An Assessment of

General Environmental

Options (GEO) Ltd's

Environmental Statement on the Proposed

Hespin Wood Incinerator.

by
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Foreword.

This report has been compiled on behalf of Cumbrians' Against Waste Incineration. It looks at the technical information presented in the applicants Environmental Statement, and where necessary, includes additional information on aspects of the issues which the environmental statements fails to examine.

The report is in two sections:

Section one is a chapter by chapter examination of the environmental statement. The purpose of this is to raise issues of relevance to the planning authority, and identify any contradictions or ambiguities in the data presented.

Section two takes some of the issues identified in section one and analyses them in detail. This deals mainly with the issues of planning policy, sustainable development, air pollution and waste management.

Where necessary, references to information sources are given at the end of each chapter. In the analysis of the data contained in the statement, procedures and assumptions are stated where the data was not available in the statement itself.

Whilst every effort has been made to utilise up-to-date information in the analysis of the environmental statement, it is possible that some of the source data used may not represent the best available information on a particular issue.

Recommendation to the planning authority.

Having carried out a thorough assessment of the environmental statement I would urge the planning authority to reject this application, primarily on the grounds that it does not conform with the development plan, and while acknowledging the Governments recent support for waste incineration, the benefits of development on this site are not sufficient to outweigh the environmental and social costs.

Secondly, although the environmental statement has been put together in a 'comprehensive' manner, there are flaws in the arguments put forward, and some of the claims made are completely and utterly untrue.

Paul Mobbs.
Sept. 1993.

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SECTION 1: Examination of the Environmental Statement.

PART 1: Overview.

1.1 The environmental statement.

The environmental statement submitted with this application is, compared to other assessments I have examined, quite comprehensive. It covers all the fields specified in Schedule 3, paragraph 2(a to d), of the regulations[1], and includes extra information - the socioeconomic impact chapter for example. However, the validity of some of the scoping activities is somewhat tarnished by the fact that the relevant decisions on design and location had already been made by the applicant before the employment of consultants to compile the environmental statement.

The main criticism I have about the statement is the content of the non-technical assessment, which as stated in paragraph 2(e) of Schedule 3, must be a summary in non-technical language of the contents of the assessment. As it appears to me, the non-technical assessment does not summarise in a comprehensive manner the issues addressed in the statement, and much of the non-technical assessment is in fact an 'advertisement' for waste incineration, which has no direct reference to the material content of the statement.

Secondly, at no point is the reuse of the land discussed in detail. In effect, this will be a large industrial plant, in a rural area, wit a basement sunk 3 metres into the earth. When the plant reaches the end of its lifetime, would the site be reused for industry - and given the proposed nature of the development a potentially polluting industry; would it be returned to a 'green field'; or would a new incineration plant be built. These questions are not properly addressed. The point must also be made that as a waste disposal plant, and an incinerator, the site would be included in the proposed register of potentially contaminated sites. This would have obvious consequences for the reuse of the site.

1.2 The proposed 'energy recycling centre'.

Having read the environmental statement through, the term used by the applicant - "energy recycling centre" - is rather misleading.

From a physical point of view, energy is constant. It cannot be created or re-formed, and even processes which take energy and raise it to a higher form, the process requires external inputs of energy, and the efficiency of conversion is low.

From a purely chemical point of view this plant does not recycle materials - it degrades them! It takes materials which have an energy value and releases this energy through combustion. Once released, these materials cannot be recreated without a much greater input of energy than that recovered from them. The term 'energy recycling centre' must therefore be looked upon as being completely misleading. This application is for a waste to energy incineration plant.

One of the topics I would expect to have seen addressed in detail in the environmental statement is the physical recycling aspect of this plant. However, the information on this topic in the statement is very poor, and it does seem as if the recycling of materials will be put very low on the list of operating priorities.

The main problem with the recycling side of things is that all materials have two economic values - one based on their value as recycled material, and one according to their potential to burn and produce electricity. From this perspective the burn value of glass and metal is negative - because they do not burn, and actually remove energy from the system as they heat up. Plastics and paper on the other hand have a great burn value. Balancing this, metal, glass, paper and plastics have a reclaim value.

To ensure the maximum operating profit, the balance between recycle vs. burn has to be operated very strictly. The major factors are...

* The value of the recycled product.

* The cost to sort/process the material.

* The value of generated electricity.

* The efficiency of generation.

* The operating/capital cost of the plant.

The greater the value of the electricity and the less the value of the recycled product, the greater the incentive to burn, or if the material has a negative value as fuel, send the material directly to landfill. Only where the value of the recycled material is great, and the material has a low or negative value as fuel, will the emphasis be on recycling.

If the plant is to make a return on the large capital cost of the incinerator, the plant will have to burn most or all of the paper, card and plastics - leaving only metals and glass as viable recycling options. Putrescibles/wood have value if composted, but the need to make a return on the large capital cost would mean that, even though compost has a small value, it would be more worthwhile to burn these materials for the energy they contain.

PART 2: Examination of each chapter of the ES.

2.1 Introduction + Non-Technical Summary (chapter 1).

1). In the introduction, paragraph 1.2.1 states that. "the Environmental Impact Assessment' of a project should not be confused with this Environmental Statement". This is a very strange statement to make given that the environmental statement is normally assumed to contain the interpreted results of the environmental impact assessment. Without a proper environmental impact assessment of the project, it is impossible to properly assess its environmental effects.

2). Paragraph 1.3.2 of the introduction gives information on the developers - but fails to name them. At no point is it stated what the actual objectives of General Environmental Options Ltd are, and this has led to great confusion locally about the relationship between the two companies involved, GEO Ltd and ABT (UK) Ltd.

The company objectives of GEO Ltd[2] are noted as follows:

* To design and build all manner of plant, but in particular that which relates to the clean disposal of all industrial, agricultural and domestic waste, in all its manifestations.

* To produce and trade in the by-products of that disposal in all its forms, chiefly being fertiliser, electricity, and potential building materials.

* To install and operate such plant and machinery relating to such activities.

* To buy, sell, and deal in such plant and to build and install in any worldwide situation which provides profit to the company.

* To employ and control a consortium of engineers and technicians and others of all professions and trades for use in the operation of the company's plants or other areas as deemed profitable to the company either directly or on contract, and to raise finance for the use of the company and for prospective customers in any currency throughout the world.

* To develop and exploit any new concepts through technology which is profitable to the company.

* To acquire and operate a transport fleet of vehicles for waste collection either domestic, agricultural or industrial in any situation or place.

The above points are not fully acknowledged in the environmental statement, even though they have a significant bearing upon the potential mode of operation of this plant.

Likewise, in paragraph 1.3.3 of the introduction, when discussing the technology licensed in Europe by ABT (UK) Ltd, it fails to note the fact that the incinerator design is licensed to ABT by the Ebara Corporation of Japan, and that many of the 50 plants it notes around the world are in fact operating in Japan - which has a different regulatory regime for energy and incineration plant to Europe and the UK.

3). As I made clear in the overview, the non-technical summary is 'unbalanced' in its approach. There is a long passage about waste incineration which presents only the 'positive' aspects of waste to energy plants, much of which does not directly relate to the material in the environmental statement. The summation of the environmental statement is very brief, and conveys very few of the facts contained in the document.

For example:

i). *"This model showed that the predicted ground level concentrations of all pollutants is well below the appropriate air quality standards and guidelines".*

The actual concentrations or "quality standards and guidelines" are not noted or explained.

ii). At no point do the notes on landscape impact discuss the chimney visibility - only the building itself.

iii). The section on the ecological assessment indicates that the negative aspects of the development are manageable. It does not acknowledge that GEO's own consultants are cautious about developing the original site in the field next door. The proximity of the new site to the old still, I believe, has relevance to the issue noted then. The quote from their consultants states...

"it is concluded that the site is of sufficient ecological value to be worthy of protection and conservation. It would not be a suitable location for an energy recycling centre".

All in all, though the other parts of the document cover the areas required in the regulations, the non-technical summary is not a balanced account of data in the statement. The purpose of the non-technical summary - as conceived by the European Commission - was to take the main points of the study, and explain each facet of the findings in language which could be understood by the lay person.

Many developers use the argument that the data is in the statement, and therefore a comprehensive non-technical explanation is not needed. The converse argument to this is firstly, many people would not know how to interpret the raw data in the statement, and secondly, most non-technical assessments - this one included - contain no reference pointers to the position in the statement where the information was taken. Unless such referencing is undertaken, the reader can find it very difficult to gain further insight into individual points.

2.2 Project Description (chapter 2).

1). On page A2 in the appendices section, it states that the appendices A to D do not form part of the environmental statement. However, section 2.1 in chapter 2 references the appendices as part of the argument for why the plant is needed. This approach in very confusing. Either the appendices are part of the ES - and on reading them I ban see no reason why they should not be - or the appendices are not - in which case there is no detailed information in the ES to support the need for the plant. The decision on the above is a point for the planning authority - but it does have implications on how part two of the ES is interpreted.

2). Section 2.2.2 on broiler litter notes that the plant will take waste from a 30 mile radius - within Cumbria. This is a somewhat confusing statement. Given that the plant is only a few miles from the border with Dumfries and Galloway (a region which also has a large number of broiler units) the company are, in effect, cutting their service area in half. I cannot see why this points is being maintained - especially when there are not enforceable planning grounds upon which the service area of a plant such as this can be limited.

Their argument on service area also prompts the question of location. If their service area is going to be cut in half because of their chosen location, wouldn't it make better economic sense to site somewhere else?

3). Waste classification.

Please refer to Part x of the second section of this report.

4). Project alternatives.

Section 2.3 on page 2.8 is a questionable attempt to justify incineration against other forms of waste disposal. Each form of waste disposal has its good points, as well as its draw-backs.

It should be noted that there are no references attached to the figures given in this section. This is interesting, since the information contained in this section does not correspond with the literature currently being reviewed in the waste management industry.

If we relate each of the wastes discussed to their 'best practicable environmental option' for disposal, the picture is very different.

The best solution for broiler litter (and the organic fraction of household/commercial waste) is anaerobic digestion to produce methane. The result of this is an inert compost - free of all pathogens, and large quantities of methane which can be burnt directly for heat or fed into gas engines to produce electricity. this solution is widely used in Denmark[3], where farms provide electricity and heat for rural communities using animal wastes.

The best solution for tyres (and plastics) is pyrolysis - not even mentioned in this section. AEA Technology Harwell & Herbert Bevan Ltd have developed a modular pyrolysis plant[4] for a low cost (£250,000) and which is capable of processing 400 tonnes of tyres per year. The plant produces a gas (mainly ethane/methane with some butane and propane) - some of which is used to fire the plant, but the surplus can be used in furnaces or a gas engine. It also produces an oil which can be processed to recover organic compounds, or burnt (has a similar calorific value to diesel). The residue left in the 'pot' is a carbon char - activated to a low grade, and so able to be used in cleaning industrial discharges.

Finally, the best solution for the non-organic part of household/commercial waste is reclamation. Some plants in Europe[5] which sort **unsegregated** wastes are recovering

20-40% of plastic film, 25-30% of dense plastic, 60-90% of ferrous metals, 25-50% glass and 10-30% of paper. As compost, plants achieve 100% reclamation of the organic content of the waste stream. These figures can be significantly increased if there is primary separation of waste streams by the public.

So, applying the criteria above, the TIF incinerator comes off worst because...

* it has the highest capital costs of all the processes above.

* it has the highest environmental impact in terms of emissions of greenhouse gases than the above.

* it generates the least employment out of all the processes above.

Finally - the 'no-development scenario' is completely unrealistic. Something will have to be done with the waste in order to meet current regulations.

2.3 Site selection (chapter 3).

The sites chosen in this part of the study are totally unsuited to a development such as this - and as acknowledged the consultants were really just 'going through the motions' to compile the environmental statement as the developer had already decided on the location for the plant. The validity of this section is therefore questionable.

2.4 Technology selection (chapter 4).

The information in this section is fairly complete, although it can be summarised in a much simpler way.

Agitated (mechanical) grate plants are not economic below about 200,000 te/y capacity because of maintenance costs. However, most of Europe has now abandoned grates in favour of fluidised bed (of one form or another - not necessarily TIF) because of its better burn characteristics, and thus it lower pollution output. Even conventional coal-fired plants are now being designed to utilise the fluidised bed principle.

2.5 Project description.

1). In relation to this chapter, please refer also to parts 1, 3, 4 and 5 in section two of this report. Most of this chapter contains standard engineering specifications - of which there is little to comment on. Safety/quality of the plant design/construction is controlled through British Standards, building regulations and HSE approved Codes of Practice.

2). Section 5.3.1 - the TIF system.

With respect to this section, I would like to note a few points.

The revolving fluidised bed incinerator was invented by Davy Engineering (in the UK) in 1969. However, the idea was not developed commercially because the philosophy at the time was for larger scale coal burning plants. The Ebara corporation in Japan took this idea and developed it further - in effect taking two revolving bed plants and putting them back-to-back. This then produced a TIF incinerator.

The design of the plant is licensed to ABT (UK) Ltd by Ebara. Most of the grate and combustion chamber is manufacturer by Ebara and imported. Other parts of the plant must meet Ebara Corporation design standards or utilise other Ebara modules. ABT itself is partly owned by the Hölter ANI group - Hölter mainly manufacture industrial pollution control equipment in Germany.

3). Recycling.

As noted earlier, much of the recycling of material is done using mechanical sorters, recovering metals and glass which have no value as combustible materials. Plastics and paper on the other hand, which are valuable for their energy content, have a much less clear reclamation regime - they will be hand picked, "as the market dictates". It must be noted also that there are no plans for composting, although this could have been designed into the plant.

The Madrid plant[6] being built by ABT has a capacity of 1,200 tonnes per day, of which it is planned to recycle 540 te/d as recycled material and compost. Given that a 45% recycling capability can be achieved in Madrid, why wasn't this option chosen for Hespin Wood? It it is a recycling centre, as the label GEO have given this project implies, recycling of materials would be the priority before incineration.

The data for recycling is given table 13.1 (funnily enough, in the traffic section) as paper/card 2400te, glass 1650te, non-ferrous metal 1350te, ferrous metal 1200te and plastics 500te. This comes to 7100 tonnes per year, or **5%** of the plant's capacity (in total, 20% of the municipal waste stream). Section 7.7.2.d also notes that this figure is dependent upon the market for recycled materials. It states that only 20% of the municipal waste stream is recyclable - a figure arrived at in a phone call by their consultants. Such a figure is in contrast to some local authorities who are committing finances to achieve a recycling target of 50%[7]. This fact would tend to confirm my earlier point that this is not a recycling centre.

4). Gas cleaning.

The technology selected meets the BATNEEC requirement for licensing by HMIP. However, current thinking in Germany is that wet scrubbing is the soundest alternative.

German waste minimisation regulations require that industrial processes use the smallest amount of material possible. The stoichiometry of scrubbing processes means that wet scrubbing comes out on top (about 1:0.8), semi-dry shortly after (about 1:1.1 or 1.3) and dry scrubbing come out worst of all (1:1.5). Also, the product of dry scrubbing is a dry lime-rich dust which has limited use. German wet scrubbing systems at the moment are being configured to manufacture sulphuric and hydrochloric acids, calcium chloride, as well as gypsum compounds. These have a much wider use - and value - in the chemical industry.

It is interesting to note that the incinerator currently being built by ABT in Berlin is fitted with wet scrubbing[8].

BASF have also completed development of NO_x (nitrogen oxides) and dioxin catalysts for fitting to combustion plants. These reduce the NO_x output of a plant in excess of 50%, and dioxin concentrations in excess of 60-70%.

Such systems would be a more viable alternative, not only because it would improve the recycling aspect of the plant, but also because they would give lower emissions to the environment. The above equipment has been designed to meet the latest revision of German incinerator emission standards, which is one of the strictest in Europe, with the exception the the Dutch.

5). Fly ash and Fujibeton.

The purpose of the environmental assessment process is to examine the potential risks involved with **all** the materials associated with a process. However, in the ES we are not informed about the 'secret ingredients' in Fujibeton. They may be toxic, carcinogenic, explosive, even radioactive, but there is no information.

The 'five other additives in minor quantities' should be described in the ES. Fujibeton is trade-marked, and so it is presumably patented as well. This should provide more than enough protection for the manufacturer without the necessity for secrecy. Fifty years ago secrecy was a valid commercial safeguard, but with todays chemical analytical techniques, secrecy is useless.

The planning authority should ask for further information on Fujibeton's additives.

6). Geology.

The geological assessment has failed to note local tectonic influences on the geology. The underlying Permo-triassic strata are acknowledged, as are the Quaternary deposits - but there is no information on tectonics.

Carlisle is near the centre of what was once an area of intense tectonic activity. During the Ordovician period (490 Ma = million years ago) the Iapetus Ocean, which separated England and Scotland, closed along a subduction zone. This created the Southern Uplands and the

Lake District volcanics. During the Silurian/Devonian period (about 395 Ma) the stabilisation of the region caused the intrusion of granites into Cumbria and Dumfries and Galloway, and the rise of the Alston block.

The result of all this tectonic activity is that Carlisle sits near the suture between the two land masses (it runs from the Solway Firth through to Holy Island), and near the end of the Pennine Fault which separates the Alston block and the Eden trough. On a smaller scale, there is a faulted west-plunging anticline which borders the western edge of Carlisle, and a smaller fault (an extension of the larger Pennine fault) running through Brampton to Canonbie.

On 26th December, 1979, Carlisle experienced an earthquake of 4.8 on the Reichter Scale - quite large for the UK. There have in fact been a number of earthquakes in a band stretching from Manchester through to Moffat - all associated with the Pennine and its intersecting faults moving. This is due to granite intrusions beneath the Alston, Askrigg and Lakeland blocks moving upwards (caused by stabilisation of the land masses due to isostacy). It is the level of earthquakes in this area which led to the setting up of the seismic monitoring centre at nearby Eskdalemuir.

In addition, the geological information in the ES does not identify whether the boundary between the sandstone and the shales is regular, an unconformity or a fault.

2.6 Traffic Assessment.

Section 7.1.1 on the first page makes it clear that the traffic assessment is incomplete, and that traffic levels will not be known until the plant opens....

"Until waste contracts are finalised for the supply of poultry litter and tyres, the wider traffic impact on the area cannot be assessed."

This section also highlights an ambiguity over the 'visitors centre'. Section 5.10.2b (page 5.30) states that, "visitors facilities emphasise the project's wish to be accessible to the public, with an extensive exhibition/interpretative area, audio/visual presentation room and conference room with associated kitchen and toilets."

This is at variants with section 7.7.2.i which states, "There are plans to have a small visitors centre. The number of visitors to the centre will, however, be controlled through the implementation of an appointment-only system."

The use of the visitors centre will be an important factor in assessing the traffic levels. It is stated that there will only be two bus parties a week - but this figure is attributed solely to Mr. E. Robinson of ABT, and the criteria upon which it is based are not stated.

The main criticism of the traffic analysis must be that despite the numerous junctions the traffic will have to negotiate when the new link road is built, and despite the fact that there will be a large number of (predominantly) HGV's generated by this development, there has been no modelling of traffic flows at major junctions to assess the likelihood of congestion

2.7 Ecological assessment (chapter 9).

Little to note about the ecological assessment, except for two points.

When the project was first proposed, there was a scheme put forward to build greenhouses on the land nearby to utilise the low-grade heat from the plant. Though a sensible suggestion, as it increases the efficiency of the plant, this would have quite a serious impact on the surrounding land. There is not indication that there will be further development in the ES - will the plant be the only development, or will other ancillary developments be proposed in the future when permission for the main plant has been gained?

Secondly, with regard to this whole application, GEO have made much of the fact that by developing this site, they will be able to safeguard an area of ecological importance. However, on page 3.8 of the statement it is acknowledged that the report of GEO's own consultants are cautious about developing the site originally identified by GEO/ABT. Penny Anderson Associates recommendation 4.4 states:

"it is concluded that the site is of sufficient ecological value to be worthy of protection and conservation. It would not be a suitable location for an energy recycling centre".

Given the fact that the current site is only a few hundred metres across the field, is the current site any more acceptable, and if so, on what basis. Given the distance, the disturbance from noise and localised air pollution (e.g. dust from lorries on the road) will be attenuated by only a small amount.

2.8 Landscape impact assessment (chapter 10).

In section 10.4.7 ('Conclusions', page 10.12) it states:

"There can be little doubt that the proposed Energy Recycling Centre at Todhills will have a visual impact on the area. The chimney will certainly be viewed from around the area and the main building will be a major component of the local landscape. However, the proposed Centre's proximity to Hespin wood and other woodland, together with the local topography, will significantly reduce the visual impact on the landscape."

"Site planning and design will reinforce the existing planting and, together with proposed earth mounding and shrub and tree planting, the lower parts of the main structure, ancillary buildings and services will be screened. This will reduce the visual intrusion of the Energy Recycling Centre significantly, particularly to those areas adjacent to the structure. The finished material and its colour must also be taken into account as a mitigating factor."

The first paragraph contradicts itself; it begins by stating that the plant 'will have' a visual impact, and then states that its surroundings will shield it - rather confusing.

Secondly, any additional planting will take between fifteen and twenty-five years to become effective - by which time the plant will be nearing the end of its operational life.

Thirdly, whilst admitting that the stack will be a dominant feature, the rest of the section then ignores the impact the stack will have on the surrounding environment.

Its is strange that there is so little attention given to the stack in the whole landscape section, given that it is the most obvious feature from any distance, and it is difficult to screen. For example, there is no information on what colour the stack will be - only the main building. Normally stacks are painted a light colour to allow radiation of heat from the surface (to stop overheating and possible distortion).

2.9 Socioeconomic impact (chapter 11).

The socioeconomic impact is very like those normally produced under American environmental assessment regulations.

Section 11.5.3 is dealt with in the separate section on planning policy.

With reference to the local unemployment statistics, this plant (considering the financial outlay in the initial and operation costs) will present a minimal improvement to the local employment market.

Considering this development in terms of the jobs it would create, 59 staff (quoted in ES, page 11.7) in an area of 14 acres (quoted in ES, page 5.6) means that 4.2 jobs per acre will be created. Local authorities normally assume that warehousing will produce 10 jobs per acre. Light industrial can create 20 jobs per acre. Office development, depending upon height, can create 25 to 70 jobs per acre. In terms of employment potential, this plant is the worst type of development to devote land to.

If we also consider the costs involved, £3 million would set up a moderate light industrial unit employing thirty or forty people. In essence then, 14 acres of land are being sacrificed to 59 jobs, rather than other types of development which could create in excess of 200 jobs.

2.10 Safety (chapter 18).

With regard to the operation of the plant, please consult the separate section on programmable logic controllers.

The main point to note about this chapter is table 24.2 (page 18.7) on potential emergency situations. Firstly the section on seismic activity has no references attached to it to confirm it as true. As I made clear in section 2.5/6 above, this area has a history of seismic activity - the area around the Pennine fault is one of the most active in England[9]. It is true that a shock above 5.5 on the Reichter scale is unlikely in the UK, but quakes in the region of 4.5 to 5.5 could cause some minor structural damage because the foundations are directly in contact with the bedrock.

Secondly, the note on 'toxic substances in the waste stream'. Given the core business of a major local employer, do the plants safety systems check for radioactivity? It is not a ridiculous question, as there are examples of materials straying off-site elsewhere. In 1991, routine sampling of allotments near the Harwell Laboratory in Oxfordshire found high levels of plutonium. After an investigation, it was found that the gardener, who worked at Harwell, had taken a steel drum which previously contained plutonium contaminated wastes for use as a water butt. In similar circumstances, what would happen if materials 'borrowed' from BNFL Sellafield or Chapelcross were put into the incinerator?

2.11 Information Appendices (Appendix A - D).

I have not undertaken a full assessment of the information contained in these appendices because the applicant does not consider them to be relevant to the environmental statement. However, from an initial study of their content, some of the points they make are very tenuous, and some of the quotes they have taken from documents are out of context.

If we take the main points - that is that incineration is the best environmental option for the types of waste in question - there is ample evidence from many source that this is not the case (see section 2.2/4 earlier in this document). As I acknowledged previously, every waste management technology has its good points and bad points, but incineration is solely a waste management solution. It is not a suitable vehicle to promote recycling, waste minimisation or reuse, and compared to other available technologies it is not the best environmental option for managing chicken litter, tyres and household/commercial waste.

References:

[1] Town and Country Planning (Assessment of Environmental Effects) Regulations, 1988 - SI 1199/1988.

[2] Company details taken from Companies House (GEO Company No. 2511171).

[3] NATTA - Open University.

[4] MPD TP-2000 Tyre Recycler. Contact AEA-Beven, Building 404, Harwell Laboratory, Didcot, Oxon. OX11 0RA. (0235) 432245.

[5] J.R. Barton, 'Mechanical sorting technology for municipal solid waste reclamation', in "Waste Management in the UK", Harwell Waste Symposium, 1988.

[6] 'Madrid - integrated treatment for urban solid waste' - Hölter ABT promotional leaflet. Also a similar leaflet on the Berlin incinerator.

[7] E.g. Oxfordshire County, Milton Keynes, Leeds.

[8] Hölter ABT promotional leaflet on the Berlin incinerator.

[9] Refer to figure 1, "Seismicity and seismic hazard in Britain", Institute of Geological Sciences Seismological Bulletin No. 4, 1976.

SECTION 2: Technical interpretation of the Environmental Statement.

PART 1: Incineration policy.

1.1 Royal Commission on Environmental Pollution 17th Report[1].

Many have viewed the RCP's report on waste incineration as a 'red carpet' thrown to incinerator developers. This is not completely the case.

If we take the conclusions of the report:

Conclusion and Recommendations: Incineration in relation to other forms of waste management.

10.1 The purpose of this study has been to establish the environmental acceptability, and appropriate role, of one form of waste treatment, incineration. This does not represent a comprehensive study of all aspects of waste management, in the manner of the Commission's Eleventh Report published in 1985. The Commission's general approach to waste management can be presented as a four-stage decision procedure:

1st: wherever possible avoid creating wastes.

2nd: where wastes are unavoidable recycle them if possible.

3rd: where wastes cannot be recycled in the form of materials, recover energy from them.

4th: when the foregoing options have been exhausted, utilise the ***best practicable environmental option*** *to dispose of wastes.*

I highlight the last part of the passage to draw attention to the fact that the RCP advocate the best practicable environmental option in dealing with waste management. As outlined elsewhere in this document, there are commercially available systems to deal with the wastes proposed for this plant in a manner which recovers more materials for reuse, and which have a lesser environmental impact.

Let us take another part of the report:

The scope for waste minimisation or recycling.

8.36 In terms of the four-stage decision procedure described at the beginning of this report (1.1), ***the first priority in waste management must always be to avoid creating wastes wherever possible****. The view was expressed to us that* ***waste minimisation if pursued with sufficient determination, might remove the necessity for incinerating any wastes, other than the most intractable clinical wastes****. The reduction of waste arisings was discussed by the Commission in its Eleventh Report, which noted that, "****Avoiding waste can bring increased commercial benefit by altering a process, by changing from one process to***

***another which might cost less in itself, or by decreasing disposal costs by generating less waste*."

From this standpoint, it is clear that incineration is not a favoured technology above other waste management options.

It should be also noted that some of the reports recommendations, that incinerator scrubber wastes not be co-disposed with other waste for example, have not been addressed in the environmental statement.

Reference:

[1] Royal Commission on Environmental Pollution 17th Report - 'Waste Incineration', HMSO, May 1993.

PART 2: Air Quality Impact.

2.1 Introduction.

When first looking at the air quality impact section, I was struck by the fact that, like the "Human Health Assessment" circulated last year, there was very little detail on the exact modelling procedure used to predict pollutant concentrations from the plant. This may be partly due to the over-reliance on computer software packages, where much of the data which goes in to the modelling process is standardised or pre-defined.

The first thing to be noted was that the air quality assessment failed to include a wind rose. However, there are maps plotting isopleths, so a wind rose must have been used in the assessment procedure. **Without the wind rose, none of the data on pollutant distribution can be independently verified and proven to be correct.**

It would have been possible to obtain a wind rose from the nearest metrological office, but it should be the responsibility of the applicant to supply information to prove that their assessment of the likely impact is correct.

2.2 The mechanics of plume modelling.

There are a number of text books widely available describing the procedures involved in plume modelling[1]. The data put forward in the environmental statement has been put together using 'expert' systems - however, the consultants have neglected to include all the necessary information to allow replication of their modelling to confirm its accuracy.

There are many factors which affect the distribution of pollutants from a stack. Wind, stack height, stack diameter and exit velocity are the very basic parameters needed to begin modelling. These figures are noted in the environmental statement. However, factors such as mixing heights and localised inversion layers are not apparently considered in the ES, which is a cause for concern given the extreme effects these phenomena can have on pollution levels.

The variation of mixing heights throughout the day due to solar heating and atmospheric cooling can have profound effects on ground level concentrations of pollutants. At night the atmosphere is typically stable with a shallow (1-300m) layer formed by surface cooling. As the Sun rises the surface heating generates convective eddies and the turbulent boundary layer increases in depth, reaching a maximum in the afternoon at a depth of around 1000m. As the solar input decreases and stops, the surface cools and a shallow stable layer begins to form again in the evening.

In this idealised day, concentrations from surface sources will thus be at a maximum in the periods when the stable layers (with low wind speeds and mixing heights) are present and minimized during the afternoon, emission rates remaining the same. Sources emitting above the stable overnight layer will not contribute to ground level concentrations until the height of the growing convective layer reaches the plume and brings the pollutants to ground level, a process known as fumigation. The pattern of ground level concentrations from elevated sources can therefore be quite different from that of surface releases. In reality the diurnal pattern of emissions can of course play a significant role.

Secondly, the environmental statement omits any reference to the accuracy of the models being used. In general the more complex the model, the more complex is the validation required. However, the confidence one has in the output of a model depends very much on the questions one is attempting to answer. The prediction of a peak concentration at a specific location will place different demands on a model from answering a question as to whether or not controlling a particular category of source in a region would have a beneficial or an adverse effect.

In general, long term (e.g., annual) average concentrations can be predicted with greater confidence than short term (hourly or less) averages. Some assessments of the likely accuracy of dispersion models in predicting the concentrations of non-reactive pollutants have been given by J.A. Jones[2] for single source situations. In summarizing work of several authors, he suggests that annual averages from a low level release can be predicted within a factor of about 2 (that is, the real figure could be two times more or less than that stated). At larger distances the factor increases with concentrations at about 100 km being predicted to within a factor of four with high probability. Factor of two accuracy for peak hourly concentrations is also suggested by Jones with the indication that if specification of the time and location of the peak are also required then the accuracy is likely to be worse.

2.3 Calculation of source terms.

Normally, dispersion modelling is carried out by calculating a standard ground concentration for an emission of 1g/s^{-1} of a particular pollutant. The source strength for a particular pollutant can be calculated by taking the concentration of the pollutant - in grams per metre cubed of exhaust gas - and multiplying by the total metre cubed of gas emitted every second. This is calculated as the cross sectional area of the stack orifice multiplied by the exit velocity.

While calculating the emission volume - that is the volume of gas emitted from the stack every second - I noted that GEO's document is not precisely correct.

The source strength (Q) is calculated below:

Number of flues (N):		q3.00	
Stack orifice diameter (D), m:		1.20	
Stack emission velocity (Vs), ms^{-1}:	15.00		
Pollutant concentration, (C) g/m^3:	1.00		
Pi:			3.141592654
SOURCE STRENGTH [Q=N*pi*(D/2)^2*Vs*C]:			**50.89m^3/s^{-1}**

The accuracy of the source strength is very important, as the ground concentration is directly proportional to the source strength level. Any error in the source strength figure is therefore carried over into the ground concentration results.

In actuality, because of the pressure difference between the stack and the ambient air, the gases in the stack will be slightly compressed, and will expand on emission. Differences in temperature will also affect the density of the gases released. For this reason, it is normal to assume standard atmospheric temperature and pressure when quoting figures - this is usually signified by using the terms 'Nm^3' or 'g/Nm^3'.

Assuming that the figures in the environmental statement are in normalised units, it is possible to calculate the emission volume. Below, the emission volume is compared to that calculated above, and, where there is a difference in the figures, the exact source strength is calculated.

Pollutant.	Emis'n Conc., mg/m^3.	Emis'n Rate, g/s^{-1}.	Emis'n Vol., m^3/s^{-1}.	Calc. Rate, g/s^{-1}.	
Carbon Monoxide.	100.0	4.100	41.00	5.089	
Total Particulates.	30.0	1.240	41.33	1.527	
Organics (as C).	20.0	0.830	41.50	1.018	
Oxides of Nitrogen.	350.0	14.570	41.63	17.813	
Sulphur Dioxide.	300.0	12.490	41.63	15.268	
Hydrogen Chloride.	30.0	1.240	41.33	1.527	
Hydrogen Fluoride.	2.0	0.080	40.00	0.102	
Dioxins.	1.0E-6	4.1E-8	41.00	5.1E-8	
Lead.		1.0	0.041	41.00	0.051
Chromium.	1.0	0.041	41.00	0.051	
Copper.		1.0	0.041	41.00	0.051
Manganese.		1.0	0.041	41.00	0.051
Nickel.		1.0	0.041	41.00	0.051
Arsenic.	1.0	0.041	41.00	0.051	
Tin.		1.0	0.041	41.00	0.051
Cadmium.	0.1	0.0041	41.00	0.005	
Mercury.	0.1	0.0041	41.00	0.005	

Approximate underestimate: 23.89%

As can be shown from the table above, the source strength in the environmental statement has been underestimated by nearly 24%. This is quite an important fact as it means that the figures in the environmental statement have also been underestimated by 24%.

2.4 Pollutant peak and annual concentrations.

For a more exact analysis of the effect of underestimating the emission rate, the table below compares the ground level concentration figures given by GEO with figures calculated using the 'correct' emission volume I noted earlier.

The OES/100 air quality standard is taken from table 3 (page 8.11), and the 'GEO' peak (with building effects) concentration figures, used to calculated the ground level concentration figure below, are taken from table 11 (page 8.18). In the calculation of my own peak ground level figures I have used the peak unit concentration of 0.13ug/m^3 mentioned in the text on page 8.18.

Pollutant.	1-hr std., ug/m^3:	GEO pk conc., ug/m^3.	Calc. conc., ug/m^3.	Fraction of LAQS.
Carbon Monoxide.	30000	9.200	16.612	0.06%
Total Particulates.	125.00	2.800	5.074	4.06%
Oxides of Nitrogen.	400.00	32.800	59.629	14.91%
Sulphur Dioxide.	350.00	28.000	50.905	14.54%
		Min.:	0.06%	
		Av.:	8.39%	
		Max.:	14.91%	

Though the figures for ground levels concentrations are only a small fraction of the air quality standard, anything more than one-hundredth of the standard must be considered a problem because of the inherent inaccuracy of modelling techniques. When calculating 1-hour averages it can normally be assumed that the figures are correct to a factor of two or three (see section 2.2 earlier) - that is, they may be two or three times more or less than the predicted figure. For example, the maximum concentration of 14.91% of the standard could well be 44% of the standard, or 4.97% of the standard. This fact is not explained in the GEO statement.

A more accurate picture can be gained by calculating the annual concentrations. However, as stated earlier, the results in the ES cannot be proven because their consultants failed to include a wind rose.

Taking the figures in the ES, and applying the correction for the 24% underestimate..

Pollutant.	LTAQS, ug/m^3	GEO conc., ug/m^3.	Conc + 23.89%., ug/m^3.	Fraction of LTAQS.

Carbon Monoxide.	550.00	0.0400	0.0722	0.013%	
Total Particulates.	5.70	0.0500	0.0906	1.590%	
Oxides of Nitrogen.	50.00	0.5800	1.0544	2.109%	
Sulphur Dioxide.	50.00	0.4900	0.8908	1.782%	
Hydrogen Chloride.	70.00	0.0500	0.0906	0.129%	
Hydrogen Fluoride.	25.00	0.0030	0.0053	0.021%	
Lead.		1.50	0.0016	0.0028	0.193%
Chromium.	0.50	0.0016	0.0028	0.578%	
Copper.		2.00	0.0016	0.0028	0.144%
Manganese.		10.00	0.0016	0.0028	0.029%
Nickel.		1.00	0.0016	0.0028	0.289%
Arsenic.	2.00	0.0016	0.0028	0.144%	
Tin.		1.00	0.0016	0.0028	0.289%
Cadmium.	0.50	0.00016	0.00029	0.058%	
Mercury.	0.50	0.00016	0.00029	0.058%	
		Min.:	0.01%		
		Av.:	0.50%		
		Max:	2.11%		

Note - LTAQS = Long Term Air Quality Standard,

Again, there is a certain amount of allowable error in these figures. Depending upon the wind rose (which we don't have!) the figures could be correct to a factor of two. However, if the wind rose has been estimated from the nearest available metrological station, this error could be much higher.

The significance of any figure over 1% of the standard can be understood if we include a correction for background pollution levels. This plant is only one of a number of plants in this area producing air pollution, and the nearby A74 is a major source of pollution from motor vehicles.

Background pollution figures are given for NO_2 and SO_2 in tables 5 and 6 on pages 8.12 and 8.13. The significance of these background levels is shown in the table below. The figures calculated in the table above are then added to the background figure, and this new value is compared to the air quality standard.

Pollutant.	Ann'l conc., ug/m^3.	Ann'l + Calc., ug/m^3.	LTAQS, ug/m^3:	Fraction of LTAQS.
Oxides of Nitrogen.	30.00	31.05	50.00	62.11%
Sulphur Dioxide.	15.00	15.89	50.00	31.78%

As can be seen, the air quality in terms of NO_x be up to 60% of the limit already - and the incinerator on the modelling suggested here will add little to this figure. However, the design of the 'Industrial Source Complex' is such that it can over-estimate short term concentrations and under-estimate long term average concentrations. However, the R91 models, still in use by many consultancies in the UK, have the same variance, but in the opposite direction (they over-estimate long-term concentrations).

It is not stated in the text whether or not trapping of the plume by metrological inversions is considered. This and many other 'natural' phenomenon can drastically change local air quality. If the effect of plume trapping and overnight inversion have not been considered, the localised effects could be very great.

This is why background levels are so significant. On the estimates above, local air quality without the incinerator would be 60% of the acceptable standard. With the incinerator, it rises a little to 62.1%. However, in extreme weather conditions the contribution from the incinerator could rise to 10 or 15%. In such a situation - during which pollution levels generated by other local sources would rise too, it is possible that this plant could help to push local pollution limits above recommended standards.

2.5 Comparison with earlier 'Human Health Assessment'.

In December 1992, ABT released a 'Human Health Assessment'[3] for the Hespin Wood plant. Information from this assessment has been included in section 8.3, pages 8.26 - 8.27. However, some of the modelling procedures in the environmental statement are different from those in the health assessment, and consequently, the risk figures quoted in the health assessment are not valid.

Below is a comparison of the maximum ground concentrations in the human health assessment (HHA), the environmental statement (ES), and the 'corrected' concentration (taking account of the 24% underestimate.

Pollutant.	HA max conc., ug/m3.	ES max conc., ug/m3.	ES. + 23.89%, ug/m3.	Increase (ES/HA), percent.	
Carbon Monoxide.	0.0400	0.5300	0.6579	1645%	
Total Particulates.	0.0500	0.1600	0.1970	394%	
Oxides of Nitrogen.	0.5800	1.8900	2.3106	398%	
Sulphur Dioxide.	0.4900	1.6200	1.9803	404%	
Hydrogen Chloride.	0.0500	0.1600	0.1970	394%	
Hydrogen Fluoride.	0.0030	0.0100	0.0127	424%	
Lead.		0.0016	0.0053	0.0065	411%
Chromium.	0.0016	0.0053	0.0065	411%	
Copper.		0.0016	0.0053	0.0065	411%
Manganese.		0.0016	0.0053	0.0065	411%
Nickel.		0.0016	0.0053	0.0065	411%
Arsenic.	0.0016	0.0053	0.0065	411%	
Tin.		0.0016	0.0053	0.0065	411%
Cadmium.	0.0002	0.0005	0.0007	411%	
Mercury.	0.0002	0.0005	0.0007	411%	

Much of the difference in the figures is due to the modelling of plume downwash due to building effects. Although the accuracy of this is arguable, the health assessment should have been revised to take account of these new pollutant level predictions.

2.7 Annual/lifetime pollutant release.

Looking at this project over its lifetime it is possible to see that it will introduce into the local ecology a large quantity of 'polluting' matter. In an area which relies on agriculture for a large part of its earnings, it would seem very strange if permission were to be given for the construction of the incinerator.

Though the media have made much of the dioxins issue, the health risk posed by dioxins as compared to the other emissions from an incinerator is very small. The irritant effects of nitrogen oxides and sulphur dioxide can have more immediate and serious effects on local people than dioxins and PIC's (products of incomplete combustion) will ever have.

Using the data in the environmental statement it is possible to make a 'guesstimate' as to the total mass of polluting matter which could be emitted by this plant. The table below takes the list of pollutants limited by the HMIP's guidance note, and using the data on the plant's operating lifetime and availability, calculates the mass released. The plant's operating lifetime is taken as 25 years, and it is assumed that it will operate for 80% of the year.

Pollutant.	Calc. Rate, g/s^{-1}.	Release Total emis'n, kg/yr.	over plants' lifetime, kg's.	
Carbon Monoxide.	5.089	128,487	3,212,172	
Total Particulates.	1.527	38,546	963,652	
Organics (as C).	1.018	25,697	642,434	
Oxides of Nitrogen.	17.813	449,704	1.12E+07	
Sulphur Dioxide.	15.268	385,461	9,636,517	
Hydrogen Chloride.	1.527	38,546	963,652	
Hydrogen Fluoride.	0.102	2,570	64,243	
Dioxins.	5.1E-8	1.3E-3	3.2E-2	
Lead.		0.051	1,285	32,122
Chromium.	0.051	1,285	32,122	
Copper.		0.051	1,285	32,122
Manganese.		0.051	1,285	32,122
Nickel.		0.051	1,285	32,122
Arsenic.	0.051	1,285	32,122	
Tin.		0.051	1,285	32,122
Cadmium.	0.005	128	3,212	
Mercury.	0.005	128	3,212	

As can be seen above, this plant has the capability to release, for example, over three tonnes of mercury, if it operates to the current emission standards for incineration plant. Even if GEO were to guarantee that the plant would never exceed more than 10% of the discharge limits, it would still mean that over its lifetime the plant could scatter over 300 kilos of mercury or cadmium within the plants 'sphere of influence' - perhaps about 15 to 20 miles distant.

2.8 Mass Balance.

To give a general overview of the materials passing through the plant, included below is a simple mass balance, compiled using data in the environmental statement.

This simple table shows that the vast majority of the waste products fed into the incinerator emerge from the stack. In effect then, over the plant's lifetime, nearly 2 million tonnes of incinerated materials will be spread into the atmosphere.

The figures for each materials stream were taken, as far as possible, directly from the environmental statement. Others were calculated - normally where the ES referred to a stream composing of 'x%' of a total tonnage.

The figure for the 'electrical' mass is purely notional - in fact much of this mass will be emitted from the stack. It assumes that the waste has an average calorific value of 12GJ/te. Taking the normal generating capacity as 15MW, it is possible to assign a certain portion of the waste stream to the electrical output.

It is possible to conduct a more intricate analysis of the gaseous output using a chemical analysis of the incineration process - however the accuracy of this is very dependent upon fuel mixes and operating conditions.

It should also be noted that the 'daily' figures have been averaged over on whole year (365.25 days). In fact, the figures will be higher (about 15%) because of the shutting down of the plant for routine maintenance.

From the data it is clear to see that much of the mass of waste fed into the incinerator comes out of the stack - and hence is deposited as chemical compounds in the surrounding area or adds to the already high concentrations of polluting gases in the atmosphere.

It is a normal procedure in an environmental assessment involving industrial processes which discharge to water or air to include a mass balance. It is notable that GEO did not include a mass balance in the ES for this plant.

Mass Input/Output Analysis.

Source values:

Plant life, yrs.:	25
Calorific value, MJ/te:	12000
Electrical output, MW:	15

MASS INPUT:

Item.	Daily input,	Annual input, tonnes.	Lifetime input, tonnes.	Expressed tonnes.	as a	percentage
Waste.		342.23	125,000	3,125,000	92.58%	
Limestone. 8.64		3,135	78,375		2.34%	
Lime.		5.85	2,138	53,450		1.58%
Sand + other.		12.94	4,727	118,175		3.50%
TOTAL:		369.66	135,000	3,375,000	100.00%	

MASS OUTPUT:

Item.	Daily output,	Annual output, tonnes.	Lifetime output, tonnes.	Expressed tonnes.	as a % of	mass input.
Noncombustible.		15.00	4,685	117,125		4.06%
Ash/waste.	42.00	13,116	327,900		11.36%	
Recyclables.		19.30	7,049	176,233		5.22%
Gas pollution.		2.95	1,078	26,957		0.80%
Electricity.	86.40	31,566	789,156		23.37%	
TOTAL:		165.65	57,495	1,437,371	44.81%	

MASS TO AIR AND/OR
NOT ACCOUNTED FOR
(tonnes): 204.01 77,505 1,937,629 55.19%

The above data is illustrated in the diagram on the following page.

References:

[1] For example:
"Pollution Effects, Causes and Controls", Roy M. Harrison, 1992.
"Environmental Impact Analysis Handbook", JG Rau & DC Wooten, McGraw Hill, 1980.

[2] J.A. Jones, "What is Required by Dispersion Models and Do They meet the Requirements?", 1988.

[3] ERL for ABT(UK) Ltd., "Energy Recycling Centre - Hespin Wood: Human Health Risk Assessment". December 1992.

PART 3: The utilisation of incinerator ash wastes as secondary aggregate.

3.1 Introduction.

In order to examine the viability of GEO's proposal to market incinerator wastes as aggregate, it is necessary to examine three things:

* The current UK market for secondary aggregates.

* Existing aggregate manufacturing operations.

* The feasibility of GEO's proposal.

* Government policy on 'waste' aggregates.

The three sections below set out the problems faced by GEO using some of the latest available information.

3.2 An overview of the aggregates industry.

Secondary aggregates currently account for only about 10% of total aggregate supply, despite the attempts of a number of local authorities to improve the reuse/recycling of materials in order to reduce the need for mineral extraction. The Department of the Environment commissioned a study of the potential of secondary aggregates, also with a view to reducing the need to meet aggregate demand from primary sources, but this report[1] noted that the large quarry operators will always have a economic advantage over companies producing secondary aggregates.

Primary aggregates are obtained mainly from sand and gravel pits, rock quarries and marine dredging. Demand for primary aggregates is derived mainly from construction industry, and reached a peak in 1989 of 300 million tonnes per annum in the UK. There are five main sources of construction aggregates in Britain (1989 figures):

* Land won sand and gravel, 109m tonnes.

* Crushed limestone, 106m tonnes.

* Crushed igneous rock, 42m tonnes.

* Crushed sandstone/gritstone, 22m tonnes.

* Marine dredged material, 21m tonnes.

In 1989/90 the estimated use of waste materials (from all sources) for aggregates purposes was 32m tonnes in Britain. At the same time primary aggregate reserves, that is, resources for which extraction permissions exist, are in the region of 7000m tonnes. Although in periods of rising demand for aggregates, greater opportunities have existed for the use of secondary aggregates, this has been countered to some extent by a trend in the construction industry towards increasingly exacting aggregate specifications.

Environmental pressures, capital intensive production methods and concentration of ownership have been the principal trends in the aggregates industry in the past two decades. Environmental pressures have been manifested in the growing difficulties in gaining planning consents for new extraction particularly for sand and gravel pits in the South East. This has helped to promote both marine dredging for aggregates and large scale capital investment in the development of hard rock superquarries. These quarries are either rail linked or, as in the case with new quarries in Scotland, are designed for sea transport to areas of high demand. The substantial costs of setting up these new quarries is one explanation for the concentration of ownership whereby four firms now account for about 50% of total output.

The conclusions drawn by Arup Economics and Planning for the Dept. of the Environment, on the potential for secondary aggregates, were as follows:

* Britain has substantial primary aggregate resources both in terms of volume and their geographical distribution.

* Environmental constraints in certain major market areas such as the South East are leading quarrying companies to exploit economies of scale by developing large highly capital intensive extraction and transportation operations based on quarries in regions such as the South West and East Midlands. Exploitation of secondary aggregates on a substantial scale would tend to require similar, large operations and continuity of demand. In bulk long distance transportation, secondary aggregates would be competing with the most efficient primary aggregate quarries, producing premium products.

* Attempts by secondary aggregate suppliers to compete in primary aggregate markets have to overcome the substantial strengths of the efficient and capital intensive major primary producers and the local market dominance of regional producers.

* Whilst primary aggregate extraction has major environmental impacts, these vary considerably depending on the type and location of operations. Currently, these inputs have no money costs or values attached to them.

* Generally, but by no means always, secondary aggregates are lower quality and hence lower priced products. There is currently therefore only limited commercial incentive to produce and market them.

3.3 Existing Secondary Aggregate Sources.

A number of waste products are currently reused, or have potential for reuse, as secondary aggregates:

* colliery spoil.
* china clay sand.
* slate aggregate.
* power station ashes.
* steel slag.
* demolition and construction wastes.
* asphalt road planings.

Arup Economics noted that, *"Although there are many instances of the successful use of waste-based, or secondary, aggregates it is evident overall that a degree of policy support would be required if take-up of these materials is to significantly increase"*.

The material which bears most relation to GEO's proposal is power station ash.

Coal-fired power stations account for 60% of all electricity generating capacity in Great Britain, burning pulverised coal, the main residue is a powder type ash called pulverised fuel ash or "pfa". Pfa is extracted from the furnace flue gases by means of mechanical arresters and/or electrostatic precipitators. Pfa accounts for 75-80% of all ash produced. The remaining 20-25% is produced by the agglomeration of hot ash particles which fall to the bottom of the furnace into a hopper. This fraction is known simply as "furnace bottom ash".

In 1988/89 some 75 million tonnes of coal were burned in coal-fired power stations in Britain and this resulted in the production of 13.2 million tonnes of ash.

Disposal of power station ash is carried out in lagoons or heaps sometimes located on the station site itself but more often at nearby sites such as disused quarries, gravel pits or low lying land along rivers or river estuaries. The largest stations produce over 1 million tonnes of ash per year.

Virtually all furnace bottom ash is sold for use as an aggregate in blockmaking on site. About 45% of pfa production, (4 million tonnes p.a.), is sold into the construction industry. It is also used primarily as a block making aggregate. Other uses include fill (where its relatively low density gives it a specialist function), a partial replacement for cement in concrete and in cement manufacture itself. A proprietary lightweight aggregate, Lytag, has also been developed and this achieves a very high sales price of around £18/tonne compared with the average ex-works price for pfa of £3/tonne.

3.4 The technical feasibility of GEO's proposal.

According to planning guidances, the economic viability of a proposal is not in itself a material planning consideration. The disposal of waste products from the site is also not directly relevant to the planning process as it is controlled under other legislation[2], and would be subject to licenses granted by the local authority or HMIP. However, from the point of view of environmental assessment, the disposal of wastes, by whatever route, is a topic which should be examined in detail.

Firstly, we should consider the differences between operations using pfa, and GEO's proposal to turn incinerator wastes into aggregates. In absolute scale, there is a disparity between the two. Blockmaking plants at the major power stations utilise hundreds of thousands of tonnes of fly and bottom ash each year. According to the figures presented by GEO in the ES[3], the maximum amount of material which will be handled will be 57 tonnes per day (about 16,650 tonnes per year). It is difficult to see how the plant, producing only two lorry loads of aggregate per day, can compete with the large quarries in the area which producing hundreds of tonnes of aggregate per day.

Secondly, there is the question of quality. Aggregates from primary sources are of a guaranteed quality, and are chemically inert. The aggregate produced from the incinerator will not be of a homogenous nature because of the variations which can occur in the feedstock. Their is also the problem that, even if the Fujibeton sealant is as effective as claimed, there will always be the 'psychological' deterrent that the aggregate comes from an incineration plant, and contains heavy metals and dioxins.

3.5 Government policy on 'waste' aggregates.

In Japan, where the process of turning incinerator ash into aggregates has been perfected, the lack of primary aggregates and thus the high cost of road fill makes the use of 'secondary' aggregates economic. In the UK, it has long been acknowledged that secondary aggregates have a use in large building projects, but only where the cost is not significantly greater than that of primary aggregates.

One of the uses proposed by GEO for the aggregate is road fill. Below is an extract from Department of the Environment Circular 20/87 on this subject (relevant sections have been highlighted):

"....The Government remain convinced that the use of waste material in a constructive and economic way is to the nation's advantage..."[4].

"....The Government welcome major waste producers' affirmations that they will continue to seek to make the use of their waste products financially attractive to clients consistent with their commercial aims, ***taking into account the costs and environmental issues that are associated with the disposal of colliery and coal-fired power station waste****"*[5].

"....at the earliest opportunity, the highway authority, in consultation with the minerals and local planning authority and waste producers, will identify whether ***suitable waste material is likely to be available within an economic transporting distance of the prospective routes of a new road. That distance will vary from place to place, but as a general guide, beyond a radius of about 10 miles transport costs are likely to make the use of waste material uneconomic except where no environmentally acceptable alternative sources of fill are available locally****...."*[6].

"....It will be for tenderers to choose their source of suitable fill on a commercial basis, but the acceptability of sites for borrow pits and disposal of surplus material is a matter for the land use planning system. Planning authorities should therefore treat planning applications for borrow pits (or the disposal of surplus material) in the same way as applications for other mineral developments, taking into account the availability of alternative sources of suitable waste material...."[7].

Given the above interpretation, it would seem unlikely that it would be an economic prospect to use the incinerator aggregate in large projects such as roads. The only road project near enough to fulfil the criteria above - the A74 improvement - will be nearing completion by the time the plant is built. Although I totally support the idea of utilising waste materials for secondary aggregate, I cannot see that the proposal put forward by GEO will be economic, partly because of the competition from primary aggregates, and partly because the volumes in question will be so small.

If this material does not go for aggregate, it will have to be dumped in the Hespin Wood landfill site nearby. This again presents problems as incinerator ash can have its toxic chemical content leached out under the biological and chemical conditions produced when it is co-disposed with municipal waste.

The Royal Commission's report on incineration recommends that incinerator wastes should be disposed of to a purpose built facility[8]. Manchester City Waste Disposal Authority has already instituted these measures for its incinerator ash, and other authorities will be following suit. The question is then, is this material cannot be co-disposed at Hespin Wood landfill, and it cannot economically be turned into aggregate, where will it go to?

References:

[1] "Occurrence and utilisation of mineral and construction wastes", Arup Economics & Planning for the Dept. of the Environment, HMSO 1991.

[2] Both criteria outlined in Planning Policy Guidance 1.

[3] ES, page 5.20 and 5.23. The 57 te/day is calculated as 42 te/day of fly as and 15 te/day of noncombustibles.

[4] to [7] Paragraphs 1, 2, 3 and 5,, circular No. 20/87 - "USE OF WASTE MATERIAL FOR ROAD FILL".

[8] Royal Commission on Environmental Pollution 17th Report, paragraph 9.68.

PART 4: Waste Classification.

4.1 Introduction.

The composition of the waste fed into the incinerator has a direct effect upon the composition of the waste gases coming out of the stack. When this proposal was originally discussed, it was stated that the plant would take commercial waste, tyres and chicken litter. The classes of waste in the ES are notionally different.

During the lengthy debate leading up to this application, GEO and ABT have stressed that the plant would not be used for burning domestic refuse or sewage sludge. It is true that the plant cannot burn sewage sludge for technical reasons - although it could do so if preheating was supplied to the primary air - but domestic refuse has always been a certainty. This fear has now been confirmed in the environmental statement (ES).

4.2 'Municipal Waste'.

The ES uses the term 'municipal waste'. The term 'municipal waste' has no definition in UK law - it is an American term. As it has no definition in the UK, it may cause some confusion - and even appears to do so within the ES itself!

In the UK, waste classes are defined in Section 75 of the Environmental Protection Act (EPA) 1990. The EPA defines the term 'controlled wastes' and then goes on to specify three different types of controlled waste - household, industrial and commercial:

* 'Household is that from domestic property, ie, buildings used for living accommodation, including caravans, residential homes, universities and schools, and hospitals and nursing homes.

* 'Industrial' is that from factories, public transport premises, public utility services such as gas, electricity, water or sewage services and from public postal or telecommunications services.

* 'Commercial' is that from premises used wholly or mainly for trade or business purposes including sports and recreational facilities but excluding household and industrial waste, waste from mines, quarries or agricultural premises and any other waste excluded by regulations made by the Secretary of State.

Mine and quarry waste along with agricultural waste is generally excluded from control and regulation under Part II of EPA 1990.

Section 5.2.3 on page 5.6 states...

"For practical purposes, household wastes (from domestic properties) and commercial waste (from supermarkets, offices, etc.) are combined and classified as municipal waste."

This is an error - as stated, there is no definition for 'municipal waste' in UK law. Household and commercial wastes are 'controlled' wastes, along with industrial wastes. Hazardous wastes, and special wastes are defined and controlled under other parts of the EPA or other Acts. In the USA, municipal waste (or, rather, 'municipal solid waste') is classed as the combined residential and commercial waste material generated in a given municipal area.

The situation about what will be burnt in the incinerator is further confused in section 5.1.2 on page 5.5. It states...

*"The proposed ERC will come into operation with broiler litter and waste tyres. Initially, two treatment lines will be installed to take a combination of both of these waste streams. However, once contracts for **municipal waste and/or commercial office waste** have been confirmed, a third line for material and energy recycling will be commissioned. All three lines will then accept all three wastes."*

It appears here then that the terms 'municipal' and 'commercial' are interchangeable.

4.3 Consequences for planning process.

As stated in PPG1[1], matters which are controlled under other Acts of Parliament should not be dealt with under procedures in the Town and Country Planning Act. Therefore, in the planning process, there is little consideration of the types of waste kept on site - that is strictly a matter for the licensing process under the Control of Pollution Act or the Environmental Protection Act.

However, in terms of environmental assessment, it is very relevant. The waste will be the primary determinand of what substances will be in the discharges from the incinerator. Household waste will contain heavy metals in the form of batteries and electrical components, and a number of complex organic compounds in the form of household chemicals, wood preservatives or pesticides.

The response of the company will certainly be that the gas cleaning plant will remove 99% of these pollutants. True - but it is then proposed to use the scrubber residue to make aggregate. I could see few problems using chicken litter, tyres and commercial waste (which mainly consists of paper) - all three are fairly homogenous waste of a roughly known composition. Household waste on the other hand is a completely heterogeneous waste which varies in composition. This introduces an uncertainty into the process which could lead to problems at a later stage.

References:

[1] Planning Policy Guidance 1, "General Policy and Principles" - HMSO, March 1992.

PART 5: Programmable logic controllers and automated control systems.

5.1 Introduction.

Due mainly to the safety problems surrounding the Sizewell 'B' Reactor Protection System evaluation by the British Computer Society, there has been a re-evaluation of the effectiveness of computerised control systems in industry.

There are two types of computerised control system:

* Dedicated Control Systems: these are computers which are built and programmed to perform specific tasks. These are the most effective - but expensive - form of automated control system.

* Programmable Logic Controllers (PLC's): in effect these are small single processor computers consisting of a CPU, memory, and a complex input/output port. They are of a standard design - 'off-the-peg' almost - which can be installed into a system and programmed to perform a limited set of functions.

Dedicated control systems can be effective, but as in the case of the Sizewell 'B' Reactor Protection System, there comes a point where the sheer size and complexity of the hardware and software systems becomes too big for the human brain to handle. The problem in the case of the incinerator is slightly different. It is not a matter of the size, but the interconnection of PLC's and a dedicated system. In essence you have two 'brains' making decision - and it may not be the same one.

5.2 Problems with PLC's.

Perhaps the best way to look at the problem of PLC's is to take one of the many articles that have appeared in trade journals in recent years on PLC's. The following comes from Process Engineering[1]:

Increasing concern amongst computer experts about the reliability of software has raised doubts in engineers' minds about the wisdom of using programmable process controllers in safety critical systems. Process Engineering first highlighted the problem in April 1984. Since the Health and Safety Executive published its report on programmable electronic systems (PES) in 1987 there have been several publications examining the risk of PES failure. The latest is a joint report by the Institute of Electrical Engineers and the British Computer Society sponsored by the Department of Trade and Industry.

With programmable logic controllers (PLC's) readily available, much of the traditional electrical equipment found on process plants can be replaced. But the consequences of such upgrading must be considered with respect to the inherent defects of the PLC and the safety of the process. Nigel Ward, UK director of US PLC manufacturer Triconex, believes that the process industry is moving towards complete dependence on programmable controllers, replacing electronic and mechanical control. However, the IEE/BCS report points out that, 'the degree of trust which we can justifiably place in the software is often much less than that which we can place in other aspects of the system.'

The safety of a process is widely accepted as a system-wide issue. All the aspects of a process line are considered in a safety assessment, but this has highlighted software as the weak link. Hardware has been tested over many years and a quantitative assessment of its reliability is possible. That does not mean that it will not fail, but the risk can be assessed. The high reliability levels used in avionics and the nuclear industry may not be required for most industrial process plants; but software experts say that in any case these levels cannot be justified when the reliability of the software cannot be quantified.

Let's look at the way software reliability is assessed. Program code is written according to the stated requirements, and then tested. Indeed, some definitions of reliability are based on meeting the specification rather than the error frequency, avoiding the problem and ignoring the implications. The accuracy and completeness of the design specification is basic to the safety of all parts of the process.

Errors, or 'bugs', are the result of a fault in the design or writing of the program. When a bug is detected, code is written or altered to correct it. Unfortunately, one correction may introduce more bugs, which then have to be corrected, and so on.

Two kinds of bug can occur. A revealed bug is one that leads to a safe failure, and these are accounted for in fail-safe systems. An unrevealed bug is usually only spotted afterwards, and it is this one that is the most dangerous. It is also the most difficult to find. Eliminating all bugs in a program, especially a complex one like a process control system, is acknowledged as unfeasible. This leaves the possibility of unrevealed bugs buried deep in the code, waiting for the set of conditions - usually extreme and possibly dangerous - that will trigger a failure. Bugs in large, complex testing simulators can overlook aspects of the operation, and testing every conceivable situation is not possible. The IEE/BCS report points out that it is not yet possible to provide guarantees that software is error free.

Peter Mellor, a lecturer at the Centre for Software Reliability at City University 'cannot see a way of assessing the risk of software in safety critical systems.' Traditional methods of testing, running the system for 10 times the required safe time, means running for 10 billion hours for a reliability of 10^{-9} (or one in a billion). Even then, unrevealed faults may not be discovered until there has been testing up to 100 times as long.

5.3 The incinerator control system.

Section 17.3.3 of the ES ('Plant Control') states:

"The proposed plant will be fully automatic and will be operated by a (DCS) computer from the control room. Information regarding the whole plant and process will be fed back into the control room and displayed there. The control room will be constantly manned by skilled operators on a 24 hours per day basis.

These control room operators will be capable of understanding all the displayed data that is received in the control room, as well as being able to undertake corrective action, should the data exceed their design condition.

This ability on the part of the operators provides an effective back-up system to the computer control, as the computer would have automatically taken first stage corrective action."

With all respect, the situation of 'trained operators' running the plant can equally be applied to the reactor accidents at Chernobyl and Three-Mile-Island. The problems at the two sites were very similar. Instrumentation did not give an accurate assessment of the condition of the plant. After some problems, the operators understood that the system was not functioning properly, and began to make alterations. These alterations to the already unbalanced systems then initiated fault sequences which eventually led to catastrophe.

It is feasible that a similar problem could occur at the Hespin Wood plant - it very much depends upon the organisational hierarchy of the PLC's and the computer system in overall control. Where PLC's conduct data sampling on the incinerator systems, and then pass it on, two problems can arise:

Firstly, the PLC may malfunction - perhaps due to a hidden software bug, and not communicate the correct information to the control system. The scope of any incident resulting from this is limited because there will be other systems in the area capable of picking up the problem.

The second and most serious problem occurs when there is a major incident and a large number of the PLC's try to communicate information to the overall control computer at the same time. Which one does the control computer answer and take action of first? Normally the PLC's are addressed in a fixed order of priority (called a daisy chain), but this can lead to problems of higher priority systems overriding lower priority systems trying to convey important information.

5.4 The solution.

There is no solution to this problem except rigorous testing of the system before commissioning of the plant. Industry is hooked on PLC's because they reduce the need to have skilled staff in charge of section of plant, and so keep running costs down. Only auditing of the systems controlled by the computer systems can detect problems.

There are two auditing methods - designed for use in the nuclear industry since the 1950's - which could be carried out, and I would urge the local authority to request that they are if permission for the plant is granted.

The first is a 'probabilistic risk assessment'. In effect, it is a study which looks at all the parts of the system, and tests for the weakest links. This can provide useful information of problem areas which may need more attention during normal operating conditions.

Secondly, leading on from the data produced above, there should be a number of 'engineering fault sequence assessments' carried out. In essence, these take a minor incident - a PLC malfunction for instance - and then look at the chain of events which can be initiated by that fault and what the outcome will be.

It is very important that the system works effectively because decision making functions are being given in the first instance to the computer. Unlike reactors, the off-site risk is not so great, but in terms of the safety of people in the plant, careful auditing should be carried out. A good example of why this is important would be the vitrification plant at Sellafield where in 1992, the radiation shielding doors on the waste vitrification plant opened without warning - as luck had it, there was no one standing in the building at the time (this fault in the system was created by BNFL installing a software 'patch' in the system which did not accord to the software writers program structure). What if, in the case of the incinerator, a pressure relief valve opened up on the combustion chamber without warning?

References:

[1] Software in the Safety Process. Process Engineering, February 1990.

PART 6: Energy 'recycling and sustainable development.

6.1 Introduction.

On page 1.10 (section 1.4) of the non-technical summary the plant is presented in the following terms:

"The project has been called an 'Energy Recycling Centre', or ERC. It has been given this name in order to highlight the fact that the recovery of energy from waste is a recognised form of recycling. The technology to be used is the revolving fluidised bed system - or TIF, licensed in Europe by ABT.

The ERC proposes to take three types of waste, used broiler litter, (soiled bedding from indoor chicken breeding units), and waste tyres that are unsuitable for retreading. The third is municipal waste, which is the general name for commercial waste and domestic waste.

Tyres and municipal waste contain recyclable elements, which will be taken out in the recycling plant. After this 'refining' of the waste, the remainder is shredded and used as a form of fuel, otherwise known as refuse derived fuel (RDF), or - 'loose waste derived fuel', where the municipal waste is processed to remove glass and metals and then shredded. Generating energy from this waste meets the Government's requirements under its 'Non-Fossil Fuel' Obligation scheme for electricity stations.

As with any combustion process, gases will be produced, which will be mainly carbon *dioxide and water in the form of steam. Ash, in the form of dust containing heavy metals and other contaminants, is contained within the gases and must removed before the gases are released into the atmosphere. In order to do this, a full gas plant will be installed as part of the proposed ERC, which will conform latest EC. and UK regulations.*

The ash that is extracted from the gases during the gas cleaning process will need to be rendered harmless. This will be achieved by sending the ash to the ERC's pelletisation plant.

It is envisaged that the lines for the waste streams will be brought into operation in a staggered sequence. The first two lines will accept broiler litter and tyres, and, once the waste contracts are finalised the third line will be commissioned to meet throughput. All three lines will then accept all three waste streams."

The description of the plant is then further extended in section 9.2.5 on page 9.30 - 9.31 (bold references discussed later in this section):

"The concept of sustainable development as first expressed in the Brundtland Report, "Half our Future", 1987, is one which is rapidly becoming an essential strategic consideration for all new developments. ***A variety of interpretations have been placed on the notion of 'sustainability' but as expressed in the Brundtland Report<A>, "Humanity has the ability to make development sustainable, to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs."<B>***

Accepting this as a baseline definition for what can be regarded as sustainable development, then there is a case by which the Energy Recycling Centre is a sustainable operation in its own right<C> *and in comparative terms with alternative uses and disposal routes of the 'fuels' used in the ERC.*

The ERC will generate energy without using fossil fuels<D>*. This not only means that the does not compromise future generations' access to these fuels but also does not leave anywhere near as great a legacy of environmental damage.* ***Both atmospheric emissions and liquid effluent discharges from the ERC are many orders of magnitude less than would be associated with the generation of an equal amount of energy from more traditional fossil fuel power stations<E>****. Besides habitat loss and damage caused by the extraction, of coal, oil and natural gas, these sources of energy place enormous stresses on the environment through the production of gases causing acid rain, the discharge of water, often polluted with chlorides and trace metals, and the production of bulk ash materials, often themselves polluted with metals and other potentially toxic products.* ***As a means of producing energy from a non-fossil fuel source the ERC places minimal demands on the environment<F>****.*

Amongst the materials to be recycled and converted to energy in the ERC are tyres, chicken litter and municipal waste. ***Currently, a number of alternative disposal routes for these 'wastes' is causing enormous environmental damage<G>****. The large stockpiles of used tyres not only have negative visual impacts in many parts of the UK but the increasing incidence of accidental tyre burns is alarming. When such an incident occurs vast quantities of toxic gases are released to atmosphere, particularly dioxins, complex hydrocarbons and metals, and can have wide ranging and long lasting impacts. Accidental tyre fires a!so have an enormous impact on water quality. In the last six months of 1991 the Yorkshire National Rivers Authority were called to five tyre fires, the run-off from which polluted a number of* *water courses used for abstraction. The leachate produced from tyre dumps can also affect local water quality.* ***It has been estimated that 4,000,000 tonnes of scrap tyres are being stock piled each year without any substantial moves to deal with the problem***<H>*. As problems of tyre disposal increase, the incidence of fly-tipping also increases.* ***In the north Manchester area, removing tyres dumped in rivers costs £10,000 per year***<I> *(ENDS Report, January 1992). Equally, the disposal of domestic putrescible waste and chicken litter to landfill not only has a record of environmental impacts related to seepage of toxic leachates to water courses and ground water, but is in itself an enormous waste of potential energy.*

It is totally irresponsible and non-sustainable to dispose of organic substances and not take advantage of their stored energy potential<J>*.*

The ERC does produce Waste, in extremely low quantities, and it does produce emissions, at extremely low levels, but the ecological impact it imposes, in comparison to the alternatives, is absolutely negligible.<K> *Modern society is rapidly recognising the need to reduce potentially damaging waste streams at source but there will always be wastes of some sort generated.* ***The advantage of the ERC is that materials formerly regarded as 'wastes' will become a new source of energy, acquired with minimal environmental impact through the application of best available technology.***<L>*"*

The arguments put forward in this section are extremely subjective, and some of the facts which have been quoted are inaccurate. Before examining the above statement in detail, it would be useful to first examine what 'sustainability' is.

6.2 Sustainable development.

The problem with 'sustainability' is that there is not one concrete definition of the term. One of the best analyses of sustainability issues and the development planning system has been produced by the Town and Country Planning Association[1].

Sustainable development is a vague concept that, at once, offers a comprehensive, consensual and conservative approach able to weld together quite disparate and conflicting interests in environment and development. But, because it is vague and its implications poorly understood, in practice it offers few clear solutions. Anyone can sign up for sustainable development so long as it requires no specific commitment to do anything that will threaten their material interests. In order to define the meaning of sustainable development it is worth returning to the oft-quoted definition in the Brundtland Report:

'Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

In this statement there are three concepts which require precise definition. The first is development - which is not the same as growth, although the two are often used synonymously. Growth involves the physical expansion of the economic system. Sustainable growth is ultimately contradictory since there are physical limits imposed by the earth and its natural resources. Development, by contrast, implies improvement and progress and includes social and cultural as well as material dimensions. Sustainable development emphasises conservation; natural resources are not simply free goods to be pillaged and pilfered at will.

The second concept is needs, defined in the Brundtland Report as 'meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life'. The environment simply cannot cope with meeting the material standards enjoyed by the rich while, at the same time, supplying basic necessities to the burgeoning populations of the developing world.

Thirdly, there is the concept of future generations. This involves the notion of stewardship: 'We have a moral duty to look after our planet and to hand it on in good order to future generations.' This means improving already degraded areas and avoiding irreversible damage (such as the destruction of species) or imposing risks on the future (from toxic or radioactive wastes, for example).

Looked at in this way the criteria for sustainable development are very tough indeed. They imply a wholesale shift from exploitation to conservation; a redistribution of resources from rich to poor; and a withdrawal now from those activities which rob or imperil future generations. On this basis we have identified sustainable development in terms of a general principle, as follows:

'To promote the enhancement of the natural and built environment in ways that are compatible with the requirement to conserve the stock of natural resources and with the need to achieve greater social equality, without imposing added costs or risks on succeeding generations.'[my emphasis]

From this general principle we have identified five fundamental goals which we believe define the purpose of sustainable development and which must underlie strategies and policies for its attainment. These are the goals of conservation, balanced development, environmental quality, political participation and social equality:

* **Conservation:** Sustainable development means the efficient use of non-renewable energy and mineral resources through higher productivity, recycling, development of alternative technology and substitution wherever these are possible and not environmentally harmful. It also means maintenance of biological diversity and potential. It will require the economic valuation of natural capital assets hitherto regarded as free goods. The conservation goal can be said to be to ensure the environmentally efficient use of land and other resources.

* **Balanced development:** This goal is concerned with the use of physical resources and their impact on the built environment. Resource conservation requires patterns of development that minimise energy consumption, promote the re-use of buildings and prevent the waste of valuable natural resources. The goal here is to achieve an appropriate balance between the built and natural environment. At the end of this series we shall set out our ideas of what a sustainable pattern of development will look like.

* **Environmental quality:** At the very least environmental quality means that processes must be avoided which degrade or pollute the environment. But it must also be an aim to improve and enhance environmental quality in those areas already degraded or grossly polluted. This goal is therefore to prevent or reduce processes that are harmful to the environment and human health.

*** Social equality:** A pattern of inequality has developed that intensifies the pressure on the environment from the high per capita demands of the rich and the struggle for survival of the poor. The conflicts that arise are a major obstacle to co-operation. Greater equality will not, in itself, achieve sustainability since, under present economic systems, both wealth and poverty degrade the environment. But greater equality will remove the sources of conflict and is a precondition for political co-operation and commitment.

*** Political participation:** Commitment will be achieved through participation, which is our fifth goal. This goal is to change values and attitudes by encouraging the increase of participation in political derision-making at all levels. Change cannot simply be ordained from above; it must also be stimulated from below. Within democratic systems of government, non-governmental organisations (like the TCPA) are able to promote ideas and mobilise support for them. Dispersal of power from the central state to the local level will encourage innovation, responsibility and support for policies of sustainable development.

The principles outlined above can then be adapted to the waste management industry:

Preventing waste amounts to the conservation of resources. It involves changes in production and design, with greater emphasis placed on quality, durability and utility. There must be a shift from a linear to a circular production process: instead of a succession of stages of production, each producing wastes that have to be managed in some way, the cycle of production must be closed. This can be achieved at each stage by a combination of re-use, alternative use or recycling of materials otherwise unused during production and, wherever possible, by the use of waste products for energy or fertilisers or for some other useful purpose. The cycle is finally closed at the point of consumption when finished products are either returned (like milk bottles) or recycled.

Much attention has been paid to recycling. The UK's performance of one bottle bank per 14,000 people compares unfavourably with Australia's one per 2,000 or Holland's one per 400. Considerable savings can be made, especially in energy consumption - production of a recycled aluminium can, for instance, only requires 5% of the energy needed to produce a new one. The use of aggregates for road-building provides a good example of the potential. Only around half the total amount of aggregates used in road repairs is recycled, most of the rest going to landfill. Meanwhile, the demand for primary aggregates is forecast to double over the next 20 years, equivalent to digging a hole three metres deep over an area the size of Berkshire. Some of the land could be saved by using more secondary aggregates.

Greater progress can be made if three fairly obvious conditions are met: setting targets, such as the Government's target of recycling half the recyclable material by the year 2000; extending the practice of separation of recyclable materials at the point of origin or at accessible collection centres; and creating markets for recycled products by realistic pricing of resources.

6.3 An analysis of the 'sustainability' claim.

In the light of the criteria above, the section from the environmental statement on the 'sustainability' of incineration can be examined in detail. In the passage reproduced in section 1.1 above, certain key statements have been highlighted and labelled. Each of these statements is analysed below.

A). A variety of interpretations have been placed on the notion of 'sustainability' but as expressed in the Brundtland Report:

As outlined above, the criteria for sustainable development have been advanced since the Brundtland Report. In terms of the sustainable - and cyclic - use of resources which were developed at the Conference for Sustainable Development in Rio de Janeiro, and in Agenda 21[2] subsequently, the mere argument of 'not compromising future generations' is not enough. There are now much wider ecological and political dimensions to 'sustainability' which the section in the ES completely fails to address.

Secondly, the phrase quoted from the Brundtland Report is only part of the whole paragraph, and takes its meaning out of context. The whole passage reads...

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains two key concepts:

** the concept of needs, in particular the essential needs of the world's poor, to which over-riding priority should be given;*

** the idea of **limitations** imposed by the state of technology and social organisations on the environment's ability to meet present and future needs."*

I have highlighted the idea of 'limitations' because this is very relevant to this case. The Brundtland Report makes it clear that, although technology is able to perform many tasks, not all of the tasks, and their results, are desirable when considering the well-being of this and future generations.

B). "Humanity has the ability to make development sustainable, to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.":

This plant does not preserve resources - it destroys them. In terms of a life-cycle analysis of products, incineration is an end point where materials are degraded and lost from the 'system'. Therefore, by degrading resources which could have been recycled, this plant does compromise the ability of future generations to meet their needs.

C). Accepting this as a baseline definition for what can be regarded as sustainable development, then there is a case by which the Energy Recycling Centre is a sustainable operation in its own right:

This plant recycle a little over 5% of its material throughput - or 20% of the mixed household/commercial wastes 'as the market dictates'. Recycling plants in other European countries are achieving recycling rates of 60 - 80%. Also, compared to similar plants being built in Spain and Berlin by ABT, the effort put into recycling is minimal. In no way therefore can this plant's primary purpose be considered to be materials recycling.

Secondly, in Europe the incineration of wastes is looked upon as a waste management option. In the UK the government are looking at waste as a means of achieving recycling targets without the needs - as is happening elsewhere in Europe - to legislate on materials usage, specifically packaging, and recycling. This plant degrades potentially recyclable materials - it is an end-point in a waste management system, not a method of recycling.

D). The ERC will generate energy without using fossil fuels:

Plastics are made from oil - a fossil fuel. Car tyres are made from oil - a fossil fuel. Paper is a material made from organic fibres, but the processing uses fossil fuels.

Directly or indirectly, this plant is burning fossil fuels. What is worse, materials like paper which can be recycled - in the process saving small amounts of fossil fuels - will have to be replaced with virgin materials, so increasing the use of fossil fuels. It cannot be said that the plant does not burn fossil fuels - it does - and in doing so removes materials from the system which if reclaimed could lessen current fossil fuel consumption.

E). Both atmospheric emissions and liquid effluent discharges from the ERC are many orders of magnitude less than would be associated with the generation of an equal amount of energy from more traditional fossil fuel power stations:

Firstly, one order of magnitude equals 10. Many could be 100, or 1,000, or 1,000,000.

Secondly, if we take a traditional fossil fuel such as coal, it contains more energy per unit volume than waste. If we take data from ETSU[3] comparing coal to waste derived fuel (RDF):

Parameter.	Coal.	RDF.	RDF/Coal, percent:	
Calorific value, GJ/te^{-1}. 28.1	15.9	56%.		
Density, kg/m^{-3}.	900	600	66%.	
Ash content, %vol.	6.5	15.7	240%.	
Moisture content, %vol.		6.1	7.4	120%.

Burning RDF to achieve the same energy output as coal therefore requires 56% more material by weight - which equates to nearly three times the volume of material. Also, to produce the same amount of energy, burning RDF produces 420% more ash.

In burning all the extra material, there will be extra discharges to air - it would be impossible to burn more material and create a smaller discharge. It is true that a traditional coal-fired power station's discharges are many times greater than an incinerator, but then again it is producing over one hundred times as much energy.

This statement by GEO's consultants is factually incorrect and is a misleading 'untruth' to persons reading the document.

F). As a means of producing energy from a non-fossil fuel source the ERC places minimal demands on the environment:

Incorrect - the chicken litter an other organic materials could be dealt with in anaerobic digestion plants which utilise methane to produce energy. The combustion of methane is also much cleaner and much more efficient per unit of energy than waste incineration. Likewise, pyrolysis of tyres produces gases which can fire gas engines to generate electricity more efficiently and cleanly, and the hydrocarbon rich residues left over can be processed into new products, so displacing oil base products currently used for similar purposes. In comparison to other technologies available, this statement is therefore factually incorrect.

G). Currently, a number of alternative disposal routes for these 'wastes' is causing enormous environmental damage:

In a recent study[4], only 18% of all landfill sites experienced pollution problems. Of these problems 48% were due to landfill gas, 4% were due to fire, 27% were due to surface water ponding and 6% subsidence. Only 15% - or 2.7% of all landfill sites - experienced problems with pollution of groundwater off-site.

How can GEO's consultants describe an incidence of 1 in 40 landfill sites leaking as 'enormous'? Yet again, GEO are misleading the public from the facts.

H). It has been estimated that 4,000,000 tonnes of scrap tyres are being stock piled each year without any substantial moves to deal with the problem:

Elm Energy's tyre incineration plant in Wolverhampton will only be taking newly scrapped off tyres because of problems about tyre composition - and thus air emissions. The Hespin Wood plant will take only five-sixths of the tyres arising in Cumbria. Therefore, this plant will not stop the accumulation of tyres in Cumbria, and on a national scale, tyre incineration will not solve the problem of existing stocks of tyres. The only disposal route which is able to take nearly all tyres is pyrolysis.

I). In the north Manchester area, removing tyres dumped in rivers costs £10,000 per year:

The presence of a tyre incinerator would make no difference. The local authorities would in fact have to pay a higher gate price at an incineration plant than at an appropriately licensed landfill site. In other words, by sending them for incineration, they could well end up paying more.

J). It is totally irresponsible and non-sustainable to dispose of organic substances and not take advantage of their stored energy potential:

I would question whether incineration is the best technology for organics. Organics are not suited to incineration because of their high water content (which reduces the calorific value), and the fact that the resultant ash is sterile, and would damage plant growth if incorporated into the soil. However, anaerobic digestion - which utilises the methane given off to efficiently generate electricity - is not affected by the water content, and the end product can be incorporated into the ground and will actively improve the soil by freeing nutrients.

K). The ERC does produce Waste, in extremely low quantities, and it does produce emissions, at extremely low levels, but the ecological impact it imposes, in comparison to the alternatives, is absolutely negligible.:

In comparison to the alternatives...

Pyrolysis for tyres;

Digestion for chicken litter and organic wastes;

Recycling and source reduction for other materials;

incinerator plants have a much greater environmental impact. This impact is two fold. Firstly, the direct emissions from the plant are greater than those from other waste management options. Secondly, incineration destroys resources, and these must be replaced - the manufacture of replacement resources then incurs extra emissions from the winning of primary materials and in the processing of these raw materials into usable materials. The waste from the incinerator is also more persistently toxic than the waste products from any of the other options outlined above.

L). The advantage of the ERC is that materials formerly regarded as 'wastes' will become a new source of energy, acquired with minimal environmental impact through the application of best available technology.:

I agree totally that in the UK's history of incineration plant, this is one of the better designs.

However, this plant is not the most acceptable solution for the wastes chosen. This plant fulfils a waste management function. It provides and easy solution to a persistent problem. However, given encourage by central government - as is done in other European countries - the alternatives could effectively solve many of our current waste management problems - especially in terms of household waste, agricultural wastes and sewage sludge. The materials chosen for this plant are not waste - they could be put to use again if processed correctly.

INCINERATION STERILISES RESOURCES PREVENTING THEIR FURTHER USE.

6.4 Conclusion.

Taking the key statements in the ES, and applying the present 'sustainable' criteria to them, it can be clearly seen that this plant is un-sustainable. This is because it destroys resources - denying their use to future generations. In destroying these resources it forces society to use up more energy to recreate new materials from virgin raw materials. Finally, in the destruction of these resources, which forces the creation of new resources, there are increased emissions to the air and land when compared to other available technologies which could effectively recycle all the wastes selected for this plant.

References:

[1] The Town and County Planning Association have published analyses of sustainable development issues over 10 month in their journal. The two articles with direct relevance are:

"Problems, Principles and Prospects." Andrew Blowers, 'Planning a sustainable future' - Town and Country Planning Journal, May 1992.

"Pollution and Waste - a sustainable burden?" Andrew Blowers, 'Planning a sustainable future' - Town and Country Planning journal, October 1992.

[2] UN Conference of the Environment and Development, Rio de Janeiro, 1992. Final conference document - global agreement on sustainable development for the 21st Century: "Agenda 21".

[3] M.P. Landy, paper to Annual Wastes Management Conference, Torbay, 1987. Ref.: ETSU-L-20.

[4] "Landfill failure risk assessment survey", David Roche, Frank Graham Consulting Engineers, 1993. 0392 432748.

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** END OF REPORT. **
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