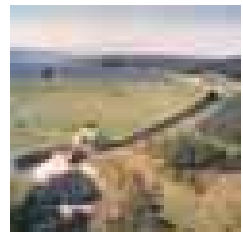


*Services to
the power
sector*



Capability statement

Entec

Entec is one of the UK's largest environmental and engineering consultancies. Our technical and business skills are dedicated to delivering strategic, technical and engineering solutions which bring commercial benefit to customers at home and overseas. This know-how is based on over 60 years' consulting experience in the public and private sectors.



Entec operates a Quality Management System in accordance with the latest requirements of the international standard BS EN ISO 9001 and an Environmental Management System compliant with BS EN ISO 14001. Both are audited by BSI Management Systems.



Unrelenting change...



Over the last two decades the UK power industry has undergone more extensive transformation than any other industrial sector, and there appears to be no let up in the pace of change.

The diagram below illustrates just some of the issues confronting the power sector. These can be distilled into seven key drivers of change:

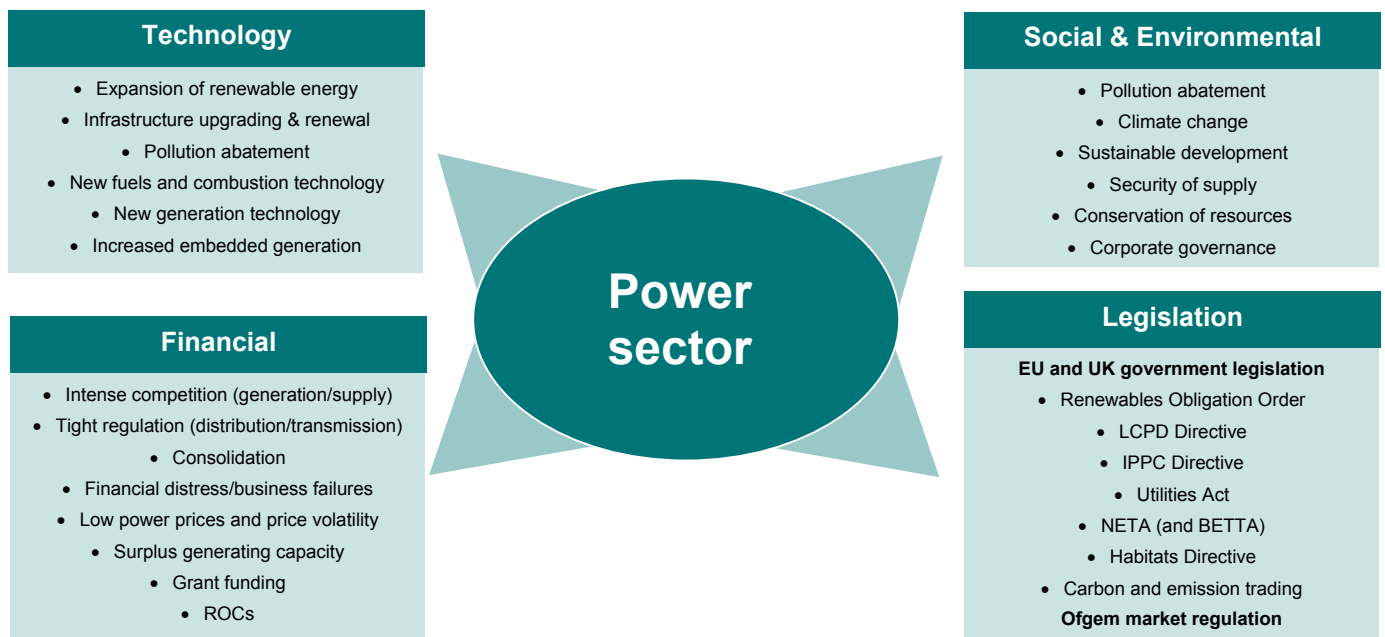
- Competition;
- Fuel/power price volatility;
- Climate change;
- Pollution abatement;
- Security of supply;
- Regulation;
- Sustainable development.

The corollary is that the power sector is experiencing:

- Mounting, and more onerous, legislation;
- Support for a greater proportion of generation from renewable sources;
- Requirement for improved environmental performance of generating plant;
- Mothballing/closure of plant and limited new conventional build;
- Market consolidation and withdrawal;
- Fears about security of supply;
- Need to upgrade the distribution and transmission infrastructure;
- Greater commitment to corporate responsibility.

Such change provides a succession of challenges, but also opportunities for those in the power sector who identify and manage these issues before the pressures further impact their profitability.

Entec is fully immersed in the advances and changes taking place in the power sector and has the knowledge and experience to help alleviate your exposure to risk in such a volatile environment.



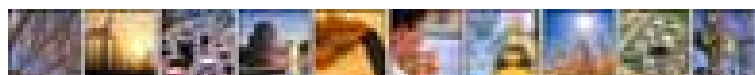
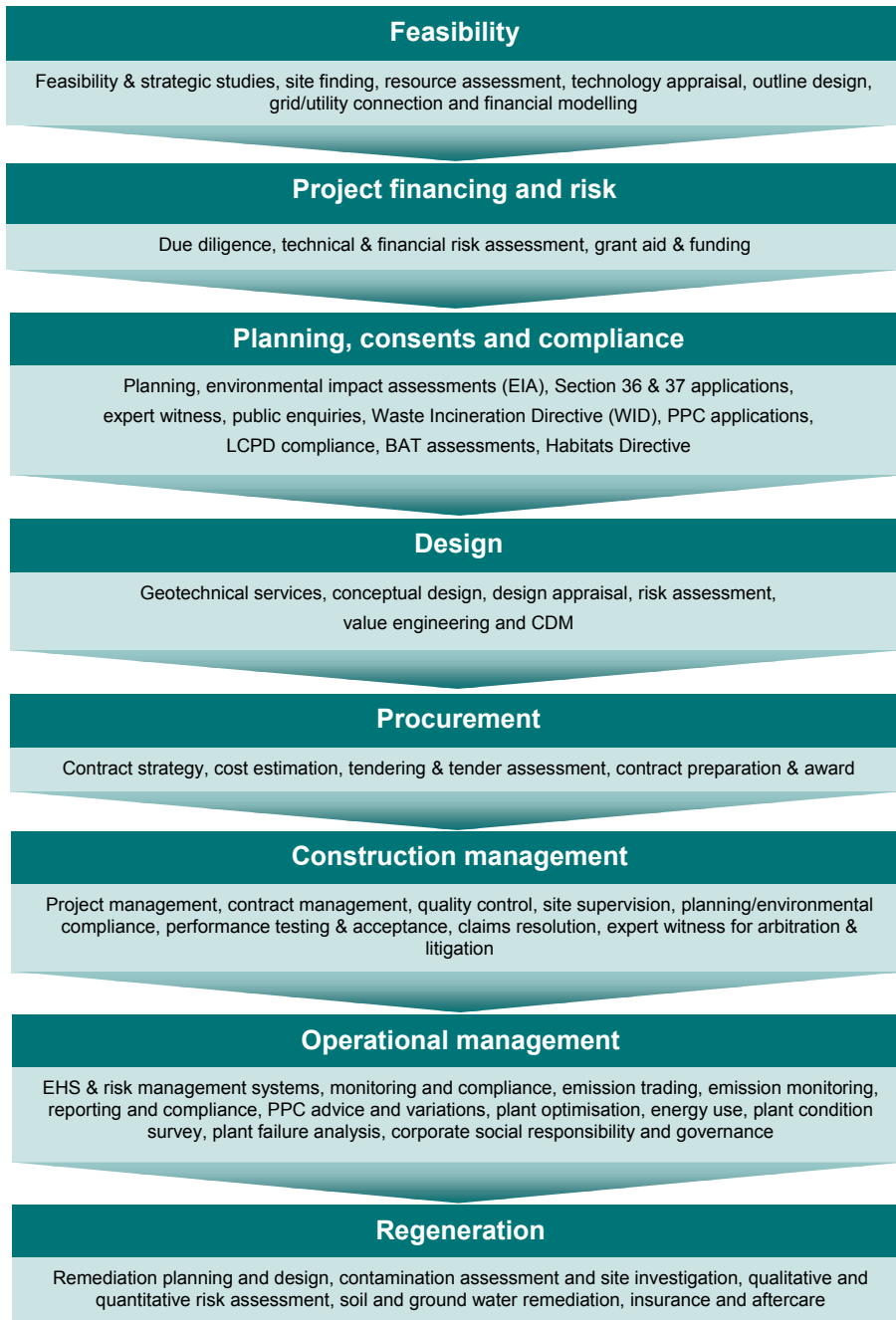
Services to the power sector

Adding value through service delivery

This diagram on this page links examples of the services Entec can offer in the delivery of power sector projects and provision of strategic expert advice. Our aim is to be a seamless provider of high quality, value for money, integrated services.

The ability to form truly multi-disciplined teams from our in-house resources is a core attribute and provides, within one organisation, the ability to deliver services through the project lifecycle, from “cradle to grave”.

Support can range from small elements of specialist assistance through to acting as a full development partner. We are also experienced in working with client associates as part of an integrated supply chain.



Entec's marketplace

We are active throughout the generation, transmission and distribution stages of the power industry supply chain.

Entec is an enthusiastic and forward thinking company with many projects at the forefront of technology and development. We are experienced at finding new and innovative solutions to the challenges of the evolving power industry.



Our capabilities and expertise extend across the full range of power generation technologies, including:

- Conventional fossil-fuelled plant
- Wind (on-shore/off-shore)
- Biomass & co-firing
- Energy-from-waste
- Landfill gas
- Ocean technologies
- CHP

Case studies

The following pages demonstrate Entec's capabilities in the area of services to the power sector, using case study examples ►



Fuel Mix Flexibility at Trombay Power Station Tata Power Company

Tata Power Company Ltd (TPCL) operates the Trombay Thermal Power Station on the outskirts of Mumbai in India. The station itself comprises four generating units, each with a different generating capacity and fuel mix capability. It is of strategic importance to the whole area and has a total generating capacity in the region of 1.4GW.

TPCL wished to improve the station's fuel mix flexibility to take better advantage of world markets, in particular, the market for low sulphur coals. TPCL wanted to increase the quantity of coal burned from 1400 Te/day to 5200 Te/day and to add a further 250MW of gas-fired capacity to one of the units. However, environmental consents placed restrictions on the quantity of coal that could be burned in addition to placing restrictions on dust and SO₂ releases.

Entec and TPCL developed a strategy involving three main elements to gain statutory approvals for the proposals:

- Generating and emissions profiles were prepared to demonstrate that, provided a degree of management on the sulphur content of coal and oil was exercised, the coal-burn limit could be immediately raised to 3000 Te/day without breaching the plants emission limits for dust or SO₂.
- An environmental impact assessment and risk assessment was prepared for the proposed increase in generating capacity to demonstrate the minimal impact of the proposal.
- A feasibility study was prepared that demonstrated the ability of the plant to burn up to 5200 Te/day of coal with appropriate modifications to the flue gas desulphurisation system.

The case for raising the coal limit to 3000 Te/day and the assessments for the proposed increase in generating capacity were approved by the relevant authorities. TPCL has retained the feasibility study internally to assist in future strategic decisions on the fuel and generating mix.



*Helping achieve an increase in
electrical generation capacity*



Black Law Windfarm Environmental Impact Assessment ScottishPower

ScottishPower's main business is the provision of dependable electricity supplies, and it operates several coal, gas, wind and hydroelectric power stations. In response to international and national concerns about climate change the UK is seeking to generate more of its electricity from renewable resources, and under the Renewables Obligation (Scotland) all electricity producers will be subject to escalating financial penalties if they fail to do this. On-shore 'windfarming' is an established renewable energy technology with the potential for substantial expansion in Scotland, and ScottishPower are relying on this to meet their obligation in the short to medium term.

Larger windfarms close to the main centres of demand are attractive for technical and environmental reasons, and ScottishPower identified a potentially suitable site at Black Law, near Forth, about 20 miles east of Glasgow. Here the company wishes to erect a 134 MW windfarm (sufficient to generate power for 80,000 homes), consisting of 67 turbines, each with a hub-height of 70m and a blade diameter of 80m. Entec was engaged to carry out the Environmental Impact Assessment of the project, co-ordinating inputs from external landscape and noise specialists as well as a multi-disciplinary in-house team, and

assisted in the design through constraints identification and mapping, and a series of specialist studies. Ancillary operations requiring assessment included the conversion of 480ha of conifer plantation to modified blanket bog and broadleaf woodland, and the sourcing of roadstone for use on the site through the reopening and restoration of a derelict opencast mine. These have required the development of a habitat management plan in consultation with the Royal Society for the Protection of Birds (RSPB) and the various landowners, and the reassessment of coal reserves and development of a revised method of working for the opencast mine, together with detailed restoration plans. Entec also undertook the EIA of the overhead power line that will connect the windfarm to the national electricity distribution system.

*Assessing the
environmental
impacts of a
large windfarm
in Scotland's
Central Belt*



Teesside Offshore Wind Farm **EDF Energy - Northern Offshore Wind**

EDF Energy is a major generator of electricity in the UK. In response to international and national concerns about climate change the UK government is seeking to generate 20% of its electricity supply from renewable sources by 2020. EDF Energy - Northern Offshore Wind Limited (NOWL) are proposing to build an offshore wind farm up to 100 MWe (sufficient to generate power for 70,000 homes), consisting of 30 turbines occupying approximately 10km², approximately 1.5km offshore of Redcar.

Entec was engaged to carry out an environmental impact assessment (EIA) for this project, carrying out studies to assess the potential impacts that the construction and operation of the wind farm may have on the following areas:

- Commercial fisheries
- Marine ecology
- Ecology and nature conservation studies
- Marine hydrophysical studies
- Landscape and visual impact assessment
- Shipping and navigation

- Noise studies
- Archaeological and cultural heritage studies
- Socio-economics and social impact assessments.

Entec's environmental specialists are assisting NOWL in applying for the appropriate marine consents to construct and operate an offshore wind farm via the appropriate regulatory channels. Onshore works above mean high water include a proposed electrical substation and cable route which are being considered as part of a planning application to the local planning authority. Entec is managing the application process to meet these planning requirements.

Our environmental specialists prepared cost-effective data collection strategies and interpreted data to develop appropriate and

innovative mitigation; ensuring that the environmental information is effectively communicated to those involved in the decision making processes. Full consultations with marine and coastal user groups and statutory organisations have been carried out to answer questions and concerns and to engage a positive stakeholder interest. Entec has a considerable experience of working with Commercial Fisheries and have carried out a full consultation with the fisheries community to collect information on fishing effort and to deal with concerns.

The skills used by the environmental appraisal team are complemented by other areas of expertise such as contaminated land, regeneration, and development planning, in conjunction with our strong track record of working with a broad range of public and private sector clients

Assessing the environmental impacts of an offshore windfarm in the North Sea at a site off Coatham Sands, between Redcar and the mouth of the River Tees



A computer generated photomontage of the view of the windfarm from Seaton Carew near Redcar



Cleveland Waste to Energy Plant Sir Robert McAlpine



*Detailed civil,
structural and building
services designs*

Cleveland Waste Management wished to develop a waste to energy plant which would convert waste from the region to power.

Following a rigorous tender process, the consortium of Sir Robert McAlpine and Volund, a Danish contractor specialising in incineration and power generation, was selected to construct the plant. Entec was a leading member of the design team supporting the consortium.

The plant burns 220,000 tonnes of municipal waste per annum and heat from the incinerator produces steam which drives a turbine capable of generating 30MW of electricity that can be fed into the National Grid.

This impressive plant incorporates a turbine hall, incinerator hall, waste handling pit and a cooling system which includes a river water extraction plant and an outfall located on the River Tees, as well as pumping mains.

Entec provided detailed civil, structural and building services designs for the entire plant, working very closely with the consortium to achieve a tight 25 month design and construction programme.

Our broad range of skills enabled us to tackle complex problems involved in the extraction of raw water from the river, its supply to and removal from the plant. This involved crossing neighbouring live chemical process plants through areas of contaminated ground.

Facts and Figures

Project
Cleveland Waste to Energy Plant

Client
Sir Robert McAlpine

Location
Billingham, Teesside, UK

Capital Project Value
£44m

Entec Services

- Civil engineering design of infrastructure, including highways, bridge, access roads and site drainage
- Scoping and management of geotechnical site investigation
- Geotechnical design
- Mechanical and electrical building services design
- Mechanical, electrical and hydraulic design of cooling water system incorporating river intake and outfall
- Structural engineering design of incinerator buildings and office accommodation



Swindon & Wiltshire Small Scale Energy from Waste Review Wiltshire County Council and Swindon Borough Council

The Waste Planning Authorities in Swindon and Wiltshire combined in order to develop a joint Waste Local Plan. Following an initial round of consultation the authorities identified a need to inform the locally developing debate on the characteristics and commercial availability of established, and emerging energy from waste technologies.

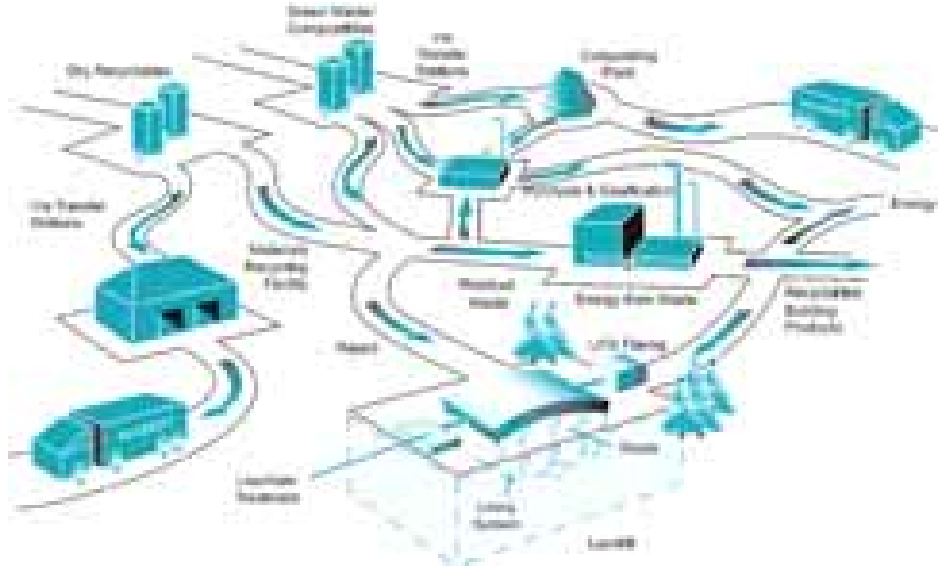
This study reviewed the main waste to energy technologies currently available for the treatment of municipal solid waste. In addition, an assessment was made of the scale of the facilities which would be appropriate for Wiltshire and Swindon.

The technologies reviewed included incineration with energy recovery, anaerobic digestion, gasification / pyrolysis and the production of refuse derived fuel (RDF).

All the options reviewed were technically proven, although some were more established than others. Incineration, for example, is a well established technology with a number of major installations in the UK. Anaerobic Digestion (AD) is also well established with approximately 50 plants currently operating within Europe, but no track record of full scale plants in the UK. Gasification/pyrolysis technology is currently in transition between the research and demonstration phases, with very few full-scale plants operating, none of which are in the UK. The RDF (refuse derived fuel) process is also a commercial technology and four plants currently operate in the UK.

The four options reviewed are not ideally suited to the same raw waste feedstock. Therefore consideration was given to the characteristics and volumes of waste produced within the region and the impact of technology selection on transport requirements within a predominantly rural area.

The report described how the mass burn and fluidised bed incineration plants can process mixed waste, but with a resultant impact on efficiency. Removing certain



Reviewing the appropriateness of waste to energy technologies in the treatment of municipal solid waste

fractions of the waste stream can result in improved efficiencies and this was linked to the impact of increased recycling, a waste processing activity likely to arise through the adoption of integrated waste management practices. This contrasted with Anaerobic Digestion which was identified as being ideally suited to the treatment of the biodegradable putrescible (organic material) and paper fractions of the waste stream, but which requires a significant pre-sorting process or separate collection if they are to operate efficiently. The study also highlighted that the emerging Gasification and Pyrolysis technologies currently require a consistent feedstock and therefore considerable pre-treatment of the waste is needed. The production of refuse derived fuel (RDF) is also a form of pre-treatment involving the removal of the combustible components out of municipal wastes and the preparation of fuel from these components.

The study concluded with a review of the relative environmental impacts of the alternatives and the projected costs likely to be incurred if development to a scale suited to the Swindon and Wiltshire area were adopted. These issues were linked to other issues around the implementation of an integrated approach to waste management and that it was unlikely that any one technology would be used to the exclusion of other technologies or options.

Entec also produced a short information leaflet detailing the key aspects of the project's findings as part of a public information exercise in raising awareness about the Waste Local Plan and the issues under consideration. Entec also provided speakers and facilitators at a number of public meetings and workshops held at various locations in the area covered by the joint Waste Local Plan.



Gasification Demonstration Plant Design Study Northumbrian Water

The gasification demonstration plant (GDP) was one of several dried sludge re-use options and technologies investigated by Northumbrian Water Ltd (NWL) and Entec for the Bran Sands site on Teesside, during the production of the sludge disposal strategy.

The gasification technology finally chosen for a full design study was the Lurgi Ruhrgas (LR) process. As well as the gasifier, to be designed and supplied by Lurgi UK, the GDP comprised two other main components; a compressor, to be supplied by Howden Donkin Blowers of Chesterfield, and a gas turbine, to be supplied by Dale Gas Power of Filey.

The three main contractors signed contracts split into three phases; design, construction and demonstration. The design phase was further divided into two parts; part one - conceptual design, and part two - detailed design. Such a structure minimised risk to NWL by permitting close scrutiny of the conceptual design to ensure that a technically feasible design solution was available prior to the commencement of detailed design work. Furthermore, on completion of the detailed design and receipt of confirmed lump sum prices for phase 2, NWL would be allowed to terminate the contract if they chose not to proceed.

The key elements of the conceptual design addressed were as follows:

- Optimum thermal capacity of the gasifier (on a cleaned gas basis) was to be 21MW. Thermal capacity was derived from a model developed within Entec based on a whole life cost assessment for the overall plant inclusive of gasifier equipment and gas turbine;
- Development of the environmental framework for the process, working alongside the IPC methodology to limit emissions within those anticipated to be set by the EA in the future authorisation for the plant;
- Justification that a three stage reciprocating compressor was suitable to meet the duty required, to compress partially cleaned raw gas from close to atmospheric pressure to 16 barg;
- Confirmation that final fuel gas composition to Solar Gas Turbines and that the proposed engine, a Taurus 60, would successfully burn the cleaned



- process gas to give satisfactory long term operation; and
- Reduction of project operating costs for treatment of aqueous effluent by initiating a wastewater design study involving recycling of aqueous liquors within the process.

Entec was appointed by NWL to manage the design study of the proposed gasification demonstration plant and to provide technical and design services. The four key elements covered in this appointment comprised:

Gasifier Island

- Provision of sludge design brief and monitoring of sludge testing programme;
- Assessment of contract deliverables against final payment;
- Programme delivery;
- Value engineering of final design;
- Resolution of gas composition thermodynamic model across compressor inter-stages; and
- Review of existing contract and redrafting of changes to reflect NWL requirements on process guarantees.

Compressor

- Review of alternative compressor types;
- Assessment of contract deliverables against final payment; and

- Programme delivery.

Power Island

- Development of a model that optimised plant size in relation to gas turbine performance;
- Calculation of fuel gas demand for turbine against ambient air temperature range;
- Assessment of contract deliverables against final payment; and
- Programme delivery.

Balance of Plant

- Supervision of accuracy and smooth flow of interface information to and from the main contractors;
- Resolve integration issues with the contractors packages;
- Addressing of environmental and planning issues;
- Design of emergency relief venting and flare system;
- Preparation of overall plant control philosophy;
- Design of materials handling systems and balance of plant;
- Hazard assessment and availability reliability and maintainability; and
- HV and LV design.



Flue Gas Desulphurisation at Eggborough Power Station Kvaerner



Reducing environmental emissions in North Yorkshire

Entec was commissioned by Kvaerner (who are acting as owner's engineer to British Energy) to undertake two major items of work in relation to the plan to install flue gas desulphurisation at British Energy's Eggborough power station. These were a BATNEEC/BPEO assessment to identify the most appropriate means of reducing emissions from the power station, in line with its integrated pollution control (IPC) authorisation requirements; and secondly, as the extension to the power station requires consent from the Department of Trade and Industry under the Electricity Act, to prepare an environmental impact assessment of the chosen option to accompany the Section 36 application.

British Energy purchased Eggborough in early 2000 in order to increase its generating flexibility which consisted of a 10 gigawatt (10GW) nuclear base load. Coal fired generation, as at Eggborough, emits large quantities of sulphur dioxide and this is the key pollutant requiring abatement. The BATNEEC/BPEO review identified wet limestone flue gas desulphurisation (FGD) as the appropriate technology and the EIA was carried out on that basis.

The EIA involved a detailed scoping exercise in consultation with the county and district authorities. This identified that the full range of environmental issues required consideration in the EIA,

although not all at the same level of detail. A comprehensive environmental statement was prepared which covered sourcing of the limestone raw material and removal of the waste product (gypsum), traffic and transportation, air quality, noise, water quality, ecology, landscape and visual impacts, contamination, health and safety and cultural heritage.

The application has been submitted to the DTI and Section 36 consent has been awarded.



Electrical Substation Sites - Contamination Surveys and Risk Assessments National Grid



National Grid is taking a proactive approach in learning more about their sites. Working with National Grid, Entec is helping to establish the environmental risks associated with the long-term use of oil-containing electrical equipment at a number of its high voltage substation sites.

A number of areas were identified for investigation including - the contamination of surface water and groundwater, off-site migration, damage to adjoining land and the health and safety issues for its staff and contractors.

Entec has completed investigations at 20 National Grid substation sites. The methods and protocols employed for a number of activities had to be strictly controlled, given the nature of the 275 and 400kv high voltage equipment involved.

The projects involved combined Phase I and II assessments by collation of desk study data to determine environmental sensitivity followed by site investigations, sampling, testing and chemical analysis. Compounds of particular interest included PCB's, petroleum products and mineral oil.

The data collected was used to undertake qualitative and quantitative risk assessments using the source-pathway-target methodology.

Reporting included recommendations for remediation to address potential environmental risks and estimates of remedial costs. Entec also undertook drainage monitoring surveys to assess the quality of discharges and the performance of Class 1 oil separators.



*Establishing the environmental liabilities
associated with oil-containing electrical equipment*



Redevelopment of the Former Aberdeen Gasworks and Chemical Works Scotoil Services

Scotoil offer services to the offshore oil industry. Their operations are based at the site of the former Aberdeen chemical and town gas works. A proportion of their land bordering on a new leisure development was surplus to operational requirements and the remaining operational area required refurbishment. The redevelopment of non-operational land was considered to be the optimum solution to deal with legacy of soil and groundwater contamination and to secure an efficient site operational area.

Entec provided environmental advice to Scotoil, reviewed all available information and completed site investigations over the proposed redevelopment area. Reclamation strategies were drawn up together with remedial cost estimates. Clean up costs were greater than the commercial redevelopment value of the land but planning regulations would not allow retail redevelopment which would attract higher land values. Entec provided technical assistance for retail use planning applications and a contaminated land expert witness at a successful planning appeal.

The Scotoil site had a potential negative value, which could have affected the prosperity of the company. Entec contributed realistic, defensible clean up cost estimates to enable higher redevelopment land values to be realised and the successful regeneration of old industrial land.

*Enabling the realisation of
higher redevelopment land values*



Review of Approaches to Report Verification for International Application National Grid Group

Photograph courtesy of National Grid Group



National Grid Group (NGG) was seeking to review its approach to non-financial (corporate social responsibility) reporting and in particular the way in which it used verification to provide assurance. It recognised the value of verification and assurance in building trust and credibility for companies. With the move to publish a Group-wide sustainability report it was important for the business to have a consistent approach based on best practice which was appropriate to business needs and culture.

In order to develop the verification strategy, Entec provided analytical and technical expertise to review existing standards and guidelines for verification and assurance. To gain insight into the practicalities of different approaches, the experiences of over 35 leading organisations were investigated through document review and interviews, to determine the reasons for the choice of verification/assurance and the value and benefit obtained. This provided an interesting and useful view into the rationale and reasoning used in the decision-making process.

The project highlighted and analysed the appropriateness of a range of approaches to building trust and credibility including formal third party verification, use of cases studies, stakeholder involvement, expert statements, etc. Informed by the existing approach to verification in NGG, the results of the project were used to make specific recommendations in relation to its future strategy for verification and means to provide assurance to the audience of its reports.



Services to the power sector

Sample client list

AES
Airtricity
AMEC Wind
Aquila
Cinergy
DEFRA
EDF Energy
Energy Developments (UK)
Force 9 Energy
Innogy
National Grid
National Wind Power
Northern Electric
Novera Energy
Powergen
Scottish Power
Tata Power
United Utilities



Services to the power sector

Entec

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