/y 4.2 µg/m³</td>
<td>10.420 kt NO₃/y 1.0 µg NO₂/m³ Particulates 405 t/y 0.1 µg/m³</td>
<td>Thermal discharge 690 MWt, max</td>
<td>Acidic deposition 579 mol H⁺/ha y</td>
<td>Outlined in EIS, Figure 5.6.1</td>
<td>Fly ash 127 kt/y Bottom ash 17.3 kt/y</td>
<td>Very little risk to residents</td>
<td>Some impact n/a</td>
</tr>
<tr>
<td>B Unit 6, zero option</td>
<td>9.22 kt SO₂/y 1.9 µg/m³ 3.24 t/y NO₃/y, 0.3 µg NO₂/m³ Particulates 200 t/y &lt;0.05 µg/m³</td>
<td>Thermal discharge 298 MWt, max Chemical influence</td>
<td>Acidic deposition 255 mol H⁺/ha y</td>
<td>Decrease in all directions</td>
<td>Fly ash 48.2 kt/y Bottom ash 6.6 kt/y</td>
<td>= A = A n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Unit 6 +Demo IGCC, proposed project</td>
<td>9.4 kt SO₂/y 2.0 µg/m³ 4.075 kt NO₃/y 4.0 µg NO₂/m³ Particulates 207 t/y &lt;0.05 µg/m³</td>
<td>Thermal discharge 590 MWt, Additional NaOCl discharge</td>
<td>Acidic deposition 279 mol H⁺/ha y Limited effect of fly ash slag storage</td>
<td>Increase in southerly direction</td>
<td>Bottom ash + CG slag 38.6-70.6 kt/y Fly ash + CG fly ash 48.2-80.2 kt/y Sulphur 5.6 kt/y</td>
<td>Evaporation residue 1.5 kt/y</td>
<td>Limited toxic risk from CO and H₂S Somewhat less than A n/a</td>
<td></td>
</tr>
<tr>
<td>D Demo IGCC only, proposed project</td>
<td>253 t SO₂/y 1.2 µg/m³ 1.167 kt NO₃/y 0.1 µg NO₂/m³ Particulates 10 t/y &lt;0.05 µg/m³</td>
<td>Thermal discharge 285 MWt, max Better than C</td>
<td>Acidic deposition 126 mol H⁺/ha y Better than C</td>
<td>Decrease in northern and westerly direction</td>
<td>CG slag 32-64 kt/y CG fly ash 0-32 kt/y Sulphur 5.6 kt/y</td>
<td>Evaporation residue 1.5 kt/y</td>
<td>= C Less than A and C n/a</td>
<td></td>
</tr>
<tr>
<td>E 99.5% sulphur recovery alternative</td>
<td>64 t SO₂/y &lt;0.05 µg/m³ NO₃ = D Particulates = D</td>
<td>= C/D Acidic deposition 22 mol H⁺/ha y Better than C/D</td>
<td>= C/D = C/D = C/D = C/D NFL 1.1 million per year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F Cooling tower = C/D</td>
<td>Thermal discharge decreases depending on operation of cooling tower. No additional NaOCl discharge</td>
<td>= C/D Expected increase in draft noise zone</td>
<td>= C/D = C/D Greater impact NFL 2.25 million per year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G Sealed slag and fly ash storage H</td>
<td>Limited reduction in fly ash emission = C/D = C/D = C/D = C/D = C/D = C/D = C/D NFL 1.15 million per year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demo IGCC + gas turbine with NO₃ with NO₃ emission of 50 g/GJ</td>
<td>600 t NO₃/y 0.1 µg/m³, NO₂ SO₂ = D Particulates = D</td>
<td>Acidic deposition 124 mol H⁺/ha y Better than C/D</td>
<td>= C/D = C/D = C/D = C/D Not known</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Dutch author of the EIS states that in order to determine the rise above the natural temperature of the River Maas in the neighbouring country, Belgium, information about installed capacity, unit load, cooling tower use, and other sources of thermal discharge, would be required. Such information was not available to that author.

Since data on fish population in the River Maas are qualitative and not quantitative, the effects of cooling water intake could not be determined quantitatively.

Feasibility studies were under way regarding development of the existing Maas power station area. This involved a proposed municipal waste incinerator and fly ash processing plant.
Experience with environmental impact assessment

An evaluation of the EIS would be carried out, and would involve emissions to the atmosphere, resulting environmental concentration, deposition, cooling water discharge, noise, and disposal/sale of residues. The scope and method of such an evaluation had not been determined at the time of publication, but the evaluation programme would be implemented within a year of the permit being issued.

5.4.7 Presentation of the EIS

The EIS was prepared in accordance with the requirements of the Environmental Protection (General Provisions) Act 1986 and has the following structure:

Table of contents
Acronyms and abbreviations
Summary
1 Introduction
2 Purpose of and need for action
3 The proposed project and its alternatives
4 The decision making process
5 Existing environment
6 Environmental consequences of proposed project and alternatives
7 Comparison of environmental consequences
8 Uncertainties
References
Appendix

The summary provides a non-technical account of each of the topics discussed in the main chapters. In Chapter 1 the proposed project is introduced, with an account of the situation leading to its proposal. The scope and procedure of the EIA is also described, together with the contents of the EIS.

Chapter 2 provides a definition of the problems leading to the need for the project, and the aim of the work. IGCC technology is described and compared with conventional pulverised coal- and gas-fired combined cycle technologies in terms of air quality, water, soil, by-products, noise, visual aspects and safety. An evaluation is made and the chapter closes with a description of the electricity plan 1989-1998 and the project goal.

In Chapter 3 the proposed project is described in detail addressing each component separately. System safety is covered as well as end use possibilities for residues. The alternatives are described, including the no-action alternative, and the final section of the chapter deals with the most environmentally acceptable alternative.

Chapter 4 provides a description of the decision-making process, illustrating how the EIA process proceeds concurrently with the permit application.

The existing environment in the area of the Maas power station is described in Chapter 5. Issues addressed include soil, cultural heritage, air quality, water quality, and others. The existing environment is considered as well as the expected environment in 1992 when unit 6 only is in operation.

| Table 11 Timetable for the Demo IGCC permit application and EIA process (Hellemans, 1991) |
|-----------------------------------------------|---------|
| EIS Application | Application |
| 1 Submission | 23.08.89 | 23.08.89 |
| 2 Publication/ announcement | 09.10.89 | 09.10.89 |
| 3 Hearing | 26.10.89 | 26.10.89 |
| 4 Objections/advice (1 month) | 09.11.89 |
| 5 Advice examined by CEIA | 09.12.89 (end) | – |
| 6 Draft granted | 29.01.90 |
| 7 Objections (0.5 month) | 13.02.90 |
| 8 Final decision | 06.04.90 |
| 9 Publication of final decision | 20.04.90 |

Chapter 6 addresses the environmental consequences of the proposed project and its alternatives. The effects of Demo IGCC and unit 6 in operation are described as well as those with Demo IGCC only in operation. Standard environmental components are considered together with safety and emergency scenarios, and the models used for the study are included in the chapter.

A comparison of the environmental consequences of the proposed project and its alternatives is given in Chapter 7. Topics covered include air quality, emissions, environmental concentration, mist formation, cooling water discharge, deposition and soil contamination, noise, safety and landscape.

Chapter 8, the final chapter of the EIS, addresses uncertainties involved in the assessment. Issues such as the possibility of greater NO\textsubscript{x} reduction, the effect of CO\textsubscript{2} emissions, the composition of inorganic emissions and the effect of the cooling water intake on aquatic systems, are discussed. The exact format for the EIS evaluation programme had yet to be defined at the time of publication, and this is addressed.

An Appendix describing the dispersion models used for the calculations concludes the document.

5.4.8 The decision

The EIS was submitted together with the permit application to the competent authority, Province of Limburg, on 23 August 1989. The timetable of events following the submission is given in Table 11. No significant delays or other problems were encountered. One objection to the
proposed project going ahead was treated as a matter of urgency and was resolved at the High Court within a matter of weeks. It was deemed to be invalid. Other objections were to be reviewed over three years following the issuance of a permit. All written comments received were published together with the response to them (Hellemans, 1991).

The CEIA requested some further technical information during its review and the EIS was finalised within three and a half months of submission. The permit was granted eight months after the application was received.

Although construction of Demo IGCC was able to begin, the permit contains certain details of environmental performance requirements as part of the ongoing project analysis.

5.5 Case study report: a programmatic EIA

General
An example of how the EIA process may be applied to a government programme can be seen in the case of the Clean Coal Technology Demonstration Program (CCTDP) in the USA (US DOE, 1989).

The Final EIS was published in November 1989 having been prepared by the US Department of Energy (US DOE). It is a document of some 300 pages including three appendices and it is divided into nine chapters.

The proposed action evaluated in the programmatic EIS (PEIS) was the continuation of the CCTDP involving the selection, for cost-shared federal funding, of one or more clean coal projects proposed by the private sector. Successful demonstration of certain clean coal technologies could lead to widespread commercialisation and the PEIS addressed the potential environmental impacts of this in the year 2010. The US DOE will use the data obtained during the EIA, along with other information, in its decision-making on specific proposals during the selection process.

5.5.1 The approach to the EIA

The process began when, on February 7, 1989, the DOE published a ‘Notice of Intent’ (NOI) to prepare an EIS for the CCTDP. This solicited comments on environmental issues related to the CCTDP and on a Programmatic Environmental Impact Analysis (PEIA) which was published in September 1988. The NOI stated that the PEIA would be used as the basis for preparing the EIS. In response to the draft PEIS, which was issued in July 1989, comments were received and were incorporated in the final PEIS with changes being made accordingly.

5.5.2 The assessment

Two alternatives were considered in the evaluation. The no-action alternative assumes that the CCTDP is not continued and conventional coal-fired technologies with FGD and NOx controls would continue to be used. The proposed action alternative assumes that CCTDP projects will be selected for funding and that successfully demonstrated technologies will undergo widespread commercialisation by the year 2010.

The overall analysis considers potential changes to output of SO2, NOx, CO2 and solid wastes. Assuming full market penetration, the upper limits of change to these four parameters was calculated for each of 22 clean coal technologies. As a result of the analysis, using data from the Regional Emission Database and Evaluation System (REDES), it was shown that repowering and retrofit of clean coal technologies capable of attaining New Source Performance Standards (NSPS) could lead to a significant reduction in SO2 and NOx output relative to the no-action alternative in 2010. Repowering technologies were shown to be the only category in which all technologies could lead to a measurable reduction in CO2.

Solid waste output was shown to vary with each technology ranging from a 23% decrease to an increase by the same amount relative to that of the no-action alternative.

The conclusion of this PEIS is that commercialisation of the clean coal technologies would have a beneficial effect on air quality and could reduce current impacts of acidic deposition. If use of clean coal technologies resulted in a reduction in the quantity of coal burned, then the quantity of CO2 produced would decrease in direct proportion.

The PEIS also considers other potential effects of the CCTDP such as those on land use, ecological systems, water resources, endangered and threatened species, socio-economic resources, and on human health and safety.

5.5.3 Presentation of the EIS

The document is well structured beginning with a cover sheet giving details of the lead agency and an abstract of the PEIS. Details of contacts for further information are also provided there. The document is structured as follows:

Executive summary
1 Purpose and need
2 Alternatives
3 Affected environment
4 Environmental consequences
5 Relationship to federal environmental requirements
References
List of preparers
List of recipients
Glossary
Appendices

The preliminary pages contain an executive summary of about ten pages which adequately describes the evaluation. The first chapter documents the purpose and need for the proposed action describing first the purpose of the CCTDP, its goals and strategy, and the various solicitations on the programme. The need for the CCTDP is discussed in relation to the demand for increased use of coal and the impediments to this. A section addressing the relationship to federal energy policy covering the fifth national energy policy plan.
and energy security is included, and the direct and indirect actions of the US DOE are discussed, as are any related actions. The scope of the PEIS is discussed in the final section of Chapter 1.

Chapter 2 deals with alternatives including the proposed action. Included in the discussion are the general assumptions made for both the no-action and proposed action alternatives, descriptions and environmental characteristics of the conventional coal technologies assumed in the no-action alternative, and descriptions of 22 clean coal technologies that are anticipated for the proposed action.

The affected environment is described in Chapter 3 beginning with a section on potential regions for commercialisation of clean coal technologies, followed by sections addressing the regional resources that may be affected. These include air, land, water, ecological and socio-economic resources. Chapter 4 presents a summary of the changes in national emissions relative to the no-action alternative for SOx, NOx, CO2 and solid waste, resulting from the maximum commercialisation of the 22 clean coal technologies by the year 2010. The relative impacts of the alternatives are discussed and sections are dedicated to discussing unavoidable adverse impacts, irreversible and irretrievable commitment of resources, as well as the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity.

The final discussion chapter of the PEIS identifies major federal laws and regulations that are generally applicable to activities under the CCTDP.

Chapters 6, 7, 8, and 9 respectively, contain a list of references, list of preparers, list of recipients and a glossary. Appendix A contains the scoping comment letters and Appendix B contains details of the environmental characteristics of the various clean coal technologies. The final pages of the PEIS are dedicated to Appendix C which contains letters of comment on the draft PEIS and staff responses.

5.6 Commentary

In this study the greatest experience of formal EIA appears to have been gained in the USA since the implementation of NEPA in 1970. Over the years, various refinements have led to an ability to carry out high quality assessments. Good resources for research, data acquisition, mathematical modelling and environmental monitoring, however, do not in themselves result in good EIA; financial backing is needed. This may not be available in all cases but those coal users and producers wishing to achieve a high standard of EIA would benefit from exchange of information through an EIA database for coal-related projects. Experience tends to result in a more efficient and cost-effective process.

The quality of EIA has been formally assessed (Wood and Jones, 1991). The ES in case study 5.2 was criticised for being inadequate in that the requirements of the (then) forthcoming Directive 85/337/EEC had not been fully met (ENDS, 1988). The EIS was reported to have inadequately addressed 'direct effects and any indirect, secondary, cumulative, short-, medium- and long-term, permanent and temporary, positive and negative effects of the project'. When discussing regional air quality, it was considered unsatisfactory to say that NOx emissions 'would not have a significant impact on atmospheric ozone concentrations in the locality' when the effects further afield are at issue. Furthermore, station design and water quality modelling was considered not to have advanced to the point where it could predict in detail the impacts of effluent discharges on the quality of waters and sediments.

Various issues in case study 5.3 could not be adequately addressed for reasons such as a lack of data or uncertainty about a project component. An independent body (US EPA, CEIA, Institute of EA) that could monitor the quality of EIA is desirable.

The scoping approach involving public participation is essential for a good EIA and makes the process more effective and efficient by determining significant issues from the outset, and reducing the likelihood of subsequent delays due to issues being raised at a late stage.

A standard format for a coal-related ES should be adopted in order to communicate the results clearly and it would also improve efficiency. This report suggests the following format for such an ES:

Preliminary pages
briefly describing the application, preparers and responsible officials, and locations of the ES

Abstract

Contents
in non-technical language

Introduction
briefly describing the EIA process, the proposal and its status, and the scoping issues

The proposed project
giving an overview of the components, and the construction and operational phases

Alternatives
describing project options and their evaluation, alternatives including the no-action alternative and identification of the preferred alternative

Affected environment
describing the land, terrestrial and aquatic ecosystems, air quality, socio-economic aspects including recreational and cultural

Environmental consequences
describing positive and negative impacts common to all action alternatives and no-action alternatives

Mitigating measures

References

Index

Appendices
6 Potential effects of EIA requirements

There are a number of possible effects of EIA requirements although assessments of many projects have been part of the planning procedures in various countries for a number of years. This chapter discusses potential effects such as costs, delays, modification and benefits. Other issues which may need further attention are highlighted in the final section.

6.1 Costs

The cost of an environmental impact assessment (EIA) can vary greatly, and accurate figures are not readily available. Enquiries into this matter with organisations in a number of countries suggest a minimum sum of around $50,000 would be required for a basic assessment. The nature of coal projects, however, generally dictates a more elaborate examination of potential impacts; the extent of detail required being dependent on the competent authority. In every case it is the proponent who must foot the bill, which is likely to be at least $300,000. It is when extensive data acquisition and mathematical modelling are necessary that costs could run to millions of dollars. The cost of printing and mailing lengthy environmental statements (ES) can be high, reaching around $1.2 million in one case in the United States (Williams, 1991). By way of illustration the following examples may be given:

It was reported recently that the average cost of EIA in the United States is about 0.1–0.5% of the capital cost of projects. In the United Kingdom the figure appears to be somewhat less (Wood and Jones, 1991). These costs are with regard to all projects requiring EIA.

The cost of the EIA featured in case study 5.1 is reported to have been in the region of $1.75 million. Of this total, about $1 million was spent on EIA-related data acquisition. The proponent employed an external contractor to carry out the EIA at an initial price of about $450,000. The higher final figure of around $750,000 was due to modifications required during the permit process. The figure of $300,000 given earlier in this section is considered to be a reasonably accurate base-line sum for a coal mine EIA. The Diamond Chuitna project incorporated roads, housing, port facilities, and other components, which resulted in a higher cost. Data acquisition was performed before the formal EIA in anticipation of all other permit applications necessary for the project, with a figure of $4–5 million reported as the probable total cost (Stiles, 1991).

As far as coal-user projects are concerned the cost of the EIA for the IGCC demonstration plant project at Buggenum, The Netherlands, (case study 5.4) was reported as being NFL400,000. Against a capital cost of around NFL1 billion this amounts to about 0.0004% (Scholten, 1991). The ES was published in July 1989 (Demkolec, 1989).

The EIA for Unit 9 at Amercentrale, The Netherlands, which is a 600 MWe pulverised coal-fired power station incorporating FGD, is reported to have cost about NFL1 million. This gives a figure of around 0.0008% against a capital cost in the region of NFL1.2 billion (Doets, 1991). The ES was published in August 1987 (N V EPZ, 1987). The average cost of EIA of a coal-fired power station in The Netherlands is reported to be about NFL600,000–700,000. Higher values may also include the licensing costs (Weier, 1991).

The cost of the Bilsthorpe EIA featured in case study 5.3 was reported to have been about £85,000. The proponent engaged the services of an external consultant for the task, at a cost of around £40,000. Additional requirements by the local authority regarding a study of CFBC ash properties amounted to approximately £30,000, with a further £10,000–15,000 due to the proponent's internal costs (Waldron, 1991b).

An accurate figure as to the cost of the Fawley 'B' project featured in case study 5.2 has not been made available. It seems unlikely that the actual sum is known because the EIA component of the development was reported not to have been...
Potential effects of EIA requirements

budgeted separately from other project-related activities at the time of the proposal. In this case, however, the figure of $300,000 is seen as a reasonably accurate base-line figure for such an EIA, with the actual cost likely to have been as high as £500,000. During enquiries into this matter a point was made regarding the high cost of the negotiations involved in the process.

The programmatic EIA featured in case study 5.5 involved a number of contractors and was reported to have cost around $500,000 in total. This sum is inclusive of data acquisition and analysis, report preparation, printing and distribution. It is likely that such a figure represents a base-line cost for an EIA of this type, which is very much programme-specific (Pell, 1991).

Typically, the EIA procedure in New South Wales, Australia, for a $100 million coal mine would cost in the order of $0.75-1 million. Of this, approximately half represents baseline studies and EIS preparation and the remainder is the time of company personnel (Hellicar, 1991).

6.2 Delays

Assessing the potential environmental impact of a major project is time consuming and delays of any kind are not welcomed by project proponents. Delays resulting from EIA requirements are regarded by coal users and producers as the major drawback of the process. There are a number of reasons why delays might occur, as indicated in Table 12. Many are avoidable.

The first step towards an efficient assessment involves gaining familiarity with the relevant legislation, the requirements for compliance, and the procedures involved in the preparation and submission of the ES. A competent EIA team should achieve this through consultations with the appropriate authorities which may include local, regional or state, and national or federal governments. Clarifying these issues is particularly important where overlap of legislation occurs.

An adequate scoping process enables significant issues to be highlighted and can reduce delays associated with assessing less important issues. Good co-ordination of the assessment to maximise efficiency is a basic management requirement.

In some cases ES containing incomplete data are submitted. This may be because of a lack of information on new subjects (for example, CFBC ash, case study 5.3) or uncertainty about the location of a project component. The competent authority may delay its decision until such information is made available by the proponent.

Where a project incorporates technology that is incapable of meeting the legislated standards, or mitigating measures need improvement, the issuing of a permit may be delayed. A problem of this kind is reported to have occurred in the EIA described in case study 5.1 (Seabourne, 1991).

Administrative hold-ups may occur following submission of an ES, but effective legislation is designed to counter this possibility by imposing time limits on decision-makers.

In cases where extensive data acquisition is deemed necessary, long delays can occur; this was so for the environmental permitting of a 200 MW coal-fired power station in New York State (Walden, 1990). Complex mathematical modelling tends to be time consuming (and expensive) and is often associated with assessments of coal-related projects.

The review process involved in EIA causes delay but again, effective legislation is designed to reduce this possibility. Where a public inquiry is called the delay can be significant.

Despite the possibilities for delay described here, the EIA process can be carried out efficiently and effectively. For example, the EIA of the IGCC demonstration plant project at Buggenum, The Netherlands, was carried out in 12 months (Scholten, 1991). The EIA for the 600 MW coal-fired power station at Amercentrale was completed in under a year and the permit was issued 8 months after submission of the ES (Doets, 1991).

6.3 Modifications

The requirements of EIA have the potential to modify coal-related projects in a number of ways.

Within an organisation an effective management structure incorporating environmental specialists is necessary. Where this is not possible or practical, external consultants may be required to carry out the EIA and prepare the statement.

Since the EIA process may determine that a particular project design is not the most environmentally acceptable option, certain modifications may be required before a permit is granted. Depending on the view of the competent authority, and stringency of legislation, the grant of a permit may be for a project that is significantly different from that originally conceived (Walden, 1990).

Coal-related projects, for example, an open-cast mine

Table 12 Reasons for delay associated with EIA requirements

<table>
<thead>
<tr>
<th>Avoidable</th>
<th>Unavoidable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfamiliar with legislation</td>
<td>Lengthy data acquisition necessary</td>
</tr>
<tr>
<td>Unfamiliar with requirements</td>
<td>Extensive mathematical modelling needed</td>
</tr>
<tr>
<td>Incompetent EIA team</td>
<td>Review process</td>
</tr>
<tr>
<td>Inadequate consultation</td>
<td>Public inquiry called</td>
</tr>
<tr>
<td>Inadequate scoping</td>
<td></td>
</tr>
<tr>
<td>Insignificant issues assessed</td>
<td></td>
</tr>
<tr>
<td>Inadequate co-ordination</td>
<td></td>
</tr>
<tr>
<td>Incomplete data</td>
<td></td>
</tr>
<tr>
<td>Inadequate ES submitted</td>
<td></td>
</tr>
<tr>
<td>Administrative hold-ups</td>
<td></td>
</tr>
<tr>
<td>Technology fails to meet standards</td>
<td></td>
</tr>
</tbody>
</table>
proposal (case study 5.1) could include a number of components for which modifications may be required. Although in such a case the mine site is fixed, the mining methods and equipment may have more environmentally acceptable options. Certain transport corridors may have greater potential environmental impact than others and the project layout may therefore require modification. Methods of transport may require modification to reduce the risk of spillage. In coastal zones, port facilities may have more environmentally acceptable locations, and the methods of transfer may require modification. In addition to the mine components, associated components may have alternatives with reduced potential impact. Such components could include workers’ accommodation areas, recreation areas or, in the case of a remote mine site, an air-strip. Underground mines may also need modifications before a permit is granted, particularly if there is a risk of subsidence.

Coal users can also be required to modify their proposed projects. In the case of power stations a number of components can be considered: Methods of receiving coal at an offshore jetty are likely to have alternatives with less potential impact, as would methods involving road and rail. The site layout may require modification to reduce impacts; this was the case for the Halfmoon cogeneration project in New York State, as shown in Figure 21.

It may be possible to reduce the visual impact of massive structures by considering alternatives to layout. Various screening measures may be required which will tend to modify the site. Sound insulation is another possible modification which can arise.

A potentially significant impact of coal use is from gaseous, liquid and solid emissions to the environment. Many countries have introduced legislation to limit emissions from coal-fired power stations and this issue has been the subject of earlier studies at IEA Coal Research (Vernon, 1988; Soud, 1991). During the EIA process expected emission levels will be determined and in cases where levels do not meet the required standards, modifications to the control technology may be required before a permit is granted. Such technology could include flue gas desulphurisation systems, electrostatic precipitators and waste-water treatment plant. Routing of power lines may also require modification to reduce potential environmental impacts.

Project components which may be subject to modification due to EIA requirements are summarised in Table 13.

Project alternatives are considered by the proponent during feasibility studies in the very early stages of planning. It may be prudent to consider all technologically feasible alternatives to the project during the EIA process, since this has the advantage of demonstrating a more complete assessment on the part of the proponent.

### 6.4 Benefits

Formalised EIA requirements can have a range of beneficial effects.

A common set of rules is aimed at providing a ‘level table’ on which projects can be assessed. The effectiveness of this, however, is dependent on the clarity of the legislation, and the capability of the competent authority in administering the law.

Proponents are encouraged to consider all possible alternatives to the project in order to determine the one which is not only technically feasible, but is likely to have minimal environmental impact. This process can result in the proponent having a more solid basis on which to tackle future environmental developments, such as a compulsory environmental audit which could require strict monitoring of environmental performance. It should be noted that the best environmental option is not necessarily less efficient or more costly, and responsible companies often carry out voluntary environmental reviews because of the benefits they expect.

A knock-on effect of EIA for coal is that growth in the control technologies industry is likely to increase.

By demonstrating a concern for environmental protection and by taking steps to minimise potential impacts, coal users and producers are likely to benefit from increased public awareness of how coal can satisfy energy demand in more environmentally acceptable ways.

### 6.5 Other issues

As a result of this study a number of issues may require further investigation. The wealth of experience gained in the USA on all types of EIA has the potential to assist those

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**Table 13 Project components potentially subject to modification**

<table>
<thead>
<tr>
<th>Extraction process</th>
<th>Transport</th>
<th>Utilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining methods</td>
<td>Corridor</td>
<td>Transport methods</td>
</tr>
<tr>
<td>Mining equipment</td>
<td>Method (conveyor, road, rail)</td>
<td>Transport corridor</td>
</tr>
<tr>
<td>Transport methods</td>
<td>Location of jetty</td>
<td>Site layout</td>
</tr>
<tr>
<td>Transport corridors</td>
<td>Containment measures</td>
<td>Screening measures</td>
</tr>
<tr>
<td>Site layout</td>
<td></td>
<td>Building design</td>
</tr>
<tr>
<td>Location of buildings</td>
<td></td>
<td>Waste disposal</td>
</tr>
<tr>
<td>Location of accommodation</td>
<td></td>
<td>Control technologies</td>
</tr>
<tr>
<td>Building design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste disposal activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of rehabilitation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 21 Modifications to the Halfmoon plant layout (Walden, 1990)
countries which are in a relatively early stage of EIA development. This could be particularly relevant to Member States of the European Community, and other countries, should EIA requirements be extended to cover policies, plans and programmes. There are indications that accumulated experience leads to a reduction in costs and delays associated with EIA.

Although there does not appear to be any direct evidence of good EIA tending to favour project approval, it is in the proponent’s interest to carry out a good EIA because of the reduced risk of delay, the potential improvement to the proposed project in terms of efficiency, and a good EIA is a means of demonstrating environmental acceptability.

Further work will be needed to assess whether stricter EIA requirements have redirected investment to other, less environmentally aware countries. This may be particularly relevant with regard to the lower costs of mining coal under less stringent environmental constraints, resulting in a cheaper product for the world market.

Whether coal has been disadvantaged or favoured by EIA requirements compared to other fuels, is another issue to be addressed.

The balance between socio-economic factors and impacts on the environment in the decision-making process is probably the most sensitive issue in EIA. It could be expected that a project proposal in an area of high unemployment would be judged quite differently from a similar one in a more affluent area. Assessing such an issue is clearly beyond the scope of this report, but the results of such a study, if carried out, would be of interest to coal users and producers.
7 Conclusions

The assessment of potential environmental impacts of major projects is not new. The process has existed for many years in one form or another. Formal procedures are, however, relatively new to most countries with the greatest experience having been gained in the USA since the implementation of the National Environmental Policy Act (NEPA) in 1970.

Legislation for environmental impact assessment (EIA) varies in complexity although there is a common underlying theme. That is, proponents of major projects likely to have significant impacts must assess such impacts, and submit a written environmental statement together with the planning application.

The requirements for EIA are variable, ranging from a basic environmental assessment that may be completed in a matter of months, to a comprehensive study that may require several years for data collection or mathematical modelling. Complications can occur where there is overlap of legislation within the country, arising from differences at federal or national, state or regional, and at local level. Until a national or, eventually, an international standard is implemented, proponents of coal projects will need to determine their requirements by consultations at all levels of government within the country of operation. Where an attempt has been made to introduce uniform regulations at the international level (Directive 85/337/EEC) the indications are that some nations are faster to act than others. The effectiveness of administering the law is currently under observation.

EIA can involve a rather convoluted set of procedures with which the proponent needs to be familiar in order to perform an efficient assessment. Where an external body exists to advise on requirements and procedures, the EIA process can be improved. The US Environmental Protection Agency, and the Commission for Environmental Impact Assessment (CEIA) in The Netherlands perform this task; the Institute of Environmental Assessment has been set up in the United Kingdom to perform a similar role. Most coal users in The Netherlands have benefitted from the involvement of CEIA where delays in reaching the permit decision appear to be shorter than elsewhere.

The majority of coal-related projects have the potential to affect the environment to a significant degree. Open-cast methods of coal extraction can directly affect terrestrial and aquatic ecosystems. Mitigating measures can be introduced to reduce such impacts to acceptable levels; these include careful planning of transport corridors, layout of mine sites, containment of product, and soil storage and rehabilitation. Underground coal mining has less potential impact but associated surface workings do. Such operations can incorporate mitigating measures in project components such as spoil heaps, transport corridors, and containment methods. The risk of subsidence would be a prime consideration.

Coal users may affect the environment in a number of ways. Large power stations have considerable land requirements and the bulk of the buildings and chimney have visual impacts which cannot be entirely eliminated by screening. Mitigating measures such as appropriate site layout can serve to reduce impacts. There are technologies to control gaseous and liquid emissions, and solid by-products may be marketed or disposed of in an acceptable manner. Other coal users will have similar potential impacts.

Considerable modifications to proposed projects can result during the EIA process. Proponents of major projects who consider technologically feasible alternatives during the formal assessment are more likely to reduce the possibility of delay in permit decision-making.

One frequent result of EIA is the benefit that the resulting modifications yield a better project, and the best environmental option is not necessarily less efficient or more costly.

The cost of EIA is difficult to determine. More information
needs to be published on details of the cost in order to allow an adequate assessment of different procedures. It appears that the most basic assessment probably costs around $50,000. For coal users and producers, however, the sum is more likely to be in the region of $300,000 for a basic assessment because of the scale and nature of most coal-related projects. More extensive studies can run to millions of dollars.

Experience of EIA serves to increase the efficiency and cost-effectiveness of subsequent similar assessments. A database of coal project EIA which promotes the exchange of information on the subject would benefit coal users and producers, and improve cost-effectiveness.
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