Appendix 1. Introduction

1.1. Strategic Infrastructure Notification

Our Ref: 26.PC0078

Your Ref:

DATE	
CEO	IN/2009/212
CFO	
EMD	
PRD	
✓ END	06/11/09
DOD	
LED	
IRD	

An Bord Pleanála

M. G. Martin - Luengo
Endesa Ireland Limited
3 Grand Canal Plaza
5th Floor
Grand Canal Street Upper
Dublin 4.

5th November 2009

Re: Combined Cycle Gas Turbine Power Plant At Great Island, Co. Wexford

Dear Sir,

Please be advised that following consultations under section 37B of the Planning and Development Act, 2000 as amended, the Board hereby serves notice under section 37B(4)(a) that it is of the opinion that the proposed development falls within the scope of paragraphs 37A(2)(a) and (b) of the Act. Accordingly, the Board has decided that the proposed development would be strategic infrastructure within the meaning of section 37A of the Planning and Development Act, 2000, as amended. Any application for permission for the proposed development must therefore be made directly to An Bord Pleanála under section 37E of the Act.

Please also be informed that the Board considers that the pre-application consultation process in respect of this proposed development is now closed.

Attached is a list of prescribed bodies to be notified of the application of the proposed development. Please also find attached the record of the meeting with the Board which took place on the 28th of October, 2009.

In accordance with section 146(5) of the Planning and Development Act, 2000 as amended, the Board will make available for inspection and purchase at its offices the documents relating to the decision within 3 working days following its decision. This information is normally made available on the list of decided cases on the website on the Wednesday following the week in which the decision is made.

If you have any queries in relation to the matter please contact the undersigned officer of the Board.

Please quote the above mentioned An Bord Pleanála reference number in any correspondence or telephone contact with the Board.

Yours faithfully,

Kieran Somers

Kieran Somers
Executive Officer

PC09.LTR

64 Sráid Maoilbhríde,
Baile Átha Cliath 1.

Tel: (01) 858 8100
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64 Marlborough Street,
Dublin 1.

Appendix 2. Background to the Project

2.1. EirGrid Input to ESB Asset Strategy

31 October 2007

Eugene Coughlan
Commission for Energy Regulation
The Exchange
Belgard Square North
Tallaght
Dublin 24

Our Ref: ESBASSET0701-001

Re. EirGrid Input to ESB Asset Strategy

Dear Eugene

I am writing to you following our tripartite meeting with ESB Power Generation on Monday 22nd October which followed an earlier tripartite meeting on Monday 27th August. At the most recent meeting we undertook to revert to you and to provide, to the extent readily available, information regarding the suitability for the installation of base load plant at the existing ESB Power Generation sites at both Tarbert and Great Island, the potential implications for other parties should base load plant be connected there, and to provide any indication based upon our best professional judgement as to how much additional peaking plant could be installed at Tarbert.

Background

EirGrid enters into contractual arrangements with parties for connection and access rights to the transmission system for a given level of contracted capacity, premised upon a given technology which allows EirGrid to plan the system premised upon an assumed load factor and running pattern. This allows EirGrid to seek to plan both the shallow connection works and associated reinforcements in the most efficient manner taking into account the costs of additional network development in combination with any benefits in terms of reduced constraint costs or enhanced operational flexibility which may result.

EirGrid currently holds connection agreements with ESB Power Generation for 589.4 MW of (mid/low merit) capacity at Tarbert and 216 MW of (mid/low merit) capacity at Great Island. Consistent with any general principle of sale or assignment EirGrid believes that it would be reasonable that the capacity rights currently assigned to any particular connection point – that is the size of the capacity associated with the given technology, load factor and assumed running pattern - could, without further works, be transferred from ESB Power Generation to another party. As part of its duty to ensure it plans a safe, secure and reliable transmission system, as well as its duty to ensure it does not discriminate unfairly, EirGrid would not be in a position to offer any additional rights to any party without first carrying out the necessary studies, or following the processes and procedures, for the issuing of connection offers to parties.

Should it be the desire of ESB Power Generation, or the Commission, to seek to offer the sites identified with either greater capacity than that currently contracted, or for redevelopment by another party utilising technology of a different kind with differences in the assumed running order of the plant, then, in order to identify the implications of the reservation of such capacity, both upon overall network development and indeed other connecting applicants, or applicants seeking to connect, EirGrid would need to undertake detailed network studies, similar to those under the process for applicants seeking to connect, and premised upon certain assumptions regarding the behaviour of these and other participants. In particular this would bring to bear questions around the priority of access of this plant when compared to other parties connected who currently have non firm access rights in anticipation of the completion of associated network reinforcements (deep works), and indeed those parties who do not yet have contracts for connection but who have been seeking access to the system and who will be processed under Gate 2 or subsequent gates as part of the group processing approach.

Notwithstanding this, EirGrid is happy to assist the Commission to the extent possible on an informal basis, and provide certain additional information to the Commission in this letter, based upon off the shelf studies available to it. EirGrid cannot, however, be definitive about the impacts, or indeed any works which might be required in the absence of carrying out detailed studies for specific plant proposals, which would need to be based upon certain assumptions concerning the treatment of access vis a vis other applicants either currently connecting, or in the application queue. While the information provided herein is based upon best System Operator professional judgement, and a number of desk exercises carried out by EirGrid, the Commission should be aware in interpreting it that the information contained herein is subject to change, given the number of assumptions which have had, by necessity, to be made about the works required for and take up of Gate 2 as well as the behaviour of other elements of the plant portfolio. EirGrid therefore stipulates that, in relation to any proposal for the redevelopment of these sites, the information provided in this or subsequent correspondence only be provided to applicants on the same basis and accompanied by the same caveats which EirGrid places upon such information.

Potential Suitability of Great Island

In general terms EirGrid can advise the Commission that Great Island is likely to be a good location on the network to connect a new base load generating station. The recently published Forecast Statement, although prepared upon a basis different to the type of analysis necessary for connection studies, identifies 250-400 MW of available generation capacity for connection at the Great Island node post the completion of the Athlone – Shannonbridge 110kV line in Qtr 4 of 2011. This would be prior to the connection of any Gate 2 wind plant. While we would not expect the level of Gate 2 plant connecting in the area to be too significant – connection offers are to be issued to c.120 MW of wind plant in the South East - the impact of further connection of wind plant, and indeed the new CCGT plant in the Cork area, would be expected to have a secondary impact and to alter the overall flows upon the network. In assessing the ability of a plant to connect, one would also have to make additional assumptions with respect to other plant seeking to connect in the area, most notably the 98 MW OCGT application which has been received by EirGrid seeking connection at Kilkenny of which EirGrid has previously made the Commission aware.

In addition to the information contained in the Forecast Statement, EirGrid has previously carried out studies as to the effect upon the network should there be plant closure, and no replacement, at Great Island. These studies showed that significant problems arise in the south east of the county which would necessitate large scale reinforcement in this area to resolve. Additional generation in the area, although is likely in itself to cause some need for reinforcement, is also likely to alleviate a portion (the scale is dependant on size and location) of the aforementioned reinforcement needs in the south east and reduce the overall needs in the area.

Therefore, in general, while EirGrid is unable to be definitive about the potential suitability of connecting additional base load plant at, or close to Great Island, in the absence of carrying out further studies, and in particular the scale of base load plant which could be accommodated ,Great Island is in a general terms a favourable location for the connection of new plant and would be happy to advise any potential or intending applicants of this verbally in anticipation of the submission of any application for connection.

Potential Suitability of Tarbert

Notwithstanding the networks access rights which are currently granted to ESB Power Generation at Tarbert and which could in accordance with the principles outlined above be assigned or transferred to another party, EirGrid is of the opinion, in general terms, that Tarbert no longer represents a desirable point for the connection of new, or replacement capacity, given the congestion, and associated reinforcements being seen in the South West of the country with ever increasing penetration of wind plant. The current network congestion being experienced in the Shannon area would be exacerbated to the extent that any replacement plant would be expected have greater run time, be closer to base load, than the existing plant portfolio. At a minimum this would have the potential to increase the level of constraints for wind plant with non-firm access in the area, and could, dependent upon the precise scenarios considered, entail considerable additional network build with longer lead times than anticipated, or higher constraint costs, prior to plant receiving firm access for their full contracted capacity. The recently published Transmission Forecast Statement indicates 'low', less than 100MW, generation opportunity at Tarbert. This was premised upon the continued connection of the existing 580MW of mid/ low merit plant but was priori to the connection of any wind plant under Gate 2. It is therefore unlikely that there would be opportunity to connect significant base load (>100MW) of plant at Tarbert without the need for significant deep reinforcements.

There will be c.650 MW of wind plant under of Gate 2 wind plant which will be issued offers in the South West and which would be likely to interact with any other thermal capacity in the area and would therefore be expected to impinge to some extent on any available capacity at Tarbert. Based on some preliminary and off the shelf studies available to EirGrid, EirGrid believes there could result an almost permanent constraint during high wind periods of the entire c. 590MW of generation in Tarbert if it were to be replaced with base load plant assuming that Gate 2 wind is granted firm access in advance of Tarbert and full take up of the Gate 2 offers in this area.

Therefore in general terms, and without the conduct of the necessary detailed connection studies, EirGrid believes that Tarbert is at this point in time not a desirable point for new connection of base load plant, but would be better suited to a more complementary form of generation for the predicted wind generation in the south west of the country. The precise scale of additional peaking plant which could be accommodated would need to be the subject of further study and would depend upon the degree to which it was expected to operate counter phase to the wind in the area.

Basis for the Assessment of Suitability for New Generation

There is increased difficulty in carrying out studies of the nature previously undertaken by EirGrid for the Commission with the ever increasing number of assumptions which must be employed in so doing given the open status of Gate 2 at this time, both in terms of the number of plant which will accept offers, but also given that the identification of the precise connection points and overall deep reinforcements which will result, as well as the criteria and access rights to be assumed for other parties still in the connection queue, both thermal and renewable. On that basis EirGrid believes that in order to be definitive about the level of capacity which could potentially be committed would necessitate the undertaking of a more detailed suite of connection studies, premised upon a set of agreed assumptions, and which would inevitably take some time to process.

EirGrid understands that consistent with the Regulatory Authorities' decision of September 2006 the concept of 'deemed firmness', whereby parties will be granted firm access prior to the completion of the identified deep reinforcements consistent with the Transmission Planning Criteria will no longer exist come the commencement of SEM. EirGrid believes that to seek to offer for contract capacity which differs from that currently held by ESB Power Generation,, in the absence of the studies to identify the necessary works, and the completion of same, would effectively constitute the granting of deemed firm access.

EirGrid therefore suggests that, while the information provided by EirGrid in this letter may provide some indication to both the Commission and ESB Power Generation as to the likely suitability of the sites identified that the best approach would be for ESB Power Generation, or any party who might have a potential interest in the sites offered, to submit connection applications for any capacity, other than that which already exists,[1] premised upon the existing plant portfolio as an ongoing concern, which they might wish to offer with the sale of any identified sites. EirGrid could then further liaise with the Commission as to the best means by which to process such applications and the appropriate assumptions to make with respect to the processing of same.

In the meantime should you wish to discuss the contents of this letter further please do not hesitate to get in touch.

Yours sincerely

Simon Grimes
Manager, Commercial & Regulation, EirGrid
EirGrid

cc. Andrew Ebrill, CER

[1] The existing capacity being premised upon existing technology and therefore assumptions concerning typical running pattern etc..

Appendix 3. Description of the Development

3.1. Residuals Management Plan

Residuals Management Plan

Great Island Generating Station

INTEGRATED PREVENTION POLLUTION CONTROL

LICENCE REGISTER NUMBER: P0606-02

LICENSEE: ENDESA

Report P04E318A – R1

Revised April 2009

TMS Consultancy Ltd.

Table of Contents

1. Introduction

1.1 Background

Environmental management at Endesa's Great Island Generating Station is regulated by the conditions of Integrated Pollution Control Licence (IPPC Licence) Reg. N° P0606-02 issued as Licence number 715 in January 2005 by the Environmental Protection Agency (EPA).

Clause 14 of IPPC Licence Reg. N° P0606-02 requires the preparation and submission to the Agency of a Residuals Management Plan (RMP). The specific requirements are laid down in Condition 14, as follows:

14.1 Following termination, or planned cessation for a period greater than twelve months, of use or involvement of all or part of the site in the licensed activity, the licensee shall, to the satisfaction of the Agency, decommission, render safe or remove for disposal/recovery, any soil, subsoils, buildings, plant or equipment, or any waste, materials or substances or other matter contained therein or thereon, that may result in environmental pollution.

14.2 Residuals Management Plan:

14.2.1 The licensee shall prepare, to the satisfaction of the Agency, a fully detailed and costed plan for the decommissioning or closure of the site or part thereof. This plan shall be submitted to the Agency for agreement within six months of the date of grant of this licence.

14.2.2 The plan shall be reviewed annually and proposed amendments thereto notified to the Agency for agreement as part of the AER. No amendments may be implemented without the written agreement of the Agency.

14.3 The Residuals Management Plan shall include as a minimum, the following:

14.3.1 A scope statement for the plan.

14.3.2 The criteria which define the successful decommissioning of the activity or part thereof, which ensures minimum impact to the environment

14.3.3 A programme to achieve the stated criteria.

14.3.4 Where relevant, a test programme to demonstrate the successful implementation of the decommissioning plan.

14.3.5 Details of costings for the plan and a statement as to how these costs will be underwritten.

14.4 A final validation report to include a certificate of completion for the residuals management plan, for all or part of the site as necessary, shall be submitted to the Agency within three months of execution of any part of the plan. The licensee shall carry out such tests, investigations or submit certification, as requested by the Agency, to confirm that there is no continuing risk to the environment.

This Report is prepared to address the above requirements.

1.2 Basis of RMP

The basis of the RMP is as follows:

- A review of the activities carried out at the station, including processes and services.

- Identification of existing and potential hazards, including evaluation of materials consumed and wastes generated.
- Consideration of historic environmental incidents and remediation works undertaken.
- Identification of items of plant and other materials that may be decommissioned, rendered safe or removed from the site for disposal or recovery in the event of closure.
- Identification of locations where cleaning, decontamination or remediation works may be required in the event of decommissioning to prevent environmental pollution.

1.3 Station Features

Great Island Generating Station is located in south-west Co. Wexford near Campile at the confluence of the River Suir with the River Barrow estuary.

The station's generating capacity stands at 240 MW and it was developed in two stages, comprising three generating units. The initial development consisted of two 60 MW units that were commissioned in 1967 and 1968. Each unit comprises a VKW boiler and a Parsons turbo-alternator. The follow-on development consisted of a single 120 MW unit that was commissioned in 1972. It comprises a Fives boiler and Parsons turbo-alternator.

The station was constructed on lands that were formerly in agricultural use and some lands were reclaimed from the estuary during development of the site. The total area of the site is approximately 65 hectares (ha).

The main features of the station include:

- Station main building housing three boiler and turbo-alternator units.
- Jetty for unloading marine oil tankers having a capacity to accept vessels up to 20,000 dwt. The cooling water intake is incorporated into the unloading jetty.
- Five tanks for storing heavy fuel oil (HFO) with a total capacity to 85,000 t.
- Minor HFO tanks including transfer tank, test tank and oil stripping tank for use in oil unloading.
- Diesel oil tank and minor vehicle refuelling tanks.
- Waste oils storage tanks.
- Cooling water system comprising pumphouse, inlet and outlet culverts, and discharge channel.
- Service reservoir and tanks for storage of incoming and treated water.
- Water treatment plant for processing of water prior to its use in the boilers.
- Neutralisation plant for treating boiler washing effluents and water treatment plant effluent.
- Generator transformers and high voltage switchgear.
- Unit and house transformers.
- Two reinforced concrete chimneys, one each serving the two 60 MW units and the 120 MW unit respectively.
- Administrative offices and canteen.

Please note that the 110 kV and 220 kV transmission compounds were removed from the scope of the IPPC Licence P0606-02 in Technical Amendment C, December 2008. URS completed an

Environmental Site Assessment on the Switching Yards and concluded that "the subject areas are suitable for the continued industrial land use. No remedial action is considered necessary within the subject areas under a continued industrial land use scenario"

- Supporting facilities including the following:
  - fire protection pumphouse
  - fuel oil pumphouse
  - diesel generators
  - chemicals storage tanks
  - chemical laboratory
  - workshop and stores

  Bedrock underlying the site comprises volcanic rocks of the Campile Formation. This consists of zones of siliceous volcanic ash and crystalline felsite. There is an overburden of glacial till and alluvial silt.

The site closed and verified an on site landfill area comprising two cells, cell 1 and cell2. Cell 1 is 22,500 m2 and cell2 is 13,500 m2. The design of the closure was based on a URS report (October 2003) and the technical specification for the closure and capping was based on that report. URS also conducted an Environmental Risk Assessment on the waste disposal areas and concluded that there was an associated low environmental risk. The cells were capped and closed in conjunction with a Quality Assurance assessment of the closure by URS ("Closure of Landfill at Great Island Power Generating Station – Construction Quality Assurance Report" 2008). The latter report concluded that "construction of the landfill cap was completed in general accordance with the specifications and drawings."

The residuals management plan thus reflects the remaining areas of the site within the scope of the IPPCL.

2. Scope of RMP

2.1 Application of RMP

Endesa has no current plans to decommission all or part of the plant, outside of the exclusions and closures outlined in Section 1.3 above. The scope of this RMP addresses the key issues that would occur in the orderly shut-down of all of the station activities.

Condition 14.1 of IPPC Licence Reg. N° P0606-02 refers to planned cessation of operations for a period of greater than twelve months. The role that Great Island Generating Station will play in the Irish electricity industry close to the time of its decommissioning will be determined by a complex array of issues and cannot be foreseen at this point in time. While a section of the plant or all of it may be unused or not in operation for a period of twelve months, circumstances could dictate that it be maintained until such time as production resumes. While this has not happened at Great Island, similar long-term storage of plant has occurred in the past at other power stations where units were mothballed for a number of years and subsequently became available again for commercial operation. In such an event the RMP will not be implemented.

There are no direct references in this RMP to partial closure. While some ancillary and support facilities at Great Island are unit related, most are not. Additionally, there are significant practical constrains involved in safely segregating working from non-working station plant.

Under a scenario involving discontinued use of one or two of the station's three units, most ancillary and support facilities would remain operational and the station would continue to operate under the conditions of IPPC Licence Reg. N° P0606-02.

2.2 Areas Addressed

General

The scope of the RMP will be the decommissioning of the site activities related to the electricity generation process and disposal of residuals arising therefrom.

This will involve decommissioning of:

- Production facilities
- Ancillary / support facilities
- Storage areas

It will also include the disposal of all residuals arising from the decommissioning itself. Here the term "residuals" is deemed to include any materials remaining on site following process decommissioning. This includes materials and wastes.

Key Issues

The principal issues to be considered in the RMP for Great Island are identified as follows:

- Liquid fuel (HFO and diesel) removal / cleaning from pipelines and tankage.
- Residual chemicals and chemical storage tank cleaning.
- Boiler cleaning.
- Drainage line cleaning.

Materials

The station stores holds approximately 3,000 coded items with an equivalent annual turnover of stock. Station purchases run to in excess of 2,500 orders annually. Most items are used in operations and maintenance activities and are of no environmental significance.

A list of the environmentally significant materials used at the station and to be disposed of during decommissioning, derived from Section 10 of the station's application for its IPPC Licence, is presented in Appendix I. The list contains details of the maximum quantities of these materials stored on site. The actual quantities remaining at shut-down would likely be much less due to scaling down of activities prior to closure, allowing a staged reduction in inventory.

Wastes

Site operations generate hazardous and other wastes. The types of waste generated are outlined in Schedule 3 of IPPC Licence Reg. N° P0606-02 and are presented as Appendix II. The list contains details of the quantities of these wastes arising annually, as indicated in the station's application for its IPPC Licence.

The amount of wastes generated will increase significantly during implementation of the RMP with the following being of particular note:

- Batteries.
- Waste lubricating oils.
- Waste transformer oils.

Additional hazardous wastes that may arise during decommissioning are as follows:

- Smoke detectors.
- Chemical paints and additives.
- Refractory brick from station chimneys.

Wastes arising during decommissioning will be managed in accordance with Condition 7 of IPPC Licence Reg. N° P0606-02.

Asbestos

Asbestos was used widely in construction of Units 1 & 2 at Great Island but very little was used in the construction of Unit 3.

In 1990 a decision was taken to remove all remaining asbestos material from Great Island and a survey of the plant was undertaken to identify where it was present. The asbestos was removed and was stored on site until 1992 when all asbestos waste, including that excavated from a designated on-site asbestos burial site, was exported to a licensed disposal site in Finland.

Small amounts of asbestos may still be incorporated in certain small items such as gaskets and gland packing. However, large-scale removal from the plant of asbestos insulation and lagging will not arise during decommissioning.

Environmental Incidents

The principal accidents or incidents of environmental significance that have occurred at Great Island were as follows:

- An oil spill in the 1970s resulted in oil being leaked from the stripping tank to the estuary during oil unloading.
- In 1985 interference with equipment in the oil storage bund led to quantity of oil being lost from one of the tanks. All oil was retained within the concrete bund.

Neither of the above lead to contamination of station lands.

Other Conditions of IPPC Licence Reg. N° P0606-02

Certain obligations may arise as a result of compliance with Condition 9.2.4 and of IPPC Licence Reg. N° P0606-02 as follows:

> 9.2.4 The licensee shall implement the groundwater programme as approved by the Agency in correspondence of 16/09/03, for removal of on-site contamination and remediation of groundwater

It is envisaged that discharge of any obligations arising from the above will predate decommissioning of the station. No significant aftercare management is predicted.

Should the opposite be the case with station closure and decommissioning occurring sooner than anticipated, works within the scope of the RMP will be completion of outstanding actions on foot of any obligations arising from the above.

Long-term Liabilities

An underground tank that was previously used for storing petrol was decommissioned some years ago.

There has been no recorded spillage of chemicals at Great Island.

The environmental monitoring programme conducted at Great Island is in accordance with the requirements of Condition 11.1 of IPPC Licence Reg. N° P0606-02. Monitoring in accordance with Schedules 1(ii), 1(iii), 2(ii), 2(iii), 4(i) and 4(ii) is designed to identify any impacts associated with operation of the station so as to allow effective remedial action or minimise environmental pollution.

Given the current knowledge concerning the long-term environmental liability associated with the site and that full compliance with IPPC Licence Reg. N° P0606-02 will ensure that additional liability will be avoided, a significant soil and groundwater programme at station decommissioning is not anticipated.

2.3 Annual Review

The RMP will be reviewed annually.

The annual review of the RMP will address all developments at Great Island. The review will also evaluate the scope of the RMP in the context of any environmental incidents at the station.

The RMP will be updated as necessary.

2.4 Exclusions

The RMP applies to the entire site, except as follows:

- Successful decommissioning is determined as being completed when all buildings, equipment, wastes or any other materials that could result in environmental pollution are removed from the site and recycled, recovered or disposed of in accordance with all regulations in force at that time. The RMP will result in a decommissioned and decontaminated site suitable for future industrial use. All buildings and some site services, whilst emptied and cleaned as part of the RMP, will remain in place following decommissioning.
- The structural form of station buildings is conventional structural steel supported on reinforced concrete foundations. Gantries and walkways for access to plant and equipment are constructed of stainless/galvanised steel open grating type flooring. These are supported on steel beams and columns. External walls comprise profiled metal cladding and roofs are constructed of profiled metal decking on purlins spanning between rafters. The materials used do not pose any environmental threat in the event of station closure, whether they are demolished or remain in place.
- Certain station areas will continue to operate or remain operational. These include facilities such as the following:
  - Diesel supply to back-up engine in the fire protection pumphouse.
- All equipment and plant at Great Island is the property of the station, other than cylinders in which bottled gas is delivered and a pressure vessel (bullet) of 1,500 l capacity in which propane gas is stored. The latter is owned by the supplier who is responsible for maintenance. The supplier will be responsible for removing any remaining propane and bringing the bullet to a safe state.

- Services that are performed by contractors on an ongoing basis include the following:
  - Unloading of marine oil tankers
  - Landscaping of station grounds
  - Rodent control
  - Hygiene services
  - Window cleaning
  - General building work

  The above activities have no implication for the RMP.

3. Criteria for Successful Decommissioning

The criteria for successful decommissioning to ensure minimum impact to the environment with respect to residuals management are as follows:

- The appropriate decontamination of all plant and equipment.
- Documented reports of all raw materials dispatched from the site.
- Documented reports on the disposal of hazardous waste including all certification required under regulations in force at the time.
- Documented reports on the disposal of non-hazardous waste including all certification required under regulations in force at the time.
- Clearance and documentation indicating final disposal for any asbestos found to be present in the station.
- Documented post-closure ADF, soil and groundwater programmes where appropriate.
- Secure archiving of all documentation.

4. Implementation of RMP

4.1 Strategy

Endesa intends to manage and execute the RMP using internal resources, supplemented as necessary and appropriate with external resources.

All external resources used for cleaning, waste disposal, etc. will be fully approved and licensed as appropriate.

A Residuals Management Team will be created to manage and execute the entire project and key activities will be supervised by personnel with appropriate experience and expertise. Only suitably qualified personnel will carry out decontamination works.

Options that will be available with regard to various residuals are broadly as follows:

• Reuse	Removal for reuse at other power station(s).
	Return to supplier
• Recovery / Recycling:	Sale to third-party
• Disposal	Disposal as waste

Waste sent off-site for recovery / recycling or disposal will only be conveyed to a permitted waste contractor and only transported from the station to the site of recovery / disposal in a manner that will not adversely affect the environment.

4.2 RMP General Activities

The activities within the RMP will be as follows:

- Cessation of all production.
- Cancellation of all incoming deliveries of materials to the station.
- Termination of all contracts other than those that are concerned with the RMP or related to safety of personnel or the environment.
- Return of materials to suppliers where possible, for resale or reuse.
- Isolation and purging of transfer lines from bulk storage to direct pipe contents back to bulk storage.
- Shutting and blanking of supply lines from bulk storage for oils and chemicals to intermediate storage and/or dilution tanks.
- Cleaning and decontamination of all plant and equipment.
- Removal of all laboratory chemicals.
- Cleaning and decontamination of all laboratory analytical instruments.
- Cleaning, decontamination and inspection of bunds, sumps and underground drains.
- Removal of old and obsolete equipment and destocking of the workshops and stores.
- Isolation and disconnection of all electrical supplies to pumps and motors.
- Draining of oil from obsolete transformers that will not be reused elsewhere.
- Decommissioning of redundant oil-filled cables and draining of header tanks.
- Cleaning of residues from boilers and cleaning and blanking off of fuel lines.
- Draining and cleaning of lube oil systems.
- Draining of water systems such as raw feedwater tanks, condensate storage tanks and supplementary cooling systems.
- Transfer of ion exchange resins to drum storage.
- Cleaning of water treatment neutralisation tank and removal of all waste and effluent for appropriate disposal.
- Maintenance of parts of the water supply system to provide wash-down and cleaning facilities during decommissioning and to meet the ongoing needs for fire protection and sanitary services.
- Maintenance of site drainage system and oil interceptors during decommissioning activities.
- Secure archiving of all relevant documentation including drawings, instrumentation diagrams, validation documentation, vendor manuals and data, project files, maintenance records, inspection records, waste disposal records and other appropriate documentation.

- Maintenance of a security presence on site on a 24-hour basis for ongoing monitoring of the site from a safety, fire protection and environmental perspective.
- Maintenance of defined site access procedures.

It is anticipated that any necessary decontamination of plant and equipment will be carried out on site. It will primarily involve cleaning in place and power washing of internal and external surfaces.

Endesa will seek approval from the Agency for any decontamination procedures and monitoring requirements to be employed.

4.3 Residual Liquid Fuel, Tankage and Pipelines

Drains in the areas where these facilities are located will be isolated before commencement of decommissioning activity.

Heavy Fuel Oil (HFO)

Great Island is fired on HFO. Its tank farm comprises five tanks each of 17,000 t capacity. There are also a transfer/service task of 4,000 t capacity, a test tank of 300 t capacity and a transfer pipeline stripping tank of 300 t capacity.

Tanks are of mild steel construction with man-made mineral fibre (MMMF) and aluminium cladding insulation. A programme of inspections of oil tanks, which includes out-of-service inspections and NDT, is undertaken in accordance with an Endesa in-house standard that specifies requirements for intervals of five, 10 and 15 years for all above ground fuel oil tanks. There have been no recorded losses of tank contents indicative of leakage through a tank base. Furthermore, where panels within tanks were replaced during application of the above in-house standard their condition was not such as to indicate that leakage had occurred. The tanks are thus expected to be in good condition at the time of decommissioning.

The maximum quantity of HFO will be used prior to the cessation of power generation so that the minimum quantity of unused HFO remains on site. Where possible, all pipelines and tanks will be drained using on-site pumps to 'loss of suction' to minimise the remaining HFO residues within tanks and pipework.

Tankage: The most effective method for cleaning of HFO tanks will be to absorb HFO residues by scrubbing / flushing with kerosene, diesel or a similar lighter petroleum based liquid. The kerosene / dissolved diesel will then be pumped to a tanker for treatment and re-separation / re-use of oil fractions and the tank will be jet washed with water / detergent to remove remaining residues. The tanks will then be suitable for either retention on site or removal for clean scrapping.

Pipelines: Pipework will be cleaned by a variety of methods including an in-situ pneumatic pipe cleaner / scourer machine (a 'pig'), retro-jetting with water, flushing with water or kerosene, or high-pressure air flushing. At this stage of cleaning the pipework will be in an acceptable state for either retention on site or removal for clean scrapping.

All cleaning activities will be facilitated by maintaining the steam heating system for all pipes and tanks to supply steam to aid the flow and removal of oil.

Diesel

The station's storage of diesel consists of a single tank of 55 t capacity within the HFO storage area. Fuel for station vehicles is held in a dedicated tank of small capacity.

The maximum quantity of diesel will be used prior to the cessation of power generation so that the minimum quantity of unused diesel remains on site.

Similar methods to those used for HFO facilities will be used for tankage and pipelines containing diesel.

4.4 Residual Chemicals and Tankage

The main bulk chemicals used at the station and that will be addressed in decommissioning or closure are as follows:

- Sulphuric Acid (H_2SO_4): Used in water treatment.
- Sodium Hydroxide (NaOH): Used in water treatment and in treatment of boiler washes.
- Hydrazine (N_2H_2): Used as an oxygen scavenger in boiler feed water.
- Ammonia (NH_3): Used for pH control in boiler steam cycle.

Stocks of the chemicals consumed in operation of the power station will be run down to a minimum at the cessation of power generation. Remaining bulk quantities of chemicals will then be available for either transfer to other power station(s), return to their supplier or disposal by contractors at licensed facilities.

Further to this, bulk storage tanks will be cleaned internally by contractors.

Cooling water is treated with 12 - 14% sodium hypochlorite (NaOCl). Stocks are held in Intermediate Bulk Containers (IBCs), which are delivered and replaced as required by the supplier. Decommissioning will be limited to internal cleaning of delivery pipelines.

With wet chemistry carried out in the station laboratory being substantially eliminated by the use of modern instrumentation, remaining stocks of laboratory chemicals that require disposal will be low.

4.5 Boiler Cleaning

The following activities already take place routinely at Great Island and are managed successfully.

Boiler Storage

A decision on station closure would likely be proceeded by a period where all or some of the station boilers are in storage. Dry storage is currently the preferred method and if this is in use no environmental emissions will result during decommissioning.

Boiler Washing

The fire side of the boilers will be washed with water using a high-pressure low-volume system The washwater from Units 1 & 2 will be drained to an internal floor sump and pumped from there to a steel settling tank. Washwater from Unit 3 will drain via the internal floor drains to an oil interceptor, the outlet from which is valved, where it will be conditioned by dosing with 47% sodium hydroxide (NaOH). It will then be pumped to the settling tank.

When the correct pH is achieved, the solids will be allowed to settle out and the supernatant effluent, being pH6 - pH9, will be discharged to the cooling water channel where it will be added to the cooling water flow in a controlled discharge to achieve a high dilution rate.

The settling tank will be cleaned down and all waste and efluent wiill be removed for appropriate disposal.

The cooling water system will be retained in operational condition until boiler washing is completed.

4.6 Drainage Line Cleaning

Drainage systems within the station involve 13 separate discharges to the Barrow Estuary. These systems, whose designations below are those used in IPPC Licence Reg. N° P0606-02, are broadly categorised as follows:

- Seven discharges fully or partly comprise trade effluents, namely PE2, PE5, PE6, PE7, PE8, SW12 and PE13.
- Two discharges comprise sewage/washing effluent, namely SW3 and SW9.
- Four discharges comprise surface waters/station drainage exclusively, namely SW1, SW4, SW10 and SW11.

Of the above, the discharges that are of concern and key components thereof are as follows:

- SW1 - HFO and diesel tank farm.
- SW4 - Oil stripping tank.
- PE5 - Boiler House of Unit 3.
- PE6 - Engine Room of Unit 3 and Boiler House (part) of Units 1 & 2.
- PE7 - Engine Room of Units 1 & 2, Boiler House (part) of Units 1 & 2 and transformer bunds.
- SW12 - Area east of Unit 3 and an internal sump.

All of the above are protected by oil interceptors and there is no potential for impact upon the Estuary if the drainage system is left in place after decommissioning. However, cleaning of station drains will be required to mitigate the potential for oil residues to be present within pipelines.

This will involve water jetting using the existing oil interceptor system and vacuum tankers. Oil interceptors will be cleaned down and all waste and effluent will be removed for appropriate disposal. No areas of heavy or free product oil residues that would require steam cleaning are expected. On completion of decommissioning the site drainage will be in a suitable condition for removal or more likely to be left in place to continue to provide surface water drainage for the site.

The station will continue to properly operate and maintain the site drainage system prior to and during implementation of the RMP.

4.7 Demolition Nuisance Mitigation

Any demolition works that are carried out in connection with or associated with the RMP have the potential to lead to elevated noise levels and to creation of dust. Additional traffic movements will also arise. The following mitigation measures are proposed:

Noise

All works will be carried out during daylight hours and noise levels will monitored to ensure compliance with the requirements set out in IPPC Licence Reg. N° P0606-02.

Noise minimisation measures will be employed. These will include such measures as using saw-cutting machinery instead of rock breaking equipment.

Dust

Surfaces that have the potential to generate dust during their demolition will be wetted prior to the work commencing.

Demolition on windy days will be avoided to the extent possible.

Traffic

While traffic will arise in the removal from site of residuals, this will coincide with the elimination of current sources of traffic associated with station operations. It is considered that the demolition related traffic will not pose undue difficulties.

5. Test Programme

5.1 Monitoring

The monitoring and reporting requirements set out in IPPC Licence Reg. N° P0606-02 will be complied with in full until the licence is surrendered to the Agency. The monitoring will identify if any contamination of air, surface water, groundwater or soils has occurred during the lifetime of the IPPC Licence.

In the event that a future environmental incident causes contamination of these media, which has not been quantified at the time of the closure of the facility, a test programme will be established as part of the RMP to identify the nature and scale of any associated environmental pollution.

Tests will be carried out on wash waters generated during the decontamination works to confirm that they are suitable for discharge.

While testing has already confirmed that there is no reason to believe that such contamination may be present, oils will be sampled and tested for PCB contamination.

5.2 Validation

Following implementation of the RMP, a validation report will be produced to demonstrate its successful implementation. It will confirm that there is no continuing risk of pollution to the environment from the site.

The Report will address:

- Disposal of materials
- Decontamination of items of plant and equipment
- Decommissioning of plant and equipment
- Results of monitoring and testing
- The need for ongoing monitoring and investigations

The report will be submitted to the Agency within three months of completion of the RMP.

5.3 Environmental Summary Report

In addition to the above validation, in line with ESB's policy in relation to closure of its power stations, a full environmental summary report will be prepared.

This will outline the following:

- The full history of the power station site from its initial development through to closure.
- The various investigations undertaken and reports prepared during the operation of the plant
- The actions taken in the course of the RMP.

The Environmental Summary Report will be made available to future users of the site, whether this is Endesa or a third party.

6. Costing & Financing

Endesa has a very significant working capital and any decommissioning or closure of Great Island would be a well resourced activity. The company has adequate resources of finance and manpower to implement the RMP through to completion.

More significantly, Endesa makes specific financial provision for closure of its power stations.

Further to the above, Great Island site covers a considerable area and being an industrial site it has considerable potential for redevelopment. Its jetty is a significant asset that will remain following decommissioning. Furthermore, much of the plant and equipment will have very significant residual value. The value of the site and its plant and equipment alone provides a fund that greatly exceeds the potential costs of decommissioning.

Specific costings have not been developed for the RMP at Great Island. However, it is evident from the limited number of issues that required inclusion in the scope of the RPM that the company's financial provisions and the value of the assets at Great Island are orders of magnitude greater than the costs that may be incurred.

7. Comment

Since commissioning of its first unit in 1967, the presence of Great Island Generating Station has not resulted in significant environmental impacts and the station will continue to be operated in a responsible manner. Issues that are likely to arise upon closure at Great Island have all be dealt with successfully in the past at other Endesa sites and similar care will be taken when decommissioning at this site.

Appendix I – Key Substances

Material / Substance	Amount Stored	Nature of Use
Algicide (Alkyl dimethyl benzyl ammonium chloride and Ethanol)	0.4 t	Water treatment
Ammonia Solution (35%)	1,500 litres	Boiler treatment
Gas Oil	50 t	Fuel
Heavy Fuel Oil (HFO)	85,000 t	Fuel
Hydrazine Solution (35%)	1.5 t	Boiler treatment
Ion Exchange Resins	150 m^3	Water Treatment
Laboratory Chemicals	Various	Laboratory analysis
Lubricating oils	10,000 litres	Lubrication
Pentomag (Magnesium Hydroxide)	13,000 litres	Boiler additive
Propane	2,000 litres	Ignition fuel
Sodium Hydroxide Solution (47%)	30 t	WTP regeneration
Sodium Hypochlorite Solution	2 t	Cooling water treatment
Sulphuric Acid	40 t	WTP regeneration

Appendix II – Station Waste

Hazardous Waste

Item	Amount
Waste Oils	16,750 litres
Oil interceptor waste	3,000 litres
Batteries	250 kg lead acid & 10 kg Ni-Cd
Oil contaminated materials	30 No. 220 litre barrels
Asbestos	50 kg
Smoke detectors	1 No.
Gaseous discharge lamps	350 No.

Other Waste

Item	Amount
Administration, plastic packaging and canteen waste	36 m^3
Waste paper and cardboard	20 bales
Grounds maintenance waste	See Note 3.
Scrap metal	14 t
Timber	2 t
Solids from boiler cleaning	5 t
Ion exchange resins	17 m^3 over 5 years
Non-hazardous insulation materials	1.5 m^3
Sewage sludge	Two-year clean
Toner cartridges	0.5 m^3
Cooking oils	200 litres

Notes:

1. The above are wastes as listed in Schedules 3(i) and 3(ii) of IPPC Licence Reg. N° 715.
2. The amounts are those arising annually, except as noted, based on Section 17 of the station's application for its IPPC Licence.
3. Waste item is listed in Schedule 3(ii) Other Wastes for Disposal/Recovery of IPPC Licence Reg. N° 715 but is not listed as a waste stream that arises at Great Island in Section 17 of the station's application for its IPC Licence.

3.2. Preliminary Demolition Environmental Assessment

CCGT Power Plant
Great Island

Preliminary Demolition
Environmental Assessment

Final Report

December 2009

Delivering sustainable solutions in a more competitive world

ERM

Endesa Ireland Limited

CCGT Power Plant Great Island Preliminary Demolition Environmental Assessment

December 2009
0100952

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For and on behalf of
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Approved by: Simon Tillotson

Signed:

Position: Partner

Date: 1st December 2009

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CONTENTS

1 INTRODUCTION

1.1 THE ASSESSMENT

Environmental Resources Management (ERM) and Mott MacDonald Ireland Limited (MM) were commissioned by Endesa Ireland Limited to undertake a preliminary demolition environmental assessment focusing on the demolition aspects of the existing Great Island Power Station located at the confluence of the River Barrow and the River Suir in County Wexford.

1.2 BACKGROUND TO THE PROJECT

Endesa Ireland Limited (hereafter referred to as Endesa) is seeking planning permission to develop a new CCGT Power Station on the existing Great Island Power Plant site, formerly owned by ESB.

After the new CCGT station is commissioned the existing station will be decommissioned in line with the Residual Management Plan developed as part of the IPPC Licence (Registration Number P0606-02) for the existing Great Island Power Plant. In addition, Endesa is committed to undertake demolition of all existing plant buildings that are not going to be utilised to support the proposed new development.

The demolition will be subject to a separate planning permission, which Endesa will apply for to Wexford County Council once a reliable and robust timeline for that process can be confirmed. The programme for the demolition will depend on the following factors:

- Agreement by Commission for Energy Regulation CER and Endesa of a detailed programme for demolition of the existing Units.

- Agreement on timing of the relocation of the existing control and protection equipment owned by ESB networks to outside the Endesa facilities. The control and protection equipment used for the remaining switchyards units, which are controlled by EirGrid, the national transmission system operator, is located in the existing turbine hall. The scheduling for decommissioning and demolition of this building will therefore be dependent on an agreement between ESB, EirGrid and Endesa.

- Collection of detailed site information to ensure that the demolition programme reflects all necessary environmental and engineering considerations associated with demolition of the existing units in close proximity to the operating new CCGT Power Plant.

The application will be supported by appropriate environmental impact assessments as required by the planning authority and relevant stakeholders. A financial provision has been included in the annual financial report for Endesa to cater for this demolition exercise.

Under the terms of the IPPC licence (Registration Number P0606-02) for the existing facility, following termination of operations or where there is a planned cessation of operations for a period greater than twelve months for all or part of site operations within the licensed activity, Endesa is obliged to decommission, render safe or remove any soil, subsoils, buildings, plant or equipment, or any waste materials or substances or other matter contained therein or thereon, that may result in environmental pollution.

A Residuals Management Plan (RMP) for the existing plant has been prepared, in consultation with the Environmental Protection Agency (EPA), outlining the activities to be undertaken during the decommissioning of the redundant plant. Decommissioning of the existing units and their associated stacks will be subject to the conditions outlined in the RMP, a copy of which is provided in Appendix 1 and further consultation with the EPA. A validation report will be submitted to the EPA for approval within three months of completion of the RMP. The report will address the following:

- Shutdown and decommissioning of plant and equipment
- Decontamination of items of plant and equipment
- Disposal of materials
- Results of monitoring and testing
- The need for ongoing monitoring and investigation

With respect to subsequent demolition of the redundant plant, Endesa will provide additional information to engage in further consultation with members of the local community and other relevant stakeholders, with the objective of addressing concerns relating to the potential environmental effects associated with the demolition of the existing units. The demolition works will, as noted above, be part of a separate planning application.

In advance of this proposed work, this document describes the envisaged demolition process and its potential related environmental effects and likely mitigation measures based on the information available at this preliminary stage of the assessment.

1.3 ASSESSMENT OBJECTIVES

This objective of this assessment is to provide a preliminary assessment of the demolition issues likely to be encountered for the environmental topics identified in the EC Directive 85/337/EEC as amended, commonly known as the Environmental Impact Assessment Directive. The function of this report is to outline:

- The likely sequence and scale of demolition activities anticipated;
- Consequences of the demolition of the redundant plant on the environmental impacts posed by the operation of the new CCGT power plant once the existing plant will have been demolished.
- Associated potential effects on the environment during the demolition phase of the existing plant and outline likely mitigation options for those effects; and
- The potential options for waste management and minimisation associated with the demolition of the existing plant.

The assessment has been completed in a qualitative manor and where possible quantities have been provided;

1.4 THE APPROACH

1.4.1 *Overview*

The assessment has been undertaken through:

- a desktop study of existing documentation to provide background historical and environmental setting information;
- a site reconnaissance visit; and
- the project team's experience of similar demolition projects and associated typical environmental issues and mitigation measures.

Each of these phases is further discussed below.

1.4.2 *Desk Study – Site History and Environmental Site Setting*

Information regarding environmental conditions on site was reviewed as part of the EIS for the new CCGT station construction, particularly that derived from previously commissioned, intrusive site investigations. A desktop review of available documentation, technical reports and mapped information was completed with a focus on establishing:

- Past and present site activities, the physical layout and topography of the site, site neighbours and sensitive environmental resources around the site.
- The site history - based on a review of available information and through discussions with site management.
- The geology, hydrogeology and hydrology at and underlying the site including the presence of groundwater and surface water features and the sensitivity and vulnerability of these resources.

The findings from the EIS for the new CCGT station construction have been reviewed in relation to the consequences of the future demolition of the old station.

1.4.3 *Site Visit*

The site assessment was based upon a two day visit to the Great Island site during which MM and ERM personnel were given a guided tour of the site and facilities by existing Endesa staff, and additional study specific visits between May and October 2009.

1.4.4 *Project Teams' Past Experience*

ERM and MM have extensive experience in assisting clients with the process of taking large sites, such as power stations, oil refineries, manufacturing facilities from operation through all stages of close down to eventual demolition and potential sale or major change of land use. This experience has been applied to this assessment.

1.5 SOURCES OF INFORMATION

Information used for the preparation of this review has been obtained from the following sources:

- Great Island Power Plant, Demolition Quantities for Dismantling provided by Endesa Ireland Ltd
- Residuals Management Plan, Great Island Generating Station, IPPC License no. P0606-02, ENDESA, Report P04E318A – R1, Revised April 2009, TMS Consultancy Ltd.
- Environmental Impact Statement for proposed power plant at Great Island, Co. Wexford (MM and ERM, 2009).
- Plans and records provided by site management

2 SITE DESCRIPTION

2.1 SITE ENVIRONMENTAL SETTING

The Great Island power plant is located on the County Wexford coastline at the confluence of the River Suir and Barrow. River Suir and Barrow are Designated Special Area of Conservation (SAC), with the River Barrow also designated as a proposed National Heritage Area (pNHA). The area surrounding the site is made up predominantly of agricultural land with a number of scattered residential properties. Cheekpoint, to the south of the site on the opposite side of the river, is the closest town (c. 700m distant). To the north the site is bordered by a railway line. The closest dwellings are along the access road to the Station to the north at a distance of approximately 300 - 400m from the demolition site.

2.2 SITE BUILDINGS

The existing station's generating capacity is 240 MW and was developed in two stages, comprising three generating units. Initial development consisted of two 60 MW units that were commissioned in 1967 and 1968. Further development consisted of a single 120 MW unit that was commissioned in 1972.

The station was constructed on land that was formerly in agricultural use and some land was additionally reclaimed from the estuary during development of the site. The total area of the site is approximately 60 hectares (ha).

The main features of the station include:

- Station main building housing three boiler and turbo-alternator units.
- Jetty for unloading marine oil tankers having a capacity to accept vessels up to 20,000 dwt. The cooling water intake is incorporated into the unloading jetty.
- Five tanks for storing heavy fuel oil (HFO) with a total capacity to 85,000 t.
- Minor HFO tanks including transfer tank, test tank and oil stripping tank for use in oil unloading.
- Diesel oil tank and minor vehicle refuelling tanks.
- Waste oils storage tanks.
- Cooling water system comprising pumphouse, inlet and outlet culverts, and discharge channel.
- Service reservoir and tanks for storage of incoming and treated water.
- Water treatment plant for processing of water prior to its use in the boilers.
- Neutralisation plant for treating boiler washing effluents and water treatment plant effluent.
- Generator transformers and high voltage switchgear.
- Unit and house transformers.

- Two reinforced concrete chimneys, each approximately 137m tall, one each serving the two 60 MW units and the 120 MW unit respectively.
- Administrative offices and canteen.

Supporting facilities including the following:

- Fire protection pumphouse.
- Fuel oil pumphouse.
- Diesel generators.
- Chemicals storage tanks.
- Chemical laboratory.
- Workshop and store.

3 POWER STATION DECOMMISSIONING ISSUES

This document focuses on the issues to be addressed associated with the future demolition of the station. This is distinct from decommissioning of the station which will occur once the new CCGT station becomes operational and the old station is 'switched off'.

The decommissioning activities are regulated by the Environmental Protection Agency under the existing Integrated Pollution Prevention and Control (IPPC) Permit for the station (ref. P0606-02).

To cover the decommissioning activities and to conform with the existing IPPC licence (Condition 14), Endesa has produced a RMP, which details the requirements following

'*termination, or planned cessation for a period greater than twelve months, of use or involvement of all or part of the site in the licensed activity, the licensee shall, to the satisfaction of the Agency, decommission, render safe or remove for disposal/recovery, any soil, subsoils, buildings, plant or equipment, or any waste, materials or substances or other matter contained therein or thereon, that may result in environmental pollution. The licensee shall prepare a fully detailed and costed plan for the decommissioning or closure of the site or part thereof.*'

The activities within the RMP, include the following:

- Return of materials to suppliers where possible, for resale or reuse.
- Isolation and purging of HFO transfer lines from bulk storage to direct pipe contents back to bulk storage.
- Shutting and blanking of supply lines from bulk storage for oils and chemicals to intermediate storage and/or dilution tanks.
- Cleaning and decontamination of all plant and equipment.
- Removal of all laboratory chemicals.
- Cleaning and decontamination of all laboratory analytical instruments.
- Cleaning, decontamination and inspection of bunds, sumps and underground drains.
- Removal of old and obsolete equipment and destocking of the workshops and stores.
- Isolation and disconnection of all electrical supplies to pumps and motors.
- Draining of oil from obsolete transformers that will not be reused elsewhere.
- Decommissioning of redundant oil-filled cables and draining of header tanks.
- Cleaning of residues from boilers and cleaning and blanking off of fuel lines.
- Draining and cleaning of lube oil systems.
- Draining of water systems such as raw feedwater tanks, condensate storage tanks and supplementary cooling systems.

- Transfer of ion exchange resins to drum storage.
- Cleaning of water treatment neutralisation tank and removal of all waste and effluent for appropriate disposal.
- Maintenance of parts of the water supply system to provide wash-down and cleaning facilities during decommissioning and to meet the ongoing needs for fire protection and sanitary services.
- Maintenance of site drainage system and oil interceptors during decommissioning activities.
- Maintenance of defined site access procedures.

Therefore, as defined within the RMP, successful decommissioning is determined as being complete when all buildings, equipment, wastes or any other materials that could result in environmental pollution and also present hazards to human health are removed from the site and recycled, recovered or disposed of in accordance with all regulations in force at that time. The RMP will result in a decommissioned and decontaminated station. All buildings and some site services, whilst emptied and cleaned as part of the RMP process, will remain in place following decommissioning.

Thereafter, demolition can be undertaken. It is understood that certain station areas will continue to operate or be left operational as part of the operation of the new CCGT Station. However, this preliminary review focuses on those main demolition activities that will take place over the majority of the old station and which have the potential for environmental impacts or issues.

4 POWER STATION DEMOLITION

4.1 MAIN PHASES OF A DEMOLITION PROGRAM

The principal issues likely to require consideration within a demolition programme or plan for the station include:

4.1.1 *Planning Phase*

- Review of all power, gas or other utilities or services which are:
  - Present and their status regarding isolation
  - Their requirements to be 'live' and for what purpose/timeframe during the demolition program
  - The requirements for isolation, capping, purging and removal etc. prior to or during demolition;

- Detailed structural survey of the remaining buildings and ground slabs to determine methods and constraints to demolition;

- Review of ground contamination issues – existing issues, prevention of access from demolition activities or plant, and areas for further investigation when demolition of structures etc. is complete and access for investigation is possible;

- Review of remaining hazards which will require removal or specialist removal prior to main demolition; e.g.
  - Asbestos identification by comprehensive Type 3 surveying and removal from areas of the site plant, facilities and pipework, if present;
  - Identification of lead-based paint areas, primarily to steelwork in relation to hot cutting and lead fume issues;
  - Identification and removal of fluorescent lighting tubes or other mercury containing equipment such as manometers on HVAC, heat switches etc.; and
  - Identification and removal of low level radiation sources such as ionising smoke detectors;

- Production of a Waste Management Plan as per "*Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects (DoEHLG, 2006)*" and "*Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision (EPA, 2006)*";

- Production of master planning and traffic management plans to scope the overall timing and duration of the work phase, and production of work specifications and tender documents for the demolition; and

- Obtain relevant permits and audits for demolition according to EPA's Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision.

4.1.2 *Work Phases*

- Hazards removal – as per those identified above;

- Soft stripping of internal non-recyclable materials such as MMMF, plasterboard, fibre board, wood, furniture, suspended ceilings, plastics etc. which are reasonably accessible to hand or hand held tool work using low level scaffolding or MEWPs;

- Limited internal stripping out of remaining non-structural metal work, piping and equipment which it is reasonable to do so for metals recovery and which cannot reasonably be achieved by remote/machine demolition and sorting;

- Phased demolition of main building components by remote/machine methods;

- Demolition of the two chimneys, the construction of which is understood to be reinforced concrete. Methods for this to be reviewed as part of the structural survey above, but anticipated to be by appropriate methods into the area now cleared of buildings (away from the new CCGT station);

- Waste management of resulting demolition arisings throughout all the above processes in accordance with the proposed Waste Management Plan, including segregation, stockpiling, methods and rate of off-site transport, on-site processing and re-use of inert materials (crushing and filling);

- Further investigation of ground contamination issues, should this be required; and

- Excavation or remediation of contaminated media, should this be required.

These phases are discussed in detail below. Where quantitative estimates have been made, these have been based on current legislation, standards or best practice, and the information reviewed as part of this report.

Work Phase Impacts/Mitigations - Asbestos + Hazards Removal

It is understood from Endesa that the majority of asbestos was removed from the station in the period 1990-1992. Therefore asbestos removal is not considered a major component of the demolition programme. However, given the age of the station and the quantities of asbestos likely to have been used in its construction and plant, a comprehensive Type 3/fully intrusive asbestos survey is recommended to identify all remaining asbestos which may have been overclad or hidden or not previously removed.

Therefore it is likely, that a certain amount of hazard removal works will be undertaken for asbestos or other hazardous materials or items as noted above.

Potential main environmental aspects:

Environmental Aspect	Anticipated Impact (either +ve ✓, –ve ✗, neutral / no effect -)		
	Pre-mitigation		Post-mitigation
Human beings – land use	-		-
Human beings – socio-economics	✓	short term +ve effect on local economy re. business from contractors undertaking work	✓
Traffic	✗	associated with people / plant movement on and off site + minor waste disposal traffic	✗
Human beings – noise and vibration	✗	noise and vibration associated with off-site traffic only	✗
Flora and fauna – terrestrial ecology	-		-
Flora and fauna – marine ecology	-		-
Soils, geology and groundwater	-		-
Surface water	-		-
Air quality and climate	-	Standard mitigation according legal requirements will have to be applied	-
Landscape and visual	-		-
Material assets – archaeology, cultural	-		-
Material assets – Utilities	-		-

Potential mitigation measures or issues:

- ***Traffic*** – minimal impact from traffic – to be managed by traffic management plan taking into account, times of day of movements, volume of movements (cars + HGVs) and traffic routes – all with respect to local communities and road capacities.

Soft stripping

Soft stripping of internal, non-recyclable materials and components' will take place prior to main demolition activities. Waste materials will be generated and will require on-site collection and storage within large metal waste bins prior to transport off-site. Waste handling and storage arrangements will need to be assessed depending on the types of waste generated Disposal is anticipated to be to landfill or other appropriate disposal or recycling outlets depending on the characteristics of the waste encountered resulting in HGV traffic movements off-site.

It is anticipated that the majority of this work will take place within existing building structures and so the impacts to the environment external to buildings is likely to be limited to waste storage and transport, rather than soft strip works themselves.

A demolition assessment was completed by an external specialist company, which reflects a "worst case" scenario as it considers the demolition of all buildings on site. As the Administrative Offices & Canteen, Cooling Water Pump House and HFO Storage facility will remain in place the waste numbers will be substantially less in reality. Based on the findings of the demolition assessment the quantities of such waste materials are estimated as: Wood (6,000kg), Plastic (1,500kg). Plasterboard or other wastes are not specified. Therefore a budget estimate of up to 10,000kg/10 tonnes (wood / plastic etc.) could be expected and it is recommended that this is increased to up to 50 tonnes to cover all other miscellaneous wastes including plasterboard.

Prior to more detailed investigations, it is not known what proportion of wood waste may be treated wood. It should be noted that power station flue systems can sometimes contain large quantities of wood treated with heavy metals e.g. CCA – copper-chrome-arsenic, or tars/creosotes. If this is the case, separate treated vs. non-treated wood waste streams may be generated, with associated differing handling, storage and disposal methods.

Therefore, even if this increased estimate is used, HGV traffic movements are not considered to be substantial, given that approximately 15 tonnes of material can be transported per load.

Potential main environmental aspects:

Environmental Aspect	Anticipated Impact (either +ve ✓, -ve ✗, neutral / no effect -) Pre-mitigation		Post-mitigation
Human beings – land use	-		-
Human beings – socio-economics	✓	short term +ve effect on local economy re. business from contractors undertaking work	✓
Traffic	✗	associated with people / plant movement on and off site + minor waste disposal traffic	✗
Human beings – noise and vibration	✗	noise and vibration associated with off-site traffic only	✗
Flora and fauna – terrestrial ecology	✗	noise and vibration associated with off-site traffic only	-
Flora and fauna – marine ecology	-		-
Soils, geology and groundwater	✗	Potential for leaching from wastes if not stored correctly	-
Surface water	✗	Potential for leaching from wastes if not stored correctly	-
Air quality and climate	✗	Potential for dust generation from wastes if not stored correctly	-
Landscape and visual	-		-
Material assets – archaeology, cultural	-		-
Material assets – Utilities	-		-

Potential mitigation measures or issues:

- ***Traffic*** – minimal impact from traffic – to be managed by traffic management plan taking into account, times of day of movements, volume of movements (cars + HGVs) and traffic routes – all with respect to local communities and road capacities; and

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- ***Incorrect waste storage on-site*** leading to leaching of wastes, particularly plasterboard, giving rise to potential impacts to ground, groundwater or surface waters, and dust generation. All such impacts should be eliminated by correct waste storage and covering.

Internal non-structural stripping (metals removal)

Limited internal stripping out of remaining non-structural metal work, piping and equipment will take place prior to main demolition activities.

Based on the findings of a demolition assessment completed by an external specialist company, Endesa Ireland estimates the quantity of metals as: iron and steel (7,410,000kg), mixed metals (3,843,000kg). Therefore a budget estimate of up to 11,000 tonnes could be expected, and it is reasonable to assume a proportion of between 50% to 70% of this, would be available for removal prior to demolition. The numbers listed reflect a "worst case" scenario as they consider the demolition of all buildings on site. However the Administrative Offices & Canteen, Cooling Water Pump House and HFO Storage facility will remain in place to service the new facility. This will lead to a reduction in waste quantities. The exact proportion will depend on the plant layout and the methods of demolition proposed by a contractor.

Stockpiling of scrap metal and HGV traffic movements off site will be required to transport metals for disposal. It is anticipated that the majority of this material will be destined for recycling

Potential main environmental aspects:

Environmental Aspect	**Anticipated Impact (either +ve ✓, –ve ✗, neutral / no effect -)**				
	Pre-mitigation			**Post-mitigation**	
Human beings – land use		-			-
Human beings – socio-economics		✓	short term +ve effect on local economy re. business from contractors undertaking work		✓
Traffic		✗✗	associated with people / plant movement on and off site + minor waste disposal traffic		✗
Human beings – noise and vibration		✗✗	noise and vibration associated with off-site traffic only		✗
Flora and fauna – terrestrial ecology		✗	noise and vibration associated with off-site traffic only		-
Flora and fauna – marine ecology		-			-
Soils, geology and groundwater		-			-
Surface water		-			-
Air quality and climate		-			-
Landscape and visual		-			-
Material assets – archaeology, cultural		-			-
Material assets – Utilities		-			-

Potential mitigation measures or issues:

- ***Traffic*** – minimisation of impact from traffic – to be managed by traffic management plan taking into account, times of day of movements, volume of HGV movements and traffic routes – all with respect to local communities and road capacities. Other traffic impact minimisation options to be considered include:
  - the staggering or limiting of off-site HGV movements by efficient on-site storage and stockpiling of metals to act as a buffer between scrap production and off-site disposal.

- o The potential for scrap metal movements by barge from the site, given that many scrap metal depots and processing areas are linked to or at other ports and quaysides, associated with the export of scrap metal for refining overseas.

Main building demolition

Phased demolition of main building components by remote/machine methods will take place, followed by removal of hardstanding and concrete slab areas. It is anticipated that the basement and foundations of the main power station will be only partially removed, and that remaining sides/bottoms will be punched to allow drainage of rainwaters.

It is understood that the two main chimneys are constructed of reinforced concrete and are approximately 140m tall and 10m in diameter at their base, rising to 4m diameter at their tops. Conventional demolition methods for chimneys of this height often involve controlled collapse, or collapse with 'telescoping' to reduce the fall area. However, during the demolition planning and structural survey phases, appropriate methods or options for demolition will need to be developed to bring them to ground level safely, given the potential restrictions posed by nearby structures with respect to ground space available for controlled collapse.

It is assumed, that all concrete, brick or similar demolition arisings will be crushed on-site to a standard backfill specification suitable for either re-use on site or aggregate/backfill use off site.

Remaining and structural metals will be separated by machine and processed into scrap metal as above.

Based on the demolition assessment by an external specialist company Endesa Ireland estimates the quantity of metals as: Concrete (1,937,000kg), concrete/brick/tiles/ceramics (66,431,500kg). Therefore a budget estimate of up to 70,000 tonnes could be expected. On a broad density assumption of 2 tonnes per m^3, this equates to approximately $35,000m^3$. These numbers do not consider that the Administrative Offices & Canteen, Cooling Water Pump House and HFO Storage facility will remain in place and therefore reflect a "worst case" scenario assuming that all buildings on site will be demolished.

Potential main environmental aspects:

Environmental Aspect	Anticipated Impact (either +ve ✓, –ve ✗, neutral / no effect -)				
	Pre-mitigation			Post-mitigation	
Human beings – land use		-			-
Human beings – socio-economics		✓	short term +ve effect on local economy re. business from contractors undertaking work		✓
Traffic		✗✗✗	associated with people / plant movement on and off site + minor waste disposal traffic		✗
Human beings – noise and vibration		✗✗✗	Noise and vibration associated with off-site traffic, onsite machinery working and slab breaking, concrete crushing.		✗
Flora and fauna – terrestrial ecology		-			-
Flora and fauna – marine ecology		✗	Potential for dust / silt generation from demolition and concrete crushing / stockpiling		-
Soils, geology and groundwater		✗-	Potential for presence of contamination beneath floor slabs and mobilisation by rainwaters leaching contaminants to groundwaters		-
Surface water		✗	Potential for dust / silt generation from demolition and concrete crushing / stockpiling		-
Air quality and climate		✗	Potential for dust / silt generation from demolition and concrete crushing / stockpiling		-
Landscape and visual		✓	Big power station and tall chimneys removed from view		-
Material assets – archaeology, cultural		-			-
Material assets – Utilities		-			-

Potential mitigation measures or issues:

- ***Traffic*** – minimisation of impact from traffic – to be managed by traffic management plan taking into account, times of day of movements, volume of HGV movements and traffic routes – all with respect to local communities and road capacities. Other traffic impact minimisation options to be considered include:
  - the staggering or limiting of off-site HGV movements by efficient on-site storage and stockpiling of metals and crushed concrete to act as a buffer between scrap production and off-site disposal.
  - The potential for scrap metal movements by barge from the site, given that many scrap metal depots and processing areas are linked to or at other ports and quaysides, associated with the export of scrap metal for refining overseas.
  - The potential for on-site re-use of crushed concrete for backfilling of basement voids. Any void capacity can be subtracted from the estimated crushed concrete volume above.
  - The potential for long-term on-site storage of crushed concrete for future use in land regeneration or reclamation at the site. If feasible, this could eliminate the off-site disposal of concrete etc. by road;
- ***Incorrect storage of crushed concrete on-site*** leading to alkaline leaching or silting, giving rise to potential impacts to ground, groundwater or surface waters, and dust generation. All such impacts should be minimised by correct stockpile management; and

- ***Leaching of contaminants present beneath floor slabs*** to ground waters. Prior investigation of soil and groundwater quality and if necessary remediation of impacts identified to ensure such leaching does not occur.

Ground Contamination Issues

An intrusive investigation undertaken by URS Ireland Ltd. in 2008 (URS 2008 subsoil investigation) has drawn the following conclusions based on the site works undertaken as detailed above:

- The site is considered suitable for the continued industrial use from the perspective of human health implications to site users;
- Risks to surface water and groundwater from a number of metals, fluoride, polycyclic aromatic hydrocarbons (PAH) and hydrocarbon indicator compounds were identified. However, previous investigations completed on the site (URS, 2009) has concluded the potential risks are not significant across the majority of the site;
- Samples collected from within the 220kV compound located in the northern section of the site identified exceedances for hydrocarbons (mineral oil), arsenic, copper and zinc which may represent a risk to human health receptors;
- Arsenic exceedances which may represent a risk to human health receptors were identified in two soil samples;
- PAH exceedances were identified in an area along the southern boundary of the site; and
- Coliforms were detected in the groundwater and surface water at the site. The URS report identified that this is likely to be as a result of local upgradient agricultural practices but may also be related to on-site activities.

Elevated concentrations of ammonia were detected in groundwater associated with the former waste disposal area at the site.

The URS report concluded that no remedial action was considered necessary at the site under a continued industrial land use scenario, based on existing data on soil and groundwater quality. However, the report identified the need for additional site assessment works to fully confirm this conclusion.

With respect to the demolition activities, additional investigation works will be required within the footprint of the buildings to be demolished to assess the presence and extent of any impacts beneath these structures and the requirement for remedial action to mitigate any risks from such impacts, once they are exposed by floor slab removal.

Potential main environmental aspects:

Environmental Aspect	Anticipated Impact (either +ve ✓, -ve ✗, neutral / no effect -) Pre-mitigation		Post-mitigation
Human beings – land use	-		-
Human beings – socio-economics	✓	short term +ve effect on local economy re. business from contractors undertaking work	✓
Traffic	✗	associated with people / plant movement on and off site + minor waste disposal traffic in the event that remediation is required.	✗
Human beings – noise and vibration	✗	noise and vibration associated with off-site traffic in the event that remediation is required.	✗
Flora and fauna – terrestrial ecology	-		-
Flora and fauna – marine ecology	-		-
Soils, geology and groundwater	✗	Potential for presence of contamination beneath floor slabs and mobilisation by rainwaters leaching contaminants to groundwaters	-
Surface water	✗	Potential for presence of contamination beneath floor slabs and mobilisation by rainwaters leaching contaminants to surface waters	-
Air quality and climate	-		-
Landscape and visual	-		-
Material assets – archaeology, cultural	-		-
Material assets – Utilities	-		-

Potential mitigation measures or issues:

- ***Leaching of contaminants present beneath floor slabs*** to groundwaters and surface waters. Prior investigation of soil and groundwater quality and if necessary remediation of impacts identified to ensure such leaching does not occur; and
- Assuming prior decommissioning of the facility has safely removed all hazardous liquids and materials from the structures, it is not anticipated that the demolition of the structures in itself will cause a contaminant impact to underlying soils and groundwaters.

4.2 WASTE

A significant amount of waste is expected to be generated during the demolition process. In view of the quantities envisaged it is envisaged that temporary storage locations will be needed on site to manage the ultimate disposal of the spoil waste off site.

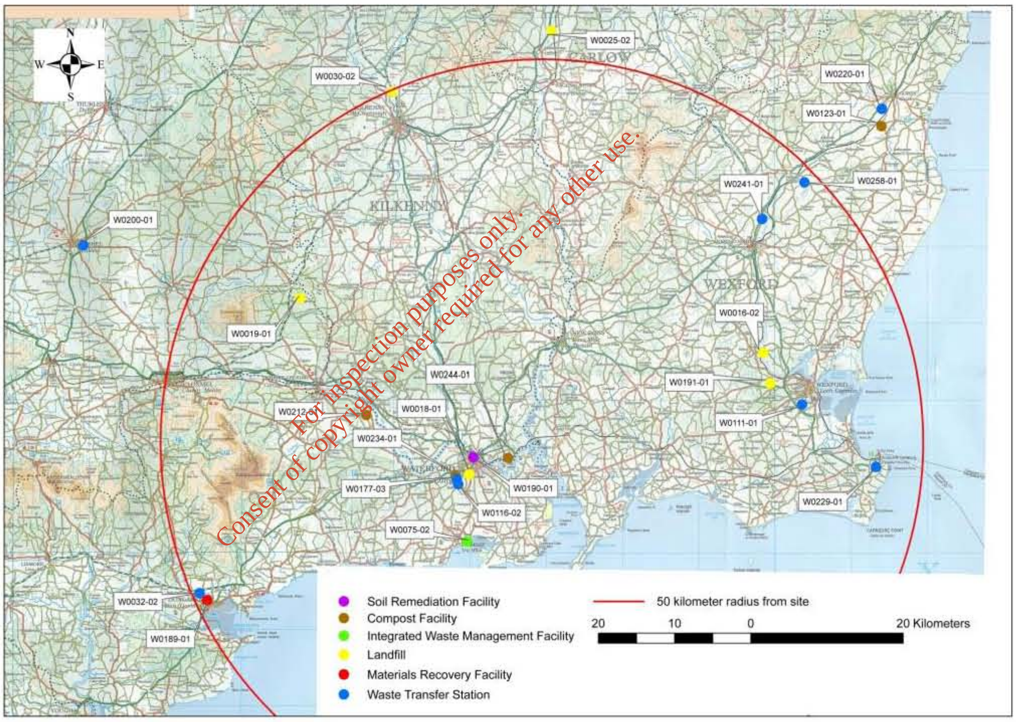
The identification of the most suitable locations will have to be undertaken once detailed information will be available. This will be described in detail within the construction and waste management plan for the demolition phase. Preference will be given to those stock piling areas which will prevent potential contamination or runoff of sediments to the adjacent surface waters which are protected under both national and European legislation.

In order to avoid/minimise any impacts to the environment and reduce costs accrued through transportation as well as disposal to landfill sites materials will be recycled or treated and reused on-site where feasible.

It is envisaged that concrete walls and foundations as well as asphalt pavement that is not contaminated would be crushed with onsite processing equipment to produce clean hard fill during the backfill stage of the project. This will also reduce the dependency on landfill locations and provide an environmentally sustainable solution to the site regeneration.

Some of the material will have to be disposed of in landfills. Therefore the project team identified suitable landfill sites that could be used for this purpose. The Environmental Protection Agency's website (www.epa.ie) holds a library of all of the waste licences for each County in Ireland. This library was used to identify all landfills and other licensed/permitted waste sites such as transfer, composting, materials recovery/recycling and soil recovery stations in the areas of County Wexford and County Kilkenny. The results are shown in the *Figure 4.1Waste Facilities, County Wexford and Kilkenny, EPA, 2009.*

Figure 4.1 ***Waste Facilities, County Wexford and Kilkenny, EPA 2009***



5 PRELIMINARY ASSESSMENT OF ENVIRONMENTAL ISSUES

5.1 INTRODUCTION

Each of the demolition work phase activities have been reviewed against the typical environmental aspects which could affected during that process. The main issues considered are as follows, with a brief commentary on the overall significance of the issue in relation to demolition.

5.2 HUMAN BEINGS – LAND USE

It is anticipated that land use will not change significantly post-demolition as the land is anticipated to remain within the overall Endesa power generation site, nor will any significant cumulative effects occur from the concurrent operation of the new plant with the demolition of the existing plant.

5.3 HUMAN BEINGS – SOCIO-ECONOMICS

Given the temporary nature of the works the socio-economic impact of the demolition scheme is relatively limited. The employment impacts on the local economy are likely to be relatively moderate, with the employment generated being temporary in nature. The only minor negative impact that can be identified at this stage is the increase in traffic which is fully addressed in the Traffic and Transport Assessment (included in Appendix 2). There are expected slightly positive cumulative effects from the concurrent operation of the new plant with the demolition of the existing plant due to an increase in employment figures.

5.4 TRAFFIC

Demolition will generate traffic impact on the site and surrounding roads due to movement of cars / workers involved in the demolition and the movement of HGVs associated with those demolition arisings that require off-site disposal.

A quantification exercise assessing the potential affects of traffic movement on the local road network have been included in Appendix 2, *Traffic and Transport Assessment*.

5.5 *HUMAN BEINGS – NOISE AND VIBRATION*

5.5.1 *Demolition phase*

In an effort to provide an indication of the potential noise sources and impacts during demolition the following qualitative assessment has been carried out.

Methodology

This section addresses the potential noise issues associated with demolition operations, identifying the main potential sources of noise and vibration, possible mitigation measure and likely impacts. *British Standard BS 5228:2009 A Code of Practice for noise and vibration on construction and open sites* provides guidance on potential noise and vibration sources and mitigation measures to be implemented.

During detailed planning of the project, consideration will be given to BS 5228 and the measures it outlines.

Noise will be produced as a result of the demolition activities on site and from the additional traffic associated with the employees accessing the site and trucks removing materials from site that cannot be reused or recycled on-site. The new power plant will be in full operation at the same time as the demolition works will be under way. Therefore, any noise produced by demolition activities will have to be added to the new baseline noise levels (cumulative effects). It is envisaged that the demolition will change the characteristics of the noise environment and the noise levels close to the site will increase during the demolition phase. Those cumulative effects are of temporary nature and are deemed of low significance taking into consideration the predicted noise level from the new plant and the distance to existing noise sensitive receptors.

Sources of noise

As mentioned noise will result from the activities on site and associated increased traffic volumes.

Demolition activities that have the potential to cause noise include but are not limited to the following:

- Breaking of concrete, brick and foundations;
- Rubble crushing, dumping and movement;
- Breaking, cutting and crushing of steel/metal; and
- Site clearing, excavation and levelling/backfilling.

Mitigation

<u>Traffic:</u>

HGV movements will be optimised by maximising the on-site recycling and reuse of demolition materials and by the stockpiling, phasing and management of the off-site disposal of materials that require removal. On this basis it is envisaged that traffic volumes will be managed to avoid significantly increasing noise levels. Measures will also be made to minimise the impact associated with employees arriving on site, although any incremental impacts are likely to occur during short periods in the morning and evening each day.

<u>Demolition Activities:</u>

The natural topography of the site with the land bank to the north provides significant screening to potential noise sensitive receptors in that direction. In addition as distance helps to attenuate noise, impacts at noise sensitive receptors in Cheekpoint which is approximately 700m to the south will naturally be minimised.

The type of plant used will be significantly influenced by the demolition approach adopted. For example the use of a demolition ball would result in high impact noise from the impact of the ball and the impact of the building fabric falling to ground. Whereas the use of pneumatic cutting jaws to cut out section of the building would remove the impact noise but there would be the need for additional cranes and plant on site and this approach could result in the demolition period being extended. Therefore the planning of the demolition process will include consideration of different approaches and the combination of techniques to minimise the impacts of noise.

In addition measures such as placing a crusher on site could reduce potential off-site noise levels associated with HGV movements, but increase on-site noise. The benefit of an on-site crusher would be the potential to reuse crushed material on site to backfill basements and trenches, which would also increase the sustainability of the project as a whole.

Noise impacts from the stripping of the building internals are reduced by the fact that the building will act as an acoustic enclosure screening noise impacts. Such works include:

- Removal of all IT and electrical equipment;
- Dismantling and removal of all power generation plant including turbines, heat recovery systems and associated boilers; and
- Removal of all recoverable metals, timber e.g. doors and associated frame and demolition of partition walls etc where appropriate so as to maximise recycling.

The building can also act as a screen for other activities such as the operation of a crusher, large generators, compressors and crane power units by locating them on the side furthest away from noise sensitive receptors – northern and eastern sides. The actual demolition of the building should, where possible, also be phased so the façade closest to the noise sensitive receptors remains in place for as long as possible.

Impacts

As previously stated it is not anticipated that the traffic associated with the demolition of the power plant will result in a significant change in the noise environment. The reuse of material on site where possible, phasing of the project and implementation of a traffic management plan would minimise the impacts.

The demolition of the main building will be designed and managed in a way that noise impacts are minimised. Consideration will be given to using demolition techniques which will not require the use of noisy plant. Additionally plant such as generators, compressors or crushers will be sympathetically located on site.

The contractors appointed to carry out the work will be required to demonstrate compliance with BS 5228 and will be required to implement a communication plan to ensure consultation with local residents is carried out and a complaints facility/procedure are in place.

Impacts from such an operation cannot be totally mitigated. However, appropriate management of the issues will minimise the potential impacts on noise sensitive receptors.

5.5.2 *Operation of new plant without existing plant*

Once the existing building has been removed there is the potential for noise from the new plant to propagate more easily into the environment and noise levels may increase at noise sensitive receptors. Included in the EIS submitted as part of the planning application, was a modelling exercise of the proposed plant with the existing building still in place. This model was re-run with the current generation station removed from the model. The results indicated that there would be no increase in the noise levels predicted at the noise sensitive receptors.

5.6 *FLORA AND FAUNA – TERRESTRIAL ECOLOGY*

The terrestrial habitats present at the site are of low ecological value and therefore impacts from the demolition of the structures would not be significant in terms of terrestrial habitats within the site itself.

From a cumulative impacts perspective during the operational phase of the proposed CCGT and the demolition the most significant effects predicted are likely to arise from demolition activities which will include increased dust which would need to be controlled such that significant levels of dust deposition do not occur in areas of planted woodland within the site boundary and adjacent habitats such as hedgerows, treelines, the pNHA and the SAC to the south of the site.

Dust can impact the vegetational composition of habitats as it can affect photosynthesis, transpiration and respiration in plants. Increased dust may also smother invertebrates and insects leading to a reduction in biodiversity and a reduction if food source for larger fauna. In order to minimise impacts on flora and fauna, a dust minimisation plan as part of the overall Demolition Environmental Management Plan will be put in place to minimise the escape of dust from the site.

Although current surveys indicate no presence of bats on site at the moment, there is a possibility that bats may be impacted by the removal of structures from the site. A bat survey of all structures will therefore be completed prior to demolition to ensure that no roosts have become established within any of the structures.

Nuisance effects on birds and mammals could occur arising from the noise levels during the demolition period and are likely to avoid the site. Noise barriers shall be put in place to minimise impacts on birds and animals in adjacent habitats.

During demolition, the increase in dust and sediment within the site has the potential to impact the adjacent watercourse and therefore mitigation measures such as silt traps and sedimentation ponds will be put in place to minimise impacts on the aquatic environment. There are no significant cumulative effects expected from the concurrent operation of the new plant with the demolition of the existing plant.

5.7 *FLORA AND FAUNA – MARINE ECOLOGY*

There are two Special Areas of Conservation (SAC) in the immediate vicinity of the Great Island Plant which are protected under the European Habitats and Bird Directives. These are:

- **River Barrow and River Nore SAC** (site no. 002162) which lies which lies directly adjacent to the site boundary; and
- **Lower River Suir SAC** (site no. 002137) which lies approximately 0.5 km west of the development site.

The Lower River Suir SAC is designated for a number of estuarine fauna including the following species listed on Annex II of the Habitats Directive: sea lamprey, river lamprey, twaite shad, Atlantic salmon and otter.

The River Barrow and River Nore SAC comprises of the upper freshwater reaches of the Barrow and Nore rivers as well as the tidal reaches and estuary as far downstream as Creadun Head in Waterford. The SAC is selected for a number of habitats listed in Annex I of the EU Habitats Directive including estuary, tidal mudflats, Salicornia mudflats, Atlantic salt meadows, Mediterranean salt meadows.

The diversity of the intertidal benthic habitat of those areas is high within the mudflats surrounding the Power Plant, containing many species which are listed in Annex I and II of EU Habitats Directive and are considered of medium value. The rocky intertidal area surrounding the Power Plant and the subtidal benthic community are regarded as being a habitat of low value. Impacts during demolition activities may potentially arise from the presence of vehicles, machinery and general construction and will result in dust, noise and vibration and visual disturbance. Research however indicates that effects from construction activities that generate dust are generally limited to within 150 - 200 metres of the point of generation and are readily amenable to proven mitigation measures. During the demolition phase increased noise levels from construction activities are likely to occur. Disturbances due to high noise levels to breeding and wintering birds has the potential that birds temporarily may avoid their normal breeding or wintering areas during periods of loud noise activities. With the exception of birds, intertidal and subtidal marine flora and fauna are not likely to be adversely affected from noise by demolition activities.

The potential exists for spills to occur during vehicle refuelling and for leaks of lubricating oils from plant during demolition activities. These releases could result in the contamination of surface water run-off and soils which in turn, if of sufficient magnitude, could impact shallow groundwaters. This has the potential, albeit limited, of impacting Annex II species of the intertidal. It is however expected to be unlikely and volumes of fuel oil stored at any one time is expected to be relatively low; additionally the refuelling positions will be provided with appropriate secondary containment and plant will be maintained to minimise leakage of oils. The distance to the intertidal area is also significant enough to limit the potential for impacts to occur. During the demolition and removal of building fabric, oil interceptors and silt traps or sedimentation ponds will intercept surface water run-off, further reducing the possibility of such contaminants entering the marine environment.

With respect to the potential for residual contamination beneath the building footprints to be mobilised following the removal of part or all of the floor slabs and foundations, additional intrusive investigations are planned to confirm the presence or otherwise of impacts. These investigations will be prior to any slab removal and will be used to identify, design and implement any remedial actions necessary to avoid the potential for contaminant impact to groundwaters or the marine environment.

There are no significant cumulative effects expected from the concurrent operation of the new plant with the demolition of the existing plant.

5.7.1 *Operation of new plant without existing plant*

During the operational phase without the existing plant it is expected that impacts on marine ecology and birds are comparable to those under the conditions with the Combined Cycle Gas Turbine (CCGT) next to the existing station.

The available information, including mitigation measures that the Project is committed to, indicate that the conservation objectives of the SAC features will be maintained, and significant adverse effects on the integrity of these sites are not likely to occur from the demolition or operational phases of the described development.

5.8 *SOILS, GEOLOGY AND GROUNDWATER*

It is not anticipated that the demolition works in of themselves will cause adverse impact to soils, geology and/or groundwater, assuming prior decommissioning of the facility has safely removed all hazardous liquids and materials from the structures.

However the removal of the existing buildings and floor slabs may expose contaminant impacts which could lead to the mobilisation of those contaminants. Therefore further investigation post decommissioning or post cessation of operations will be undertaken within the footprint of the buildings to assess the presence and extent of any such impact and the requirement for remedial action to mitigate any such impact. During the demolition process of the existing plant there are no cumulative effects likely to occur for the Soil, Geology or Groundwater aspect.

5.9 *SURFACE WATER*

An assessment of the potential impacts of the proposed works on the water resources of the site has been undertaken to consider flood risk, drainage, surface water quality. The closest principal watercourse to the site is the River Barrow. The site is also crossed by a complex system of drainage pipes and culverts. There is no history of flooding associated with this site.

It is considered that the most likely environmental effects arising from the demolition process which will occur concurrently with the operation of the proposed CCGT will consist of suspended solids and potentially heavy metals or hydrocarbon based contamination of surface water run-off.

To control these effects any surface water run-off will be diverted to settlement ponds with discharges from these ponds directed/pumped via hydrocarbon interceptors to the existing drainage network on-site prior to final discharge to receiving waters in a manner consistent with the existing surface water drainage regime on the site.

It is unlikely that there will be any long-term adverse impacts on water quality providing works on site are undertaken in accordance with best practice. It is likely that in the long-term, water quality may improve slightly due to a significant improvement in the quality of runoff discharged from the site. Pollution Prevention Guidelines (e.g. as published by CIRIA), best practice techniques and current legislation are applied to ensure the surface water runoff does not have adverse cumulative effects on the receiving watercourse or surrounding water environment will be implemented.

5.10 AIR QUALITY AND CLIMATE

It is considered that the significant likely effects arising from the demolition process in the context of air quality and climate can be categorised under:

- demolition dust;
- emissions from plants and vehicles; and
- long-term operational effects.

Demolition Dust

The distances from source that demolition dust effects are felt will depend on the extent and nature of built in mitigation measures, prevailing wind conditions, and the presence of natural screening by e.g. vegetation or existing physical screening such as boundary walls on a site. However, research indicates that effects from demolition and construction activities that generate dust are generally limited to within 150 – 200m of the site boundary.
The closest dwelling is located over 200 metres from the proposed demolition areas. On this basis, and given the rural nature and lack of receptors in near vicinity to the site, the overall risk of dust effects is considered to be 'minor' . Activities undertaken during the demolition phase will be controlled through an appropriate Demolition Environmental Management Plan which will provide specific detail of the type and location of activities and particularly of site specific controls for environmental protection, and will be updated as the development progresses.

Emissions from Plant and Vehicles

The number of HGV movements associated with the demolition works will be determined by a specific traffic impact assessment; however, current estimations are that HGV movements will not exceed 40 per day (i.e. 20 loads travelling two ways). At this frequency, based on a 5.5 day working week, the demolition period would be of 12 months' duration. In addition to the transportation of demolition waste from site, there will be vehicle movements associated with approximately 100 workers on site during the demolition phase.

Table 5.10.1 presents the results of a screening level DMRB1 air quality assessment of potential ground level concentrations resulting from demolition traffic flows, assuming a conservative 40 HGV movements plus 200 LDV (one 2-way light duty vehicle movement per worker) movements (a total of 240 vehicles at 17% HGV).

(1)[1]The Design Manual for Roads and Bridges (DMRB) Spreadsheet Tool uses daily traffic flows, speeds and percentage HDVs as a measure of vehicle fleet mix to calculate traffic contributions of pollutants for specified assessment years. Available to download at: http://www.highways.gov.uk/business/238.aspx

The results in Table 5.10.1 indicate that at 20 m from the road centreline, predicted maximum annual mean nitrogen dioxide (NO_2) contributions from demolition traffic on local roads would be less than 0.2 µg/m³ which is 0.5 % of the annual mean objective of 40 µg/m³ and hence is 'extremely small' in magnitude and 'negligible' overall, in accordance with the significance criteria adopted within the air quality assessment undertaken for the project. NO2 effects further from the road are less, as are particulate (PM10) effects at all locations considered.

This assessment assumes that all demolition traffic enter and exit the site via one route, which represents a conservative approach.

Table 5.10.1: *DMRB Screening Assessment Results*

Receptor Distance from Road Centreline (m)	Annual Mean NO_2 Contribution (µg/m³)	Annual Mean PM_{10} Contribution (µg/m³)
20	0.17	0.02
70	0.06	0.01
115	0.02	< 0.01
175	0.01	< 0.01

Note: Assessment assumes vehicles are travelling at a speed of 30mph (48kph).
Specified distances from the road centreline are in accordance with the DfT's transport analysis guidance (WebTAG) and a representative of receptors within 50 m bands up to 200 m.
Results presented to 2d.p. to indicate level of change, this is not a reflection of model accuracy.

Long Term Operational Effects and Cumulative Effects during the Demolition Phase

The existing buildings which may be demolished range in height up to 50 m and hence are taller than any of the proposed new buildings or structures associated with the CCGT project, the tallest of which is 31 m. The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. The existing buildings are, therefore, likely to have affected the outcome of the stack height determination and overall assessment results.

Demolition of the structures will not have any negative long term effect on air quality, rather it may reduce the predicted air quality effects of the proposed CCGT's operation as a result of lesser building wake effects on site.

The worst case scenario cumulative effects will arise during the demolition of the structures in tandem with the operation of the proposed CCGT. It is anticipated that the dust and airborne pollutants generated during the demolition phase of the project can be mitigated using standard mitigation techniques typical of any heavy civil engineering project (i.e. dust sweeping and dampening of internal road surfaces, the judicious use of water sprays and bowsers on stockpiles of materials likely to generate dust, limitation on idling of demolition plant and vehicles, etc.). In this regard the cumulative effects are not considered to present significant additional environmental effects.

In summary it can be concluded that the demolition of existing buildings on the Great Island site may result in minor adverse short term effects as a result of dust generation, but potentially positive effects in terms of local air quality in the longer term operational phase of the project.

5.11 LANDSCAPE AND VISUAL

Demolition phase

For the duration of the demolition process, impacts on landscape character and visual amenity will arise and these will be derived, in the beginning, from the visible activities associated with the demolition of the power plant buildings together with the presence of large plant and machinery required for this purpose. Later as the demolition process advances, some beneficial impacts on landscape character and visual amenity will be derived from the removal of the building structures which are detracting elements.
The significance of the adverse landscape and visual impacts will vary throughout the demolition period dependent on the type and intensity of demolition activity that is taking place at a particular time. Towards the end of the demolition phase, beneficial impacts will begin to be apparent as the old power plant is removed from the site.

Post Demolition Stage

Landscape

Direct impacts on the receiving landscape will arise as a result of the removal of structures associated with the existing Great Island power plant. As these structures represent elements which compromise the quality of the receiving landscape, this direct impact is assessed to be positive.

Indirect impacts on the wider landscape character, specifically the local landscape character areas (LLCAs) and the County Landscape character areas for Counties Wexford, Kilkenny and Waterford will be beneficial. The beneficial impact on the character of these landscapes will be derived from an overall net reduction in the size and scale of the Great Island power plant arising as a result of the introduction of the new smaller power plant and the removal of the larger existing power plant. The beneficial impacts on receiving landscape character will amount to the following:

- The proposed power plant, where visible, from within these landscapes, is likely to be seen as a much smaller element in the skyline compared with the existing plant which will be removed;

- There are areas within a given landscape character where the existing power plant is currently visible but where the proposed power plant will not be visible. The removal of the existing power plant will mean that these areas or landscapes will no longer be indirectly affected by the Great Island power plant. Thus, the proposed change, comprising the introduction of the proposed new smaller power plant and the removal of the existing large power plant will result in a beneficial impact on receiving landscape character.

For similar reasons, beneficial impacts on the setting of cultural assets, designated landscape and protected views and scenic routes are likely to arise.

The significance of the beneficial impact will vary with each landscape receptor dependant on its location relative to the proposals and the extent or geographic area from which views of the proposed change will be gained.

Viewers at fixed viewpoint locations

Visual impacts at the viewpoint locations will usually be beneficial and this is because the existing larger old power plant will be replaced by the smaller new power plant.

There is potential to include further viewpoint locations in the assessment where the existing power plant is visible and the proposed power plant is not visible. In these locations, a beneficial visual impact change to the existing view is anticipated.

Mitigation

During the demolition phase the following mitigation measures would be recommended

- Installation of temporary hoardings for the purpose of screening the demolition activities;
- Stockpiles of demolition waste are to be removed prior to the end of the demolition period; and
- Control lighting during hours of demolition in the hours of darkness if applicable;

For the operational phase a landscape design will be developed in cooperation with the local authority and the relevant stakeholders. During the demolition process of the existing plant there are no significant cumulative effects likely to occur for the landscape and visual aspect.

5.12 *MATERIAL ASSETS: ARCHAEOLOGY AND CULTURAL HERITAGE*

During demolition of the existing plant no impacts for Archaeology and Cultural Heritage are envisaged to occur due to the fact that there are no recorded monuments or sites of archaeological or architectural value on site. There will be no affects through the operational phase on Archaeology and Cultural Heritage once the existing plant is demolished.

However, as noted above, there is the potential for previously unrecorded archaeological remains to survive on the site. It is recommended that archaeological monitoring should be conducted by a qualified archaeologist during the site clearance and excavation works. During the demolition process of the existing plant there are no cumulative effects likely to arise for the archaeological and cultural heritage aspect.

5.13 MATERIAL ASSETS: UTILITIES

A small number of utilities services have been identified within the study area. Standard utilities are associated with the water supply and the telecommunication services to and off site. There is a water main, owned by the local authority provides water to the water reservoir in the north of the site. Demolition will mainly take place on the lower tier of the site and therefore any interruptions to the services will be very unlikely.

On the northern side of the station grounds are two substations owned by ESB (220 kV and 110kV). These are both connected to the national/regional grid network of the region via overhead power lines crossing the northern part of the site. Both stations will remain in place and therefore no impacts due to demolition or any cumulative effects are likely to occur.

6 CUMULATIVE IMPACTS

The potential for the Great Island demolition project to have cumulative impacts on any environmental medium has been considered. All findings that have been made in this preliminary assessment in this regard are detailed in the individual chapters of the preliminary environmental assessment (see *Sections 5.1 -5.13*).

The approach adopted within this assessment considers cumulative impacts for the demolition process running concurrently with the operation of the proposed development of the CCGT Great Island Power Station. The preliminary assessment for the cumulative effects takes into consideration the appropriate mitigation measures put in place where applicable. The proposed scheme is a significant infrastructure project and as such, a certain amount of disruption during the demolition phase is inevitable. The mitigation strategy that is outlined within this report will help to ensure that the potential for cumulative impacts is minimised as much as possible.

The potential for other schemes in the same area as the Great Island Power Station, which potentially could have a cumulative impact, will have to be detailed once a clear time frame has been decided and projects that are in the planning system or are likely to go ahead at that time can be defined. Given the rural location of the proposed scheme, cumulative impacts arising due to the existence of another major construction projects are unlikely. It is therefore very unlikely that other projects within the closer development area will contribute in a negative way to the future scenario assessed and are set out under the single heading for all environmental aspects.

Appendix 1

Residuals Management Plan

Prepared by:

Endesa Ireland Ltd.

Residuals Management Plan

Great Island Generating Station

INTEGRATED PREVENTION POLLUTION CONTROL

LICENCE REGISTER NUMBER: P0606-02

LICENSEE: ENDESA

Report P04E318A – R1

Revised April 2009

TMS Consultancy Ltd.

Table of Contents

1. Introduction

1.1 Background

Environmental management at Endesa's Great Island Generating Station is regulated by the conditions of Integrated Pollution Control Licence (IPPC Licence) Reg. N° P0606-02 issued as Licence number 715 in January 2005 by the Environmental Protection Agency (EPA).

Clause 14 of IPPC Licence Reg. N° P0606-02 requires the preparation and submission to the Agency of a Residuals Management Plan (RMP). The specific requirements are laid down in Condition 14, as follows:

14.1 Following termination, or planned cessation for a period greater than twelve months, of use or involvement of all or part of the site in the licensed activity, the licensee shall, to the satisfaction of the Agency, decommission, render safe or remove for disposal/recovery, any soil, subsoils, buildings, plant or equipment, or any waste, materials or substances or other matter contained therein or thereon, that may result in environmental pollution.

14.2 Residuals Management Plan:

14.2.1 The licensee shall prepare, to the satisfaction of the Agency, a fully detailed and costed plan for the decommissioning or closure of the site or part thereof. This plan shall be submitted to the Agency for agreement within six months of the date of grant of this licence.

14.2.2 The plan shall be reviewed annually and proposed amendments thereto notified to the Agency for agreement as part of the AER. No amendments may be implemented without the written agreement of the Agency.

14.3 The Residuals Management Plan shall include as a minimum, the following:

14.3.1 A scope statement for the plan.

14.3.2 The criteria which define the successful decommissioning of the activity or part thereof, which ensures minimum impact to the environment

14.3.3 A programme to achieve the stated criteria.

14.3.4 Where relevant, a test programme to demonstrate the successful implementation of the decommissioning plan.

14.3.5 Details of costings for the plan and a statement as to how these costs will be underwritten.

14.4 A final validation report to include a certificate of completion for the residuals management plan, for all or part of the site as necessary, shall be submitted to the Agency within three months of execution of any part of the plan. The licensee shall carry out such tests, investigations or submit certification, as requested by the Agency, to confirm that there is no continuing risk to the environment.

This Report is prepared to address the above requirements.

1.2 Basis of RMP

The basis of the RMP is as follows:

- A review of the activities carried out at the station, including processes and services.

- Identification of existing and potential hazards, including evaluation of materials consumed and wastes generated.
- Consideration of historic environmental incidents and remediation works undertaken.
- Identification of items of plant and other materials that may be decommissioned, rendered safe or removed from the site for disposal or recovery in the event of closure.
- Identification of locations where cleaning, decontamination or remediation works may be required in the event of decommissioning to prevent environmental pollution.

1.3 Station Features

Great Island Generating Station is located in south-west Co. Wexford near Campile at the confluence of the River Suir with the River Barrow estuary.

The station's generating capacity stands at 240 MW and it was developed in two stages, comprising three generating units. The initial development consisted of two 60 MW units that were commissioned in 1967 and 1968. Each unit comprises a VKW boiler and a Parsons turbo-alternator. The follow-on development consisted of a single 120 MW unit that was commissioned in 1972. It comprises a Fives boiler and Parsons turbo-alternator.

The station was constructed on lands that were formerly in agricultural use and some lands were reclaimed from the estuary during development of the site. The total area of the site is approximately 65 hectares (ha).

The main features of the station include:

- Station main building housing three boiler and turbo-alternator units.
- Jetty for unloading marine oil tankers having a capacity to accept vessels up to 20,000 dwt. The cooling water intake is incorporated into the unloading jetty.
- Five tanks for storing heavy fuel oil (HFO) with a total capacity to 85,000 t.
- Minor HFO tanks including transfer tank, test tank and oil stripping tank for use in oil unloading.
- Diesel oil tank and minor vehicle refuelling tanks.
- Waste oils storage tanks.
- Cooling water system comprising pumphouse, inlet and outlet culverts, and discharge channel.
- Service reservoir and tanks for storage of incoming and treated water.
- Water treatment plant for processing of water prior to its use in the boilers.
- Neutralisation plant for treating boiler washing effluents and water treatment plant effluent.
- Generator transformers and high voltage switchgear.
- Unit and house transformers.
- Two reinforced concrete chimneys, one each serving the two 60 MW units and the 120 MW unit respectively.
- Administrative offices and canteen.

Please note that the 110 kV and 220 kV transmission compounds were removed from the scope of the IPPC Licence P0606-02 in Technical Amendment C, December 2008. URS completed an

Environmental Site Assessment on the Switching Yards and concluded that “the subject areas are suitable for the continued industrial land use. No remedial action is considered necessary within the subject areas under a continued industrial land use scenario”

- Supporting facilities including the following:
  - fire protection pumphouse
  - fuel oil pumphouse
  - diesel generators
  - chemicals storage tanks
  - chemical laboratory
  - workshop and stores

  Bedrock underlying the site comprises volcanic rocks of the Campile Formation. This consists of zones of siliceous volcanic ash and crystalline felsite. There is an overburden of glacial till and alluvial silt.

The site closed and verified an on site landfill area comprising two cells, cell 1 and cell2. Cell 1 is 22,500 m2 and cell2 is 13,500 m2. The design of the closure was based on a URS report (October 2003) and the technical specification for the closure and capping was based on that report. URS also conducted an Environmental Risk Assessment on the waste disposal areas and concluded that there was an associated low environmental risk. The cells were capped and closed in conjunction with a Quality Assurance assessment of the closure by URS (“Closure of Landfill at Great Island Power Generating Station – Construction Quality Assurance Report” 2008). The latter report concluded that “construction of the landfill cap was completed in general accordance with the specifications and drawings.”

The residuals management plan thus reflects the remaining areas of the site within the scope of the IPPCL.

2. Scope of RMP

2.1 Application of RMP

Endesa has no current plans to decommission all or part of the plant, outside of the exclusions and closures outlined in Section 1.3 above. The scope of this RMP addresses the key issues that would occur in the orderly shut-down of all of the station activities.

Condition 14.1 of IPPC Licence Reg. N° P0606-02 refers to planned cessation of operations for a period of greater than twelve months. The role that Great Island Generating Station will play in the Irish electricity industry close to the time of its decommissioning will be determined by a complex array of issues and cannot be foreseen at this point in time. While a section of the plant or all of it may be unused or not in operation for a period of twelve months, circumstances could dictate that it be maintained until such time as production resumes. While this has not happened at Great Island, similar long-term storage of plant has occurred in the past at other power stations where units were mothballed for a number of years and subsequently became available again for commercial operation. In such an event the RMP will not be implemented.

There are no direct references in this RMP to partial closure. While some ancillary and support facilities at Great Island are unit related, most are not. Additionally, there are significant practical constrains involved in safely segregating working from non-working station plant.

Under a scenario involving discontinued use of one or two of the station's three units, most ancillary and support facilities would remain operational and the station would continue to operate under the conditions of IPPC Licence Reg. N° P0606-02.

2.2 Areas Addressed

General

The scope of the RMP will be the decommissioning of the site activities related to the electricity generation process and disposal of residuals arising therefrom.

This will involve decommissioning of:

- Production facilities
- Ancillary / support facilities
- Storage areas

It will also include the disposal of all residuals arising from the decommissioning itself. Here the term "residuals" is deemed to include any materials remaining on site following process decommissioning. This includes materials and wastes.

Key Issues

The principal issues to be considered in the RMP for Great Island are identified as follows:

- Liquid fuel (HFO and diesel) removal / cleaning from pipelines and tankage.
- Residual chemicals and chemical storage tank cleaning.
- Boiler cleaning.
- Drainage line cleaning.

Materials

The station stores holds approximately 3,000 coded items with an equivalent annual turnover of stock. Station purchases run to in excess of 2,500 orders annually. Most items are used in operations and maintenance activities and are of no environmental significance.

A list of the environmentally significant materials used at the station and to be disposed of during decommissioning, derived from Section 10 of the station's application for its IPPC Licence, is presented in Appendix I. The list contains details of the maximum quantities of these materials stored on site. The actual quantities remaining at shut-down would likely be much less due to scaling down of activities prior to closure, allowing a staged reduction in inventory.

Wastes

Site operations generate hazardous and other wastes. The types of waste generated are outlined in Schedule 3 of IPPC Licence Reg. N° P0606-02 and are presented as Appendix II. The list contains details of the quantities of these wastes arising annually, as indicated in the station's application for its IPPC Licence.

The amount of wastes generated will increase significantly during implementation of the RMP with the following being of particular note:

- Batteries.
- Waste lubricating oils.
- Waste transformer oils.

Additional hazardous wastes that may arise during decommissioning are as follows:

- Smoke detectors.
- Chemical paints and additives.
- Refractory brick from station chimneys.

Wastes arising during decommissioning will be managed in accordance with Condition 7 of IPPC Licence Reg. N° P0606-02.

Asbestos

Asbestos was used widely in construction of Units 1 & 2 at Great Island but very little was used in the construction of Unit 3.

In 1990 a decision was taken to remove all remaining asbestos material from Great Island and a survey of the plant was undertaken to identify where it was present. The asbestos was removed and was stored on site until 1992 when all asbestos waste, including that excavated from a designated on-site asbestos burial site, was exported to a licensed disposal site in Finland.

Small amounts of asbestos may still be incorporated in certain small items such as gaskets and gland packing. However, large-scale removal from the plant of asbestos insulation and lagging will not arise during decommissioning.

Environmental Incidents

The principal accidents or incidents of environmental significance that have occurred at Great Island were as follows:

- An oil spill in the 1970s resulted in oil being leaked from the stripping tank to the estuary during oil unloading.
- In 1985 interference with equipment in the oil storage bund led to quantity of oil being lost from one of the tanks. All oil was retained within the concrete bund.

Neither of the above lead to contamination of station lands.

Other Conditions of IPPC Licence Reg. N° P0606-02

Certain obligations may arise as a result of compliance with Condition 9.2.4 and of IPPC Licence Reg. N° P0606-02 as follows:

> 9.2.4 The licensee shall implement the groundwater programme as approved by the Agency in correspondence of 16/09/03, for removal of on-site contamination and remediation of groundwater

It is envisaged that discharge of any obligations arising from the above will predate decommissioning of the station. No significant aftercare management is predicted.

Should the opposite be the case with station closure and decommissioning occurring sooner than anticipated, works within the scope of the RMP will be completion of outstanding actions on foot of any obligations arising from the above.

Long-term Liabilities

An underground tank that was previously used for storing petrol was decommissioned some years ago.

There has been no recorded spillage of chemicals at Great Island.

The environmental monitoring programme conducted at Great Island is in accordance with the requirements of Condition 11.1 of IPPC Licence Reg. N° P0606-02. Monitoring in accordance with Schedules 1(ii), 1(iii), 2(ii), 2(iii), 4(i) and 4(ii) is designed to identify any impacts associated with operation of the station so as to allow effective remedial action or minimise environmental pollution.

Given the current knowledge concerning the long-term environmental liability associated with the site and that full compliance with IPPC Licence Reg. N° P0606-02 will ensure that additional liability will be avoided, a significant soil and groundwater programme at station decommissioning is not anticipated.

2.3 Annual Review

The RMP will be reviewed annually.

The annual review of the RMP will address all developments at Great Island. The review will also evaluate the scope of the RMP in the context of any environmental incidents at the station.

The RMP will be updated as necessary.

2.4 Exclusions

The RMP applies to the entire site, except as follows:

- Successful decommissioning is determined as being completed when all buildings, equipment, wastes or any other materials that could result in environmental pollution are removed from the site and recycled, recovered or disposed of in accordance with all regulations in force at that time. The RMP will result in a decommissioned and decontaminated site suitable for future industrial use. All buildings and some site services, whilst emptied and cleaned as part of the RMP, will remain in place following decommissioning.

- The structural form of station buildings is conventional structural steel supported on reinforced concrete foundations. Gantries and walkways for access to plant and equipment are constructed of stainless/galvanised steel open grating type flooring. These are supported on steel beams and columns. External walls comprise profiled metal cladding and roofs are constructed of profiled metal decking on purlins spanning between rafters. The materials used do not pose any environmental threat in the event of station closure, whether they are demolished or remain in place.

- Certain station areas will continue to operate or remain operational. These include facilities such as the following:
  - Diesel supply to back-up engine in the fire protection pumphouse.

- All equipment and plant at Great Island is the property of the station, other than cylinders in which bottled gas is delivered and a pressure vessel (bullet) of 1,500 l capacity in which propane gas is stored. The latter is owned by the supplier who is responsible for maintenance. The supplier will be responsible for removing any remaining propane and bringing the bullet to a safe state.

- Services that are performed by contractors on an ongoing basis include the following:
  - Unloading of marine oil tankers
  - Landscaping of station grounds
  - Rodent control
  - Hygiene services
  - Window cleaning
  - General building work

  The above activities have no implication for the RMP.

3. Criteria for Successful Decommissioning

The criteria for successful decommissioning to ensure minimum impact to the environment with respect to residuals management are as follows:

- The appropriate decontamination of all plant and equipment.
- Documented reports of all raw materials dispatched from the site.
- Documented reports on the disposal of hazardous waste including all certification required under regulations in force at the time.
- Documented reports on the disposal of non-hazardous waste including all certification required under regulations in force at the time.
- Clearance and documentation indicating final disposal for any asbestos found to be present in the station.
- Documented post-closure ADF, soil and groundwater programmes where appropriate.
- Secure archiving of all documentation.

4. Implementation of RMP

4.1 Strategy

Endesa intends to manage and execute the RMP using internal resources, supplemented as necessary and appropriate with external resources.

All external resources used for cleaning, waste disposal, etc. will be fully approved and licensed as appropriate.

A Residuals Management Team will be created to manage and execute the entire project and key activities will be supervised by personnel with appropriate experience and expertise. Only suitably qualified personnel will carry out decontamination works.

Options that will be available with regard to various residuals are broadly as follows:

• Reuse	Removal for reuse at other power station(s).
	Return to supplier
• Recovery / Recycling:	Sale to third-party
• Disposal	Disposal as waste

Waste sent off-site for recovery / recycling or disposal will only be conveyed to a permitted waste contractor and only transported from the station to the site of recovery / disposal in a manner that will not adversely affect the environment.

4.2 RMP General Activities

The activities within the RMP will be as follows:

- Cessation of all production.
- Cancellation of all incoming deliveries of materials to the station.
- Termination of all contracts other than those that are concerned with the RMP or related to safety of personnel or the environment.
- Return of materials to suppliers where possible, for resale or reuse.
- Isolation and purging of transfer lines from bulk storage to direct pipe contents back to bulk storage.
- Shutting and blanking of supply lines from bulk storage for oils and chemicals to intermediate storage and/or dilution tanks.
- Cleaning and decontamination of all plant and equipment.
- Removal of all laboratory chemicals.
- Cleaning and decontamination of all laboratory analytical instruments.
- Cleaning, decontamination and inspection of bunds, sumps and underground drains.
- Removal of old and obsolete equipment and destocking of the workshops and stores.
- Isolation and disconnection of all electrical supplies to pumps and motors.
- Draining of oil from obsolete transformers that will not be reused elsewhere.
- Decommissioning of redundant oil-filled cables and draining of header tanks.
- Cleaning of residues from boilers and cleaning and blanking off of fuel lines.
- Draining and cleaning of lube oil systems.
- Draining of water systems such as raw feedwater tanks, condensate storage tanks and supplementary cooling systems.
- Transfer of ion exchange resins to drum storage.
- Cleaning of water treatment neutralisation tank and removal of all waste and effluent for appropriate disposal.
- Maintenance of parts of the water supply system to provide wash-down and cleaning facilities during decommissioning and to meet the ongoing needs for fire protection and sanitary services.
- Maintenance of site drainage system and oil interceptors during decommissioning activities.
- Secure archiving of all relevant documentation including drawings, instrumentation diagrams, validation documentation, vendor manuals and data, project files, maintenance records, inspection records, waste disposal records and other appropriate documentation.

- Maintenance of a security presence on site on a 24-hour basis for ongoing monitoring of the site from a safety, fire protection and environmental perspective.
- Maintenance of defined site access procedures.

It is anticipated that any necessary decontamination of plant and equipment will be carried out on site. It will primarily involve cleaning in place and power washing of internal and external surfaces.

Endesa will seek approval from the Agency for any decontamination procedures and monitoring requirements to be employed.

4.3 Residual Liquid Fuel, Tankage and Pipelines

Drains in the areas where these facilities are located will be isolated before commencement of decommissioning activity.

Heavy Fuel Oil (HFO)

Great Island is fired on HFO. Its tank farm comprises five tanks each of 17,000 t capacity. There are also a transfer/service task of 4,000 t capacity, a test tank of 300 t capacity and a transfer pipeline stripping tank of 300 t capacity.

Tanks are of mild steel construction with man-made mineral fibre (MMMF) and aluminium cladding insulation. A programme of inspections of oil tanks, which includes out-of-service inspections and NDT, is undertaken in accordance with an Endesa in-house standard that specifies requirements for intervals of five, 10 and 15 years for all above ground fuel oil tanks. There have been no recorded losses of tank contents indicative of leakage through a tank base. Furthermore, where panels within tanks were replaced during application of the above in-house standard their condition was not such as to indicate that leakage had occurred. The tanks are thus expected to be in good condition at the time of decommissioning.

The maximum quantity of HFO will be used prior to the cessation of power generation so that the minimum quantity of unused HFO remains on site. Where possible, all pipelines and tanks will be drained using on-site pumps to 'loss of suction' to minimise the remaining HFO residues within tanks and pipework.

Tankage: The most effective method for cleaning of HFO tanks will be to absorb HFO residues by scrubbing / flushing with kerosene, diesel or a similar lighter petroleum based liquid. The kerosene / dissolved diesel will then be pumped to a tanker for treatment and re-separation / re-use of oil fractions and the tank will be jet washed with water / detergent to remove remaining residues. The tanks will then be suitable for either retention on site or removal for clean scrapping.

Pipelines: Pipework will be cleaned by a variety of methods including an in-situ pneumatic pipe cleaner / scourer machine (a 'pig'), retro-jetting with water, flushing with water or kerosene, or high-pressure air flushing. At this stage of cleaning the pipework will be in an acceptable state for either retention on site or removal for clean scrapping.

All cleaning activities will be facilitated by maintaining the steam heating system for all pipes and tanks to supply steam to aid the flow and removal of oil.

Diesel

The station's storage of diesel consists of a single tank of 55 t capacity within the HFO storage area. Fuel for station vehicles is held in a dedicated tank of small capacity.

The maximum quantity of diesel will be used prior to the cessation of power generation so that the minimum quantity of unused diesel remains on site.

Similar methods to those used for HFO facilities will be used for tankage and pipelines containing diesel.

4.4 Residual Chemicals and Tankage

The main bulk chemicals used at the station and that will be addressed in decommissioning or closure are as follows:

- Sulphuric Acid (H_2SO_4): Used in water treatment.
- Sodium Hydroxide (NaOH): Used in water treatment and in treatment of boiler washes.
- Hydrazine (N_2H_2): Used as an oxygen scavenger in boiler feed water.
- Ammonia (NH_3): Used for pH control in boiler steam cycle.

Stocks of the chemicals consumed in operation of the power station will be run down to a minimum at the cessation of power generation. Remaining bulk quantities of chemicals will then be available for either transfer to other power station(s), return to their supplier or disposal by contractors at licensed facilities.

Further to this, bulk storage tanks will be cleaned internally by contractors.

Cooling water is treated with 12 - 14% sodium hypochlorite (NaOCl). Stocks are held in Intermediate Bulk Containers (IBCs), which are delivered and replaced as required by the supplier. Decommissioning will be limited to internal cleaning of delivery pipelines.

With wet chemistry carried out in the station laboratory being substantially eliminated by the use of modern instrumentation, remaining stocks of laboratory chemicals that require disposal will be low.

4.5 Boiler Cleaning

The following activities already take place routinely at Great Island and are managed successfully.

Boiler Storage

A decision on station closure would likely be proceeded by a period where all or some of the station boilers are in storage. Dry storage is currently the preferred method and if this is in use no environmental emissions will result during decommissioning.

Boiler Washing

The fire side of the boilers will be washed with water using a high-pressure low-volume system The washwater from Units 1 & 2 will be drained to an internal floor sump and pumped from there to a steel settling tank. Washwater from Unit 3 will drain via the internal floor drains to an oil interceptor, the outlet from which is valved, where it will be conditioned by dosing with 47% sodium hydroxide (NaOH). It will then be pumped to the settling tank.

When the correct pH is achieved, the solids will be allowed to settle out and the supernatant effluent, being pH6 - pH9, will be discharged to the cooling water channel where it will be added to the cooling water flow in a controlled discharge to achieve a high dilution rate.

The settling tank will be cleaned down and all waste and efluent wiill be removed for appropriate disposal.

The cooling water system will be retained in operational condition until boiler washing is completed.

4.6 Drainage Line Cleaning

Drainage systems within the station involve 13 separate discharges to the Barrow Estuary. These systems, whose designations below are those used in IPPC Licence Reg. N° P0606-02, are broadly categorised as follows:

- Seven discharges fully or partly comprise trade effluents, namely PE2, PE5, PE6, PE7, PE8, SW12 and PE13.
- Two discharges comprise sewage/washing effluent, namely SW3 and SW9.
- Four discharges comprise surface waters/station drainage exclusively, namely SW1, SW4, SW10 and SW11.

Of the above, the discharges that are of concern and key components thereof are as follows:

- SW1 - HFO and diesel tank farm.
- SW4 - Oil stripping tank.
- PE5 - Boiler House of Unit 3.
- PE6 - Engine Room of Unit 3 and Boiler House (part) of Units 1 & 2.
- PE7 - Engine Room of Units 1 & 2, Boiler House (part) of Units 1 & 2 and transformer bunds.
- SW12 - Area east of Unit 3 and an internal sump.

All of the above are protected by oil interceptors and there is no potential for impact upon the Estuary if the drainage system is left in place after decommissioning. However, cleaning of station drains will be required to mitigate the potential for oil residues to be present within pipelines.

This will involve water jetting using the existing oil interceptor system and vacuum tankers. Oil interceptors will be cleaned down and all waste and effluent will be removed for appropriate disposal. No areas of heavy or free product oil residues that would require steam cleaning are expected. On completion of decommissioning the site drainage will be in a suitable condition for removal or more likely to be left in place to continue to provide surface water drainage for the site.

The station will continue to properly operate and maintain the site drainage system prior to and during implementation of the RMP.

4.7 Demolition Nuisance Mitigation

Any demolition works that are carried out in connection with or associated with the RMP have the potential to lead to elevated noise levels and to creation of dust. Additional traffic movements will also arise. The following mitigation measures are proposed:

Noise

All works will be carried out during daylight hours and noise levels will monitored to ensure compliance with the requirements set out in IPPC Licence Reg. N° P0606-02.

Noise minimisation measures will be employed. These will include such measures as using saw-cutting machinery instead of rock breaking equipment.

Dust

Surfaces that have the potential to generate dust during their demolition will be wetted prior to the work commencing.

Demolition on windy days will be avoided to the extent possible.

Traffic

While traffic will arise in the removal from site of residuals, this will coincide with the elimination of current sources of traffic associated with station operations. It is considered that the demolition related traffic will not pose undue difficulties.

5. Test Programme

5.1 Monitoring

The monitoring and reporting requirements set out in IPPC Licence Reg. N° P0606-02 will be complied with in full until the licence is surrendered to the Agency. The monitoring will identify if any contamination of air, surface water, groundwater or soils has occurred during the lifetime of the IPPC Licence.

In the event that a future environmental incident causes contamination of these media, which has not been quantified at the time of the closure of the facility, a test programme will be established as part of the RMP to identify the nature and scale of any associated environmental pollution.

Tests will be carried out on wash waters generated during the decontamination works to confirm that they are suitable for discharge.

While testing has already confirmed that there is no reason to believe that such contamination may be present, oils will be sampled and tested for PCB contamination.

5.2 Validation

Following implementation of the RMP, a validation report will be produced to demonstrate its successful implementation. It will confirm that there is no continuing risk of pollution to the environment from the site.

The Report will address:

- Disposal of materials
- Decontamination of items of plant and equipment
- Decommissioning of plant and equipment
- Results of monitoring and testing
- The need for ongoing monitoring and investigations

The report will be submitted to the Agency within three months of completion of the RMP.

5.3 Environmental Summary Report

In addition to the above validation, in line with ESB's policy in relation to closure of its power stations, a full environmental summary report will be prepared.

This will outline the following:

- The full history of the power station site from its initial development through to closure.
- The various investigations undertaken and reports prepared during the operation of the plant
- The actions taken in the course of the RMP.

The Environmental Summary Report will be made available to future users of the site, whether this is Endesa or a third party.

6. Costing & Financing

Endesa has a very significant working capital and any decommissioning or closure of Great Island would be a well resourced activity. The company has adequate resources of finance and manpower to implement the RMP through to completion.

More significantly, Endesa makes specific financial provision for closure of its power stations.

Further to the above, Great Island site covers a considerable area and being an industrial site it has considerable potential for redevelopment. Its jetty is a significant asset that will remain following decommissioning. Furthermore, much of the plant and equipment will have very significant residual value. The value of the site and its plant and equipment alone provides a fund that greatly exceeds the potential costs of decommissioning.

Specific costings have not been developed for the RMP at Great Island. However, it is evident from the limited number of issues that required inclusion in the scope of the RPM that the company's financial provisions and the value of the assets at Great Island are orders of magnitude greater than the costs that may be incurred.

7. Comment

Since commissioning of its first unit in 1967, the presence of Great Island Generating Station has not resulted in significant environmental impacts and the station will continue to be operated in a responsible manner. Issues that are likely to arise upon closure at Great Island have all be dealt with successfully in the past at other Endesa sites and similar care will be taken when decommissioning at this site.

Appendix I – Key Substances

Material / Substance	Amount Stored	Nature of Use
Algicide (Alkyl dimethyl benzyl ammonium chloride and Ethanol)	0.4 t	Water treatment
Ammonia Solution (35%)	1,500 litres	Boiler treatment
Gas Oil	50 t	Fuel
Heavy Fuel Oil (HFO)	85,000 t	Fuel
Hydrazine Solution (35%)	1.5 t	Boiler treatment
Ion Exchange Resins	150 m^3	Water Treatment
Laboratory Chemicals	Various	Laboratory analysis
Lubricating oils	10,000 litres	Lubrication
Pentomag (Magnesium Hydroxide)	13,000 litres	Boiler additive
Propane	2,000 litres	Ignition fuel
Sodium Hydroxide Solution (47%)	30 t	WTP regeneration
Sodium Hypochlorite Solution	2 t	Cooling water treatment
Sulphuric Acid	40 t	WTP regeneration

Appendix II – Station Waste

Hazardous Waste

Item	Amount
Waste Oils	16,750 litres
Oil interceptor waste	3,000 litres
Batteries	250 kg lead acid & 10 kg Ni-Cd
Oil contaminated materials	30 No. 220 litre barrels
Asbestos	50 kg
Smoke detectors	1 No.
Gaseous discharge lamps	350 No.

Other Waste

Item	Amount
Administration, plastic packaging and canteen waste	36 m^3
Waste paper and cardboard	20 bales
Grounds maintenance waste	See Note 3.
Scrap metal	14 t
Timber	2 t
Solids from boiler cleaning	5 t
Ion exchange resins	17 m^3 over 5 years
Non-hazardous insulation materials	1.5 m^3
Sewage sludge	Two-year clean
Toner cartridges	0.5 m^3
Cooking oils	200 litres

Notes:

1. The above are wastes as listed in Schedules 3(i) and 3(ii) of IPPC Licence Reg. N° 715.
2. The amounts are those arising annually, except as noted, based on Section 17 of the station's application for its IPPC Licence.
3. Waste item is listed in Schedule 3(ii) Other Wastes for Disposal/Recovery of IPPC Licence Reg. N° 715 but is not listed as a waste stream that arises at Great Island in Section 17 of the station's application for its IPC Licence.

Appendix 2

Traffic and Transport Assessment

Prepared by:

Mott MacDonald

Traffic and Transport Assessment

for the Demolition of the Existing Power Plant at Great Island Co. Wexford

November 2009

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02	23/11/2009	JH	SD	DH	Draft

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Content

1. Traffic

1.1 Introduction

This report has been prepared to supplement the Traffic and Transport Assessment which has been prepared in support of an EIS for the construction of a new power plant at Great Island Co. Wexford.

This report deals with the potential impacts, on roads and traffic, likely to arise from the demolition of the existing power plant at Great Island. The demolition of the existing power plant is not necessary to facilitate the construction of the proposed new power plant nor will it be a direct consequence of constructing the new power plant. To cover all eventualities, however it has been decided to assess the impacts of the demolition of the existing power plant.

1.2 Background

This report has been prepared in accordance with the "Traffic and Transport Assessment Guidelines" as published by the National Roads Authority in September 2007. The report assesses the existing traffic and transport conditions in the area and the impacts that traffic generated by the demolition of the existing power plant at Great Island would likely have on the road network local to the development.

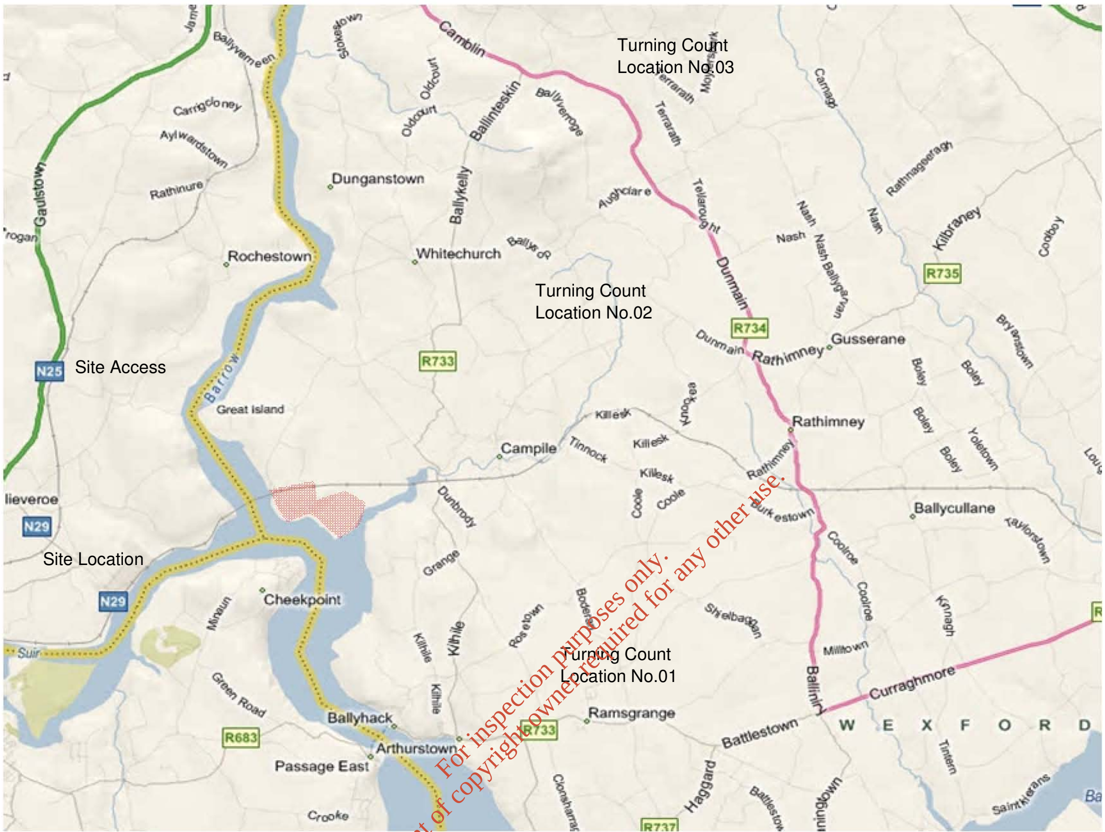
1.3 Traffic Impact Assessment

1.3.1 Traffic Counts

The traffic counts used in the original TTA were used in the preparation of this report. For the original TTA to obtain traffic volumes representative of those generally experienced in the vicinity of the proposed development turning movement counts were conducted at a number of key junctions in the vicinity of the development. The junctions at which turning movement counts were to be undertaken were agreed with Wexford County Council. The counts were conducted between the hours of 07:00 and 10:00 and 16:00 and 19:00 on Tuesday the 8th of September 2009. This date was chosen as the national school at Ballinamona was open again after summer holidays from late August onwards. The locations at which counts were undertaken are detailed below and illustrated inn Figure 10.1.

- Junction 1 - R733/R683 at Arthurstown
- Junction 2 – R733/Site Access Road
- Junction 3 – R733/R734 at Balinteskin

Figure 10.1 Traffic Count Locations



1.3.2 Receiving Environment

1.3.2.1 Site Location

The Great Island site is an existing power generating plant located on a 68 hectare site at the confluence of the River Suir and the River Barrow, on the shores of Waterford Harbour, see Figure 10.2 hereunder.

Figure 10.2 Site Location Map

1.3.2.2 Local Road Network

The site is accessed via a 5km section of local road, this section of local road forms a priority junction with the R733 a Ballinamona. The section of local road accessing the site is generally rural in character with road widths varying between 4.0 to 5.0 meters along the majority of this 5km section. This section of local road exhibits a number of acute changes in horizontal alignment with a particularly "tight" bend at Fisherstown. The road also narrows to approximately 3.5 meters in width for an approximately 400 metre section along the "causeway". The "causeway" is essentially a viaduct which historically formed a linkage between Great Island and the mainland prior to the silting over of the Barrow River basin. Figure 10.3 below refers:

Figure 10.3 Local Road Network Accessing the Site

1.3.2.3 Public Transport Facilities

A subsidised CIE bus service is in operation to the site.

1.3.3 Existing Traffic Conditions

The capacity and operation of a road network is dependant on the junctions within that network and it is the capacity and operation of these junctions that generally determines the capacity and vehicle delay on the network. In order to assess the current traffic conditions on the road network appropriate to the site, traffic surveys were carried out at the junctions that traffic generated by the proposed development would likely affect, namely:

- Junction 1 - R733/R683 at Arthurstown
- Junction 2 – R733/Site Access Road
- Junction 3 – R733/R734 at Balinteskin

1.3.3.1 Interpretation of Traffic Surveys

Classified junction turning movement counts were carried out between the hours of 07:00 and 10:00 and 16:00 and 19:00 on Tuesday the 8th of September 2009.

Analysis of the traffic counts revealed the AM system peak hour to be between 08:00 and 09:00 and the PM system peak to be between 17:00 and 18:00.

1.3.3.2 Analysis of the Existing Operation and Capacity of the Junctions

Having established the link flows and turning movements on the local road network in the vicinity of the development site, an analysis of the operation and capacity of the junctions surveyed was undertaken. The analysis was undertaken using the computer modelling programme PICADY as produced by the Transport Research Laboratory (TRL) in the UK. This particular programme is used to predict capacities, queue lengths and delays at priority junctions.

PICADY output files contain tables consisting of demand flows, capacities, queues and delays for each time segment of the peak hour analysis. These tables contain start and finish times, and for each arm of the junction, traffic demand, capacity, Ratio of Flow to Capacity (RFC), start queue length, end queue length and queuing delay. The RFC provides the basis for judging the acceptability of junction designs and the capacity of existing junctions. Briefly an RFC of 85% or less is considered to be acceptable. An RFC of this value would indicate that at peak times the junction operates at 85% of its capacity and thus has a reserve capacity of 15%. This level of reserve capacity is considered by traffic engineers to be the level of reserve capacity generally required at a junction to cater for periods of unusually high traffic flows, such as bank holiday weekends etc.

A summary of the PICADY results for the existing surveyed junctions is provided in Table 10.1.

Assessment Year	Time Period	Junction 01	Junction 02	Junction 03
			RFC Max	
2009	AM Peak	5.8%	9.4%	26.8%
	PM Peak	8.7%	10.1%	24.9%

As can be seen from the above table the junctions are currently operating well within capacity.

1.3.4 Trip Generation

1.3.4.1 Demolition Phase Trip Generation

A draft dismantling report for the de-commissioning of the existing power plant at Great Island has been prepared by has been prepared by an external consultant engaged by Endesa.

The main features of the power plant to be decommissioned addressed in this report are:

- Main station building housing three boilers and turbo-alternator units
- Heavy Fuel Oil, Diesel, Waste and Water Storage Tanks
- Water cooling system comprising pump house, inlet and outlet culverts and discharge channel

- Water treatment plant
- Generator transformers and high voltage switchgear
- Two reinforced concrete chimney stacks
- Administrative Offices and Canteen

The majority of the demolition waste will be made up of concrete and rubble, wood, glass, metal and plastic. Based on a worst case scenario where all of the above elements of the existing power plant are demolished and on the figures provided in Endessa Desarrollo's report the existing structures at Great Island equate to 79648 Tonnes. In reality however it is likely that certain elements of the existing facility will remain in place to service the new facility, this is therefore a very conservative worst case approach.

Prior to the de-commissioning of the existing plant a Residual Management Plan (RMP) will be submitted to the Environmental Protection Agency (EPA) for approval. This report will set out a fully detailed and costed de-commissioning programme outlining the methodology for de-commissioning.

A traffic management plan for the demolition of the existing power plant will be developed and submitted to Wexford County Council prior to the undertaking of any decommissioning works.

Assuming that all de-commissioning waste is adequately "broken-up" on site and taking a standard rigid bodied HGV load of 15 tonnes, the quantity of waste to be de-commissioned equates to 5310 HGV's. It has been assumed for the purposes of this report that all de-commissioning works will take place in the year 2015. This is a "worst-case" scenario as it would lead to an intensification of trips to and from the site, in reality the demolition of the existing plant could, if required, be spread over a longer timeframe. This is very conservative approach as it is likely that the demolition of the existing plant will be spread over a longer timeframe to avoid any impact on the operation of the new plant. Therefore in reality a less intense distribution of traffic will occur than that presented in this "worst-case" scenario report.

Based on a five day working week and a fifty week working year it is assumed that 21 HGVs loads per day will be required over the course of 2015 to fully decommission the existing power plant. It is estimated that there will be circa 100 workers on site during the demolition phase.

For construction workers, trip generation estimates have been based on the assumption that all construction workers arrive by passenger vehicle to the site during the morning peak hour and depart during the evening peak hour. Further it was assumed that the occupancy of these passenger vehicles is 1.25 persons per vehicle. Estimates for peak hour arrivals for heavy vehicles have been based on first engineering principles and experience drawn from similar schemes.

Based on these assumptions, morning peak hour, evening peak hour and daily trip generations have been estimated. A summary of these estimates are shown in Table 10.2.

Table 1.1: Demolition Phase Trip Generation Estimates

Traffic Type	Am Peak Hour		Pm Peak Hour		Weekday Daily Total	
	In	Out	In	Out	In	Out
Construction Workforce	80	0	0	80	80	80
Heavy Vehicles	2	2	2	2	21	21
Total	82	2	2	82	101	101

As shown in the table above, the proposed site is expected to generate approximately 84 trips (82 in / 2 out) during the morning peak hour, 84 trips (2 in / 82 out) during the during the evening peak, and 202 weekday daily trips (202 in / 202 out).

1.3.4.2 Operational Phase Trip Generation

During the operational phase it is estimated that twenty three full time day employees will work at the site, and 6 deliveries will be made per day. Additional to the twenty three day workers there will be a team of 15 shift workers i.e. 38 permanent employees in total. The shift workers will operate on a three shift basis as follows: Shift 1 from 00:00 to 09:00, Shift 2 from 09:00 to 15:30 and Shift 3 from 15:30 to 24:00. This distribution of shifts over the 24 hour day will result in five shift workers arriving at the site and five departing during the AM peak hour with no arrivals or departures expected during the PM peak hour. For the workers, a conservative occupancy rate of one passenger per vehicle has been estimated. Peak hour trip generation estimates have been formulated from first engineering principles. The morning peak hour, evening peak hour, and weekday daily trip generation estimates are summarised in Table 10.3.

Table 1.2: Operational Phase Trip Generation Estimates

Traffic Type	AM Peak Hour		PM Peak Hour		Weekday Daily Total	
	In	Out	In	Out	In	Out
Full Time Work Force	23	0	0	23	23	23
Shift Workers	5	5	0	0	15	15
Deliveries	2	2	2	2	6	6
Total	**30**	**7**	**2**	**25**	**44**	**44**

1.3.5 Combined Trip Generation in 2015

The demolition of the existing power plant is anticipated to occur during 2015. The expected year of opening of the new power plant is expected to be 2013. Therefore post-commissioning the demolition phase traffic for the existing power plant will run in parallel with the operational phase traffic of the new power plant. On this basis it was decided that any assessment of the impacts of demolition phase traffic would include operational phase traffic. The table below outlines combined demolition and operational phase traffic which has been used in the preparation of this report.

Table 1.3: Demolition Trip Generation Estimates

Traffic Type	Am Peak Hour		Pm Peak Hour		Weekday Daily Total	
	In	Out	In	Out	In	Out
Workforce	108	5	0	103	118	118
Heavy Vehicles	4	4	4	4	27	27
Total	112	9	4	107	145	145

1.3.6 Trip Distribution

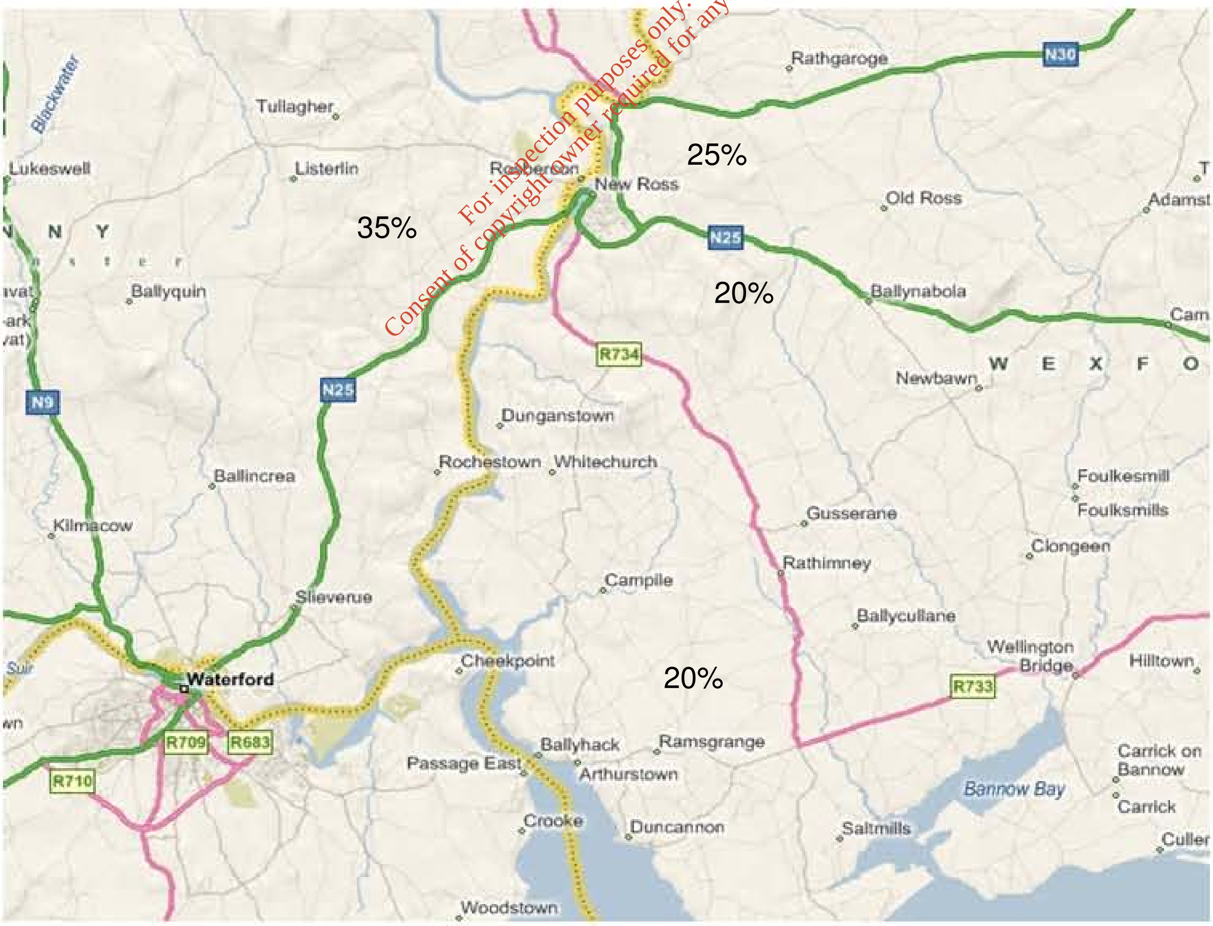
The distribution of trips generated by the development is based on available routing towards the strategic road network and the location of the major urban areas in the vicinity of the development site. The trip distribution profile is detailed in Table 10.4 below.

Table 1.4: Projected Distribution Profile

N30 & N25 East	45%
N25 West	35%
R733	20%

This distribution of trips to the site is shown graphically in Figure 10.4 below:

Figure 10.4 Trip Distribution



1.3.7 Assessment Years

The peak volumes of demolition traffic are expected to occur during 2015. Since the new plant will be operational at this time operational traffic has been added to demolition traffic for the purposes of undertaking a robust assessment of junction capacities at this time. Junction capacity forecasts, during both the AM and PM peak hours, were undertaken for the following scenarios:

- Existing Conditions;
- Year 2015 Baseline Conditions; and
- Year 2015 Baseline Conditions plus Demolition and Operational Traffic.

The National Roads Authority (NRA) 2003 publication *Future Traffic Forecasts 2002 to 2040* was used to calculate growth factors for the road network traffic. The following table outlines the calculated growth factors to convert from 2009 to 2015.

Table 1.5: Traffic Growth Factors

	Non-National Roads HGV	Non-National Roads Cars & LGVs
2009	112	115
2015	121	124
Growth Factor	1.080	1.078
Overall Growth Factor Applied	**1.079**	

1.3.8 Highway Capacity Impacts

Developments add traffic to the existing road networks in their immediate vicinity and to a lesser extent further downstream from the development location. As mentioned previously the proposed development will impact on the following three junctions:-

- Junction 1 - R733/R683 at Arthurstown
- Junction 2 – R733/Site Access Road
- Junction 3 – R733/R734 at Balinteskin

A junction capacity analysis was therefore undertaken on the above mentioned junctions. Capacity analysis was undertaken for the future year 2015 without the proposed development in place and with the proposed development in place plus demolition of the existing power plant. The RFC values obtained for the junctions during the AM and PM peak periods are outlined in the Table 10.6 and Table 10.7 below.

Table 1.6: Ratio of Flow to Capacity at Junction (2015 Do Nothing)

		Junction 01	Junction 02	Junction 03
			RFC Max	
2015 Do Nothing	AM	6.50%	10.20%	28.90%

		Junction 01	Junction 02	Junction 03
	PM	4.80%	10.90%	72.10%

Table 1.7: Ratio of Flow to Capacity at Junctions (2015 Do Something)

		Junction 01	Junction 02	Junction 03
			RFC Max	
2015 Do Something	AM	10.20%	30.50%	31.80%
	PM	8.10%	47.70%	88.90%

As can be seen from the above tables the junctions operate well within capacity in 2015 in the Do Nothing scenario (without development in place).

When the demolition and operational phase traffic was added to the network it was noted that there were increases in the Ratio of Flow to Capacity (RFC) at all three junctions. Junctions one and two still operate well within their theoretical capacity of 85%. In the PM peak hour however, junction no.03 does slightly exceed its theoretical capacity and reaches an RFC of 88.9%.

The traffic added to this junction as a result of the development during the PM peak is relatively small in volume and as can be seen from the above tables contributes only to a 16.8% (72.10% to 88.9%) increase in RFC relative to the Do Nothing scenario. The majority of the increase in RFC, 47.2 % (24.9% to 72.1%), at this junction from 2009 to 2015 occurs as a result of natural traffic growth.

This natural traffic growth has been estimated by using the National Roads Authority (NRA) future traffic forecasts. Whilst the NRA future traffic forecasts are currently the only available guidance document for estimating future traffic growth on Irish roads it should be noted that the future traffic forecasts were compiled prior to the recent economic downturn in Ireland. The future traffic forecasts predict year on year growth on all Irish roads, however this is not the case at present.

In order to evaluate the current traffic growth profile in the vicinity of the development is we interrogated the NRA's website and assessed the traffic growth trend at the closest permanent traffic counter to the development site. The closest traffic counter is located to the east of Ballynobola on the N25. When the available output from this counter was assessed we noted:

- Traffic growth from 2007 to 2008 was -2.4%
- Traffic growth from 2008 to July 2009 was -6.6%

On this basis we predict that from 2009 to 2015 the traffic growth estimated by the NRA future traffic forecasts will not be of the magnitude which is currently estimated and therefore the RFC at junction no.03 should not exceed 85%.

1.3.9 Pavement Integrity Impact

For the original TTA and arising from the consultation with Wexford County Council it was decided that given the level of traffic likely to be generated by the development during its construction stage it would be prudent to assess the structural strength of the existing local road accessing the site.

In order to assess the existing structural condition and the residual life of the section of local road accessing the site the services of Pavements Management Services Ltd. (PMS Ltd.) were engaged to carry out falling weight deflectometer testing on behalf of Endesa Ireland Ltd.

The Falling Weight Deflectometer works on the same principle as all deflection devices; a load of known magnitude is imparted to the pavement, and the resulting deflections of the pavement are measured. For this project, interest centred on deflections under typical HGV wheel loads of 40 kN. Additionally a coring and dynamic cone pentrometer (DCP) testing programme was carried out by PMS Ltd. to determine the as-constructed thicknesses of the existing pavement layers.

In order to facilitate PMS Ltd. in the preparation of their report Mott MacDonald Ireland furnished PMS with the existing Annual Average Daily Traffic (ADDT) and HGV content on the local road. We also outlined estimated levels of traffic likely to be generated by the proposed development during both its construction and operational phases.

In order to take account of the proposed demolition of the existing power plant Mott MacDonald Ireland subsequently furnished PMS estimated levels of traffic likely to be generated by the demolition of the existing plant. The figures developed by Mott MacDonald Ireland and outlined to PMS Ltd are summarised in the following tables.

Table 1.8: Existing AADT and HGV Content

Existing AADT and Percentage HGV Content on the Local Road	
AADT	%age HGV
831	3.4%

Table 1.9: Construction & Operational Traffic Requirements

Construction Traffic Requirements	
400 Car Trips / Day	20 HGV Deliveries / Day
Operational Traffic Requirements	
23 Car Trips / Day	6 HGV Deliveries / Day
Demolition Traffic Requirements	
80 Car Trips / Day	21 HGV Deliveries / Day

Testing on the local road was carried out by PMS Ltd on the 14th of October of 2009 and a report on the test results and future maintenance requirements was forwarded to Mott MacDonald Ireland.

Using the above estimates of HGV movements and the existing Annual Average Daily Traffic (AADT) and percentage HGV content on the local road PMS have estimated the required maintenance / upgrading on the local road to maintain its structural integrity over a twenty year design period. Their report states that:

"DEHLG guidelines specify that where Surface Curvature Indexes (SCI's) are greater than 250 microns, a hot-mix only overlay is not suitable. Taking into account the design traffic requirement and the fact that the SCI's along the length of each carriageway are generally well in excess of 250 microns, a Clause 804/wet-mix macadam overlay was deemed to be more appropriate than a hot-mix overlay.

A minimum thickness of 150 mm of wet-mix macadam is specified in the DEHLG guidelines for strengthening of Non-National roads. The wet mix/Clause 804 overlay layer should be double surface dressed to seal the unbound material. The thicknesses shown may be superseded by construction requirements.

It should be noted that.....if significantly higher HGV traffic volumes than those shown are anticipated, an overlay consisting hot-mix surface layer over a wet-mix/Clause 804 layer would be more appropriate."

Table 10.10 below shows the Clause 804/Wet-mix macadam overlay requirements to cater for construction, operational and demolition phase traffic on the local road and to provide a twenty year residual pavement life as estimated by PMS Ltd, by segment for the section of local road based on Non-National Road models (50th% failure curve).

Table 1.10: Overlay Requirements

Lane	Chainage	Overlay Requirements (Wet-mix / Clause 804)
WBCW	0 to 700	225mm
WBCW	700 to 950	150mm
WBCW	950 to 1450	175mm
WBCW	1450 to 1850	150mm
WBCW	1850 to 2400	225mm
WBCW	2400 to 3150	150mm
WBCW	3150 to 4250	175mm
WBCW	4250 to 5000	150mm
EBCW	0 to 625	225mm
EBCW	625 to 1125	150mm
EBCW	1125 to 2325	200mm
EBCW	2325 to 3125	150mm
EBCW	3125 to 4175	200mm
EBCW	4175 to 5000	150mm

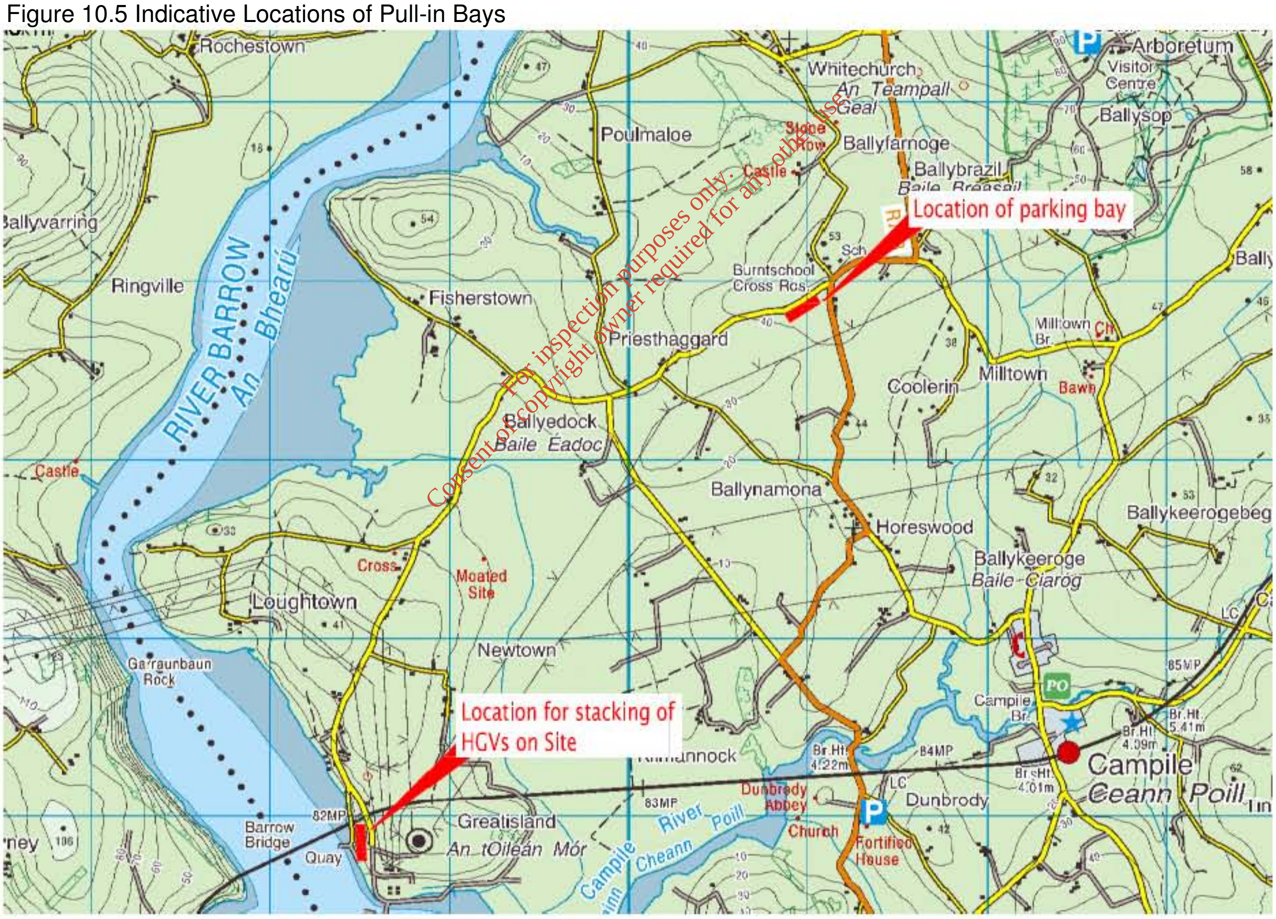
- **Note:** The overlay requirements to cater for the demolition traffic are relatively minor and amount to an additional 25mm of wet mix / clause 804 overlay at certain locations along the section of local road.

1.3.10 Mitigation Measures for HGV Passage

A traffic management plan was identified in the main TTA to allow for the safe passage of HGVs along the section of local road accessing the site. It is suggested that for the demolition phase of the existing power plant a similar traffic management plan would be brought into operation. The traffic management plan suggests that two parking bays for HGVs should be constructed at appropriate locations at either end of the local road. The pull-in bays would be of a sufficient size to allow for the "stacking" of a minimum of four HGVs at a time. Each pull-in bay would be manned by a traffic controller. The traffic controllers on each bay would be in radio contact with each other, when a stream of HGVs had safely passed along the length of the local road the traffic controller at the end of the road which the stream had just passed would release HGVs from the bay under his control. Whilst this stream passed along the road the controller at the opposing end would "stack" HGV traffic into the bay under his control and vice versa.

Two suitable locations have been identified for the construction of these parking bays. One location is within the grounds of the development site, whilst the other location is located on agricultural lands adjacent to the local road immediately after its junction with the R733. Figure 10.5 below outlines indicative locations of where the proposed pull in bay could be located.

Figure 10.5 Indicative Locations of Pull-in Bays



1.4 Summary Conclusion

This assessment identifies the existing, 2009, base traffic conditions at three critical junctions in the vicinity of the site of the existing power plant at Great Island Co. Wexford. The traffic conditions at these critical junctions have been assessed for the future year 2015 for two scenarios, the Do Nothing Scenario and the Do Something Scenario. The Do Something Scenario assigns the operational and demolition phase traffic associated with the new and existing power plants to the traffic carrying network. The analysis indicates that the junctions will operate within capacity in 2015 in the Do Nothing Scenario. In the 2015 Do Something scenario one of the junctions operates slightly above theoretical capacity in the PM peak hour. The majority of the increase in capacity at this junction can be attributed to natural traffic growth estimated from the NRA future traffic forecasts. The NRA future traffic forecasts estimate year on year traffic growth on Irish roads. Given that we are currently experiencing a decline in traffic on Irish roads it is suggested that the NRA future traffic forecasts will not be of the magnitude which is currently estimated and therefore the RFC at junction no.03 should not exceed 85%.

Pavement integrity testing has been carried out along the entirety of the 5km section of local road accessing the development site. The current AADT and percentage HGV content along with the estimated construction and operational and demolition phase traffic volumes have been used to determine the quantum of remedial works required along the section of local road to achieve a twenty year residual life. A wet mix / clause 804 overlay varying between 150 to 225 mm has been suggested along the entire length of the local road.

Given that the width and alignment of the 5 kilometre section of local road accessing the development site is not sufficient to allow for two HGVs travelling in opposing directions to safely pass each other a traffic management plan has been developed. The traffic management plan proposes the installation of a parking bay at either end of the local road. Sufficient space has been allocated on the site of the development for the operation of one of the said parking bays. A location for the construction of a temporary parking bay immediately after the junction of the local road and the R733 has been identified on agricultural lands located adjacent to the north-east of the affected section of local road. The acquisition of this portion of land has been negotiated with the affected land owner and the construction of a parking bay at this location for the duration of the demolition programme is anticipated.

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3.3. Quantitative Risk Assessment – Land Use Planning Report

Quantitative Risk Assessment – Land Use Planning Report CCGT Power Plant Great Island

Client: Endesa Ireland Limited

November 2009

Delivering sustainable solutions in a more competitive world

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Endesa Ireland Limited

Quantitative Risk Assessment – Land Use Planning Report CCGT Power Plant Great Island

November 2009

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CONTENTS

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Endesa Ireland Limited (Endesa) plans to construct and operate a gas fired power station on the site of the existing Great Island heavy fuel oil (HFO) power station on the confluence of the River Suir and River Barrow in County Wexford, Ireland.

The Irish health and safety regulator, the Health and Safety Authority (HSA), requests that operators applying for planning permission for new major hazard facilities submit a quantitative risk assessment (QRA) report with their planning application. The QRA report assists the HSA in coming to an informed view on the safety implications of the proposed facility with respect to land use planning in the vicinity of the establishment. In addition to safety risks, the HSA must also make a judgement on the risk of major accidents to the environment (MATTEs).

In order to provide a comprehensive set of risk results, the above ground installation (AGI) associated with the connection between the power plant and the incoming pipeline (provided by Bord Gáis) have also been addressed in the study.

The general QRA methodology used for this study is consistent with the approach used by the HSA [1]. In addition, guidance documents produced by the UK Health and Safety Executive have also been used as the basis for the methodology [2].

In order to make the necessary comparisons with risk criteria (see *Section 5*), the scope of the QRA was to generate the following risk outputs:

- Individual risk of fatality contours;
- The individual risk of fatality at the nearest residential property; and,
- The societal risk of fatality for the workforce and people off-site in the vicinity of the installation.

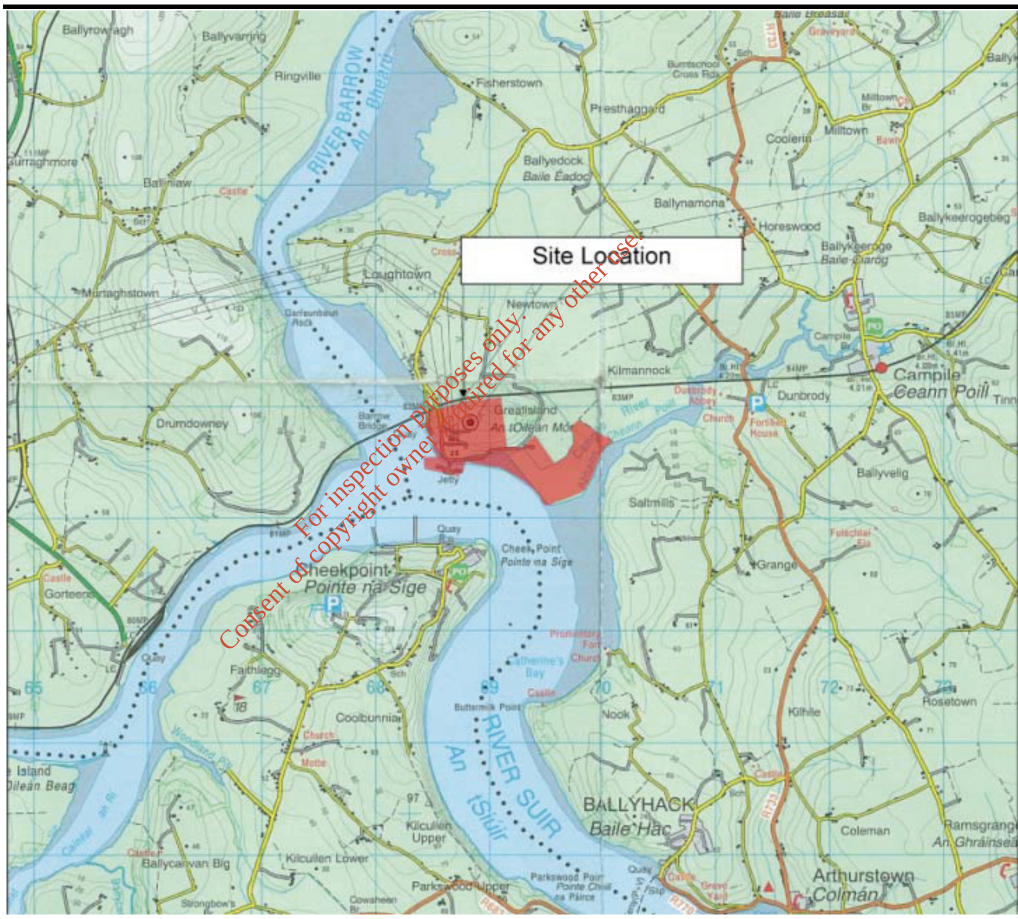
1.2 LOCATION AND SURROUNDINGS

The Great Island site is an existing power generating plant located on a 68 hectare site at the confluence of the River Suir and River Barrow, on the shores of Waterford Harbour. The nearest area of settlement is at Cheekpoint on the opposite side of the estuary, in County Waterford, which is approximately 1 km from the site of the proposed power plant. The nearest house is 100m from the main gate. There is also a hamlet in Newtown, which is 200m from the northern site boundary, which comprises 8 to 10 houses. The village of Campile is located approximately seven kilometres away (*see Figure 1.1*).

The surrounding area is predominantly agricultural. A railway track and some agricultural lands are located to the north of the site. To the south is the River Suir estuary. More agricultural lands are located to the east. The River Barrow flows along the western boundary of the site.

The River Barrow and the River Suir, as well as the neighbouring estuary, are designated as Special Areas of Conservation (SAC) under the European Directive on the Conservation of Natural Habitats and Wild Flora and Fauna (92/43/EEC), otherwise known as the Habitats Directive.

Figure 1.1 Site Location



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The power generation buildings and infrastructure ("Station Grounds") comprise a series of tiered benches cut into the bedrock, which step down towards the River Suir estuary (*see Figure 1.1*). A former waste disposal area with two rectangular shaped cells is located to the east of the Station Grounds. It is not intended to construct in the aforementioned waste disposal area, which will remain intact throughout the construction and operational phases. There is a heavily vegetated undeveloped area known as the Wetlands beyond the former waste disposal area.

1.3 *OUTLINE OF THE PROPOSED DEVELOPMENT*

1.3.1 *Overview*

The existing plant comprises three generation units with a total electricity generation capacity of 240 MW, (two 60 MW units and one 120 MW unit). Heavy Fuel Oil (HFO) is the main fuel and distillate oil is used for start-up. The HFO is shipped to the site and stored in an oil tank farm. Distillate oil, also stored on site, is tankered to site by road.

Great Island Power Plant currently operates on Heavy Fuel Oil (HFO) with a maximum electrical export capacity of 216 MW. All of these units are at the end of their life span.

Endesa proposes to construct a new Combined Cycle Gas Turbine (CCGT) power plant at Great Island. The new CCGT power plant will use the best available technology to generate approximately 430 MW of electricity at an efficiency of circa 58%. The new CCGT plant will operate on natural gas with a back-up supply of distillate oil. It is anticipated that the introduction of the new technology will bring substantial improvement in relation to effects on the environment.

It is intended that the new CCGT power plant will be commissioned in 2012. The new CCGT will be constructed while the existing units are still in service whilst maintaining the highest safety standards. The existing oil fired power plant will continue to operate until the new plant is operational. Once the CCGT plant becomes operational the existing units will be decommissioned.

1.3.2 *Combined Cycle Power Plant*

Endesa intends to develop a circa 430 MW Combined Cycle Gas Turbine (CCGT) power plant at Great Island, County Wexford.

The proposed process of operation is summarised in the following paragraphs and illustrated in *Figure 1.2*.

A 'Combined Cycle' plant combines the technologies of gas turbines and steam turbines in order to produce electricity more efficiently than can be produced using either of these technologies separately.

The gas turbine consists of a compressor section, a combustion chamber and a turbine section. Air is drawn in through an intake filter, compressed and fed into the combustion chamber where fuel is injected and ignited. The resulting hot combustion gases pass through the turbine which rotates the shaft that drives the electrical generator to produce electrical energy.

The high temperature exhaust gases exiting the gas turbine will pass through a Heat Recovery Steam Generator (HRSG) which is used to produce steam from high purity water. Any hot gases remaining from the process will be emitted to atmosphere via an exhaust gas stack.

The steam generated in the HRSG is passed through a steam turbine which converts the thermal energy in the hot steam to mechanical energy which is then used to drive an electrical generator which produces electrical energy. The exhaust steam from the steam turbine will be condensed back to water by cooling it with seawater in a condenser. This condensed water will then be fed back into the HRSG so that the process can start again.

The CCGT power plant proposed for Great Island will be arranged in a "single-shaft" arrangement which means that the gas turbine and steam turbine will be installed in a straight line with a common electrical generator located between each turbine.

The new power plant will use the most up to date technology and it is intended that it will operate as a 'base-load' plant with an efficiency of approximately 58%.

The plant will be designed to operate primarily on natural gas supplied from the Bord Gáis Networks' grid. A new natural gas pipeline will be required to bring natural gas to the power plant and this will be constructed and operated by Bord Gáis Networks/Gaslink.

The power plant will also include back up storage of distillate oil which will allow the plant to operate for five days in case of an unlikely interruption to the gas supply. This is in accordance with the Commission for Energy Regulation (CER) requirements presented in CER Decision Paper *CER/09/001, Secondary Fuel Obligations on Licensed Generation Capacity in the Republic of Ireland, January 2009.*

The electrical power generated will be exported from the power plant via the existing 220 kV substation located at the Great Island site.

Cooling water (CW) will be required for the new power plant to absorb heat from the steam turbine condenser and other heat exchangers associated with the proposed CCGT power plant. It is intended to continue to abstract seawater from the River Suir for this purpose, in accordance with current operations, utilising the existing water intake, supply and outfall systems. A seawater CW system has been continuously in operation at the site since the late 1960's. It is anticipated that the existing CW system will continue to be used so that no new construction in the River Suir environment will be required. It is also anticipated that, when fully commissioned, the volume of aqueous discharges from the proposed CCGT plant will be considerably less than the existing licensed discharges. Consequently, the discharge flow rate, and subsequent area of heat dissipation in the receiving waters, are predicted to be significantly less. In addition, it is anticipated that the volume of cooling water required to operate, at full capacity, for the proposed CCGT will be significantly less than that required for the existing units.

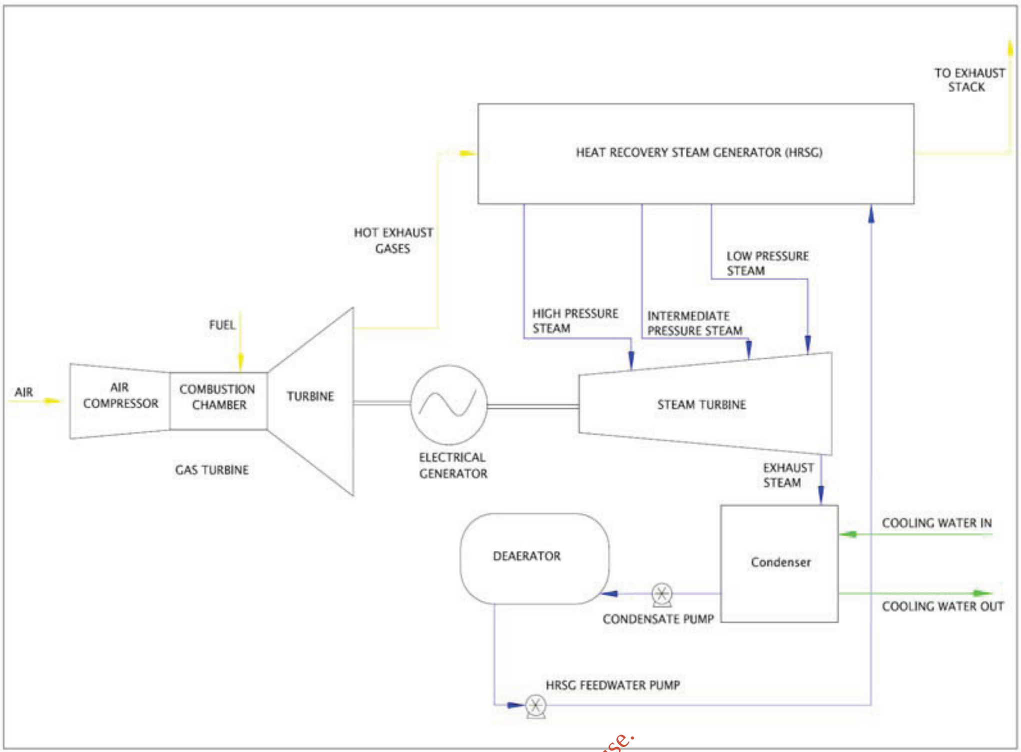
As well as the main power train items (Gas Turbine, Steam Turbine, HRSG and Generator) there will be a number of auxiliary systems required to operate the plant including:

- Water treatment plant
- Water storage facilities
- Distillate oil system and storage facilities
- Fuel gas system / Above Ground Installation (AGI)
- Fire protection system
- Compressed air system
- HRSG chemical dosing system
- Exhaust Stack
- Auxiliary boiler (if required)
- Transformers
- Electrical switchgear
- Electrical cabling
- Drainage system
- Foul water treatment system
- Building structures to house the main power train items
- Workshop / stores building
- Internal roads and parking

It is intended to utilise as much of the existing power plant infrastructure as possible including:

- Fuel storage tanks
- Cooling Water pumphouse, inlet and outfall
- Administration / Control Building
- Workshop and Stores
- Fire pumphouse building
- Surface water drains
- Roads and fencing
- 220 KV station
- Raw Water/Fire Water Storage

Figure 1.2 Single Shaft CCGT Cycle Flow Schematic



1.3.3 *Incoming Gas Pipeline*

The incoming gas pipeline to the Great Island site will be owned and operated by Bord Gáis and will be connected to the site boundary AGI, which will also be Bord Gáis' responsibility. The gas supplied to the AGI will normally be at a pressure of 40 barg, but can be as high as 70 barg. The pipeline diameter is yet to be confirmed, but is expected to be 150mm. The gas pressure will on occasion fall below this value, but will not be less than a guaranteed value of 19 barg. The operating pressure of the gas at the outlet from the AGI will be selected to suit the requirements of the gas turbine, but will not be more than 50 barg.

At times when the incoming gas pressure to the AGI is below the pressure required by the gas turbine, the gas will be compressed to the required pressure by compressors located near the gas turbine, before being routed to the combustion chamber of the gas turbine system.

1.3.4 *Above Ground Installation (AGI) and Gas Lines*

The AGI will consist of the final section of the supply pipework, tariff metering, pressure control and a suitable valved connection for the pipeline which will convey gas to the new power plant. Bord Gáis will supply, install, erect and commission the AGI that will be positioned to the north-east of the power plant.

The proposed pipeline connecting the AGI to the gas compressor will be up to 10" (250 mm) in diameter and will be routed east-west from the AGI to the gas compressor. The gas will then be compressed, if required, to 50 barg and routed to the combustion chamber of the gas turbine system.

1.3.5 *Distillate Storage and Containment*

Distillate oil will be the standby fuel for the gas turbine in addition to fuel for the emergency generator set. It is proposed that the middle tank to the north of the storage area will be completely refurbished for the storage of the distillate oil. The inventory of distillate present on site will be 11,000m^3, which is the minimum legal requirement.

1.4 SEVESO IMPLICATIONS

The Great Island facility will be a lower tier Seveso site because of the inventory of distillate that will be present. Distillate is a generic name used to describe a complex mixture of hydrocarbons, mainly paraffinic, naphthenic and aromatic in the range C10-C28. Other commonly used names are diesel and gas oil and are listed under petroleum products with respect to the Seveso Directive. The threshold quantity of petroleum products for a lower tier establishment is 2,500 tonnes and 25,000 for top tier.

The requirements for lower tier establishments are summarised as follows (as defined in the HSA's (2007) *A Short Guide to the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2006. S.I. No. 74 of 2006*):

- notification to the HSA and the local planning authority;
- discharging certain general duties;
- preparation and implementation of a major accident prevention policy;
- action in the event of a major accident; and
- maintaining a register of notifiable incidents.

Figure 1.3 Location of Existing Great Island Power Plant

Figure 1.4 Existing Facility Layout

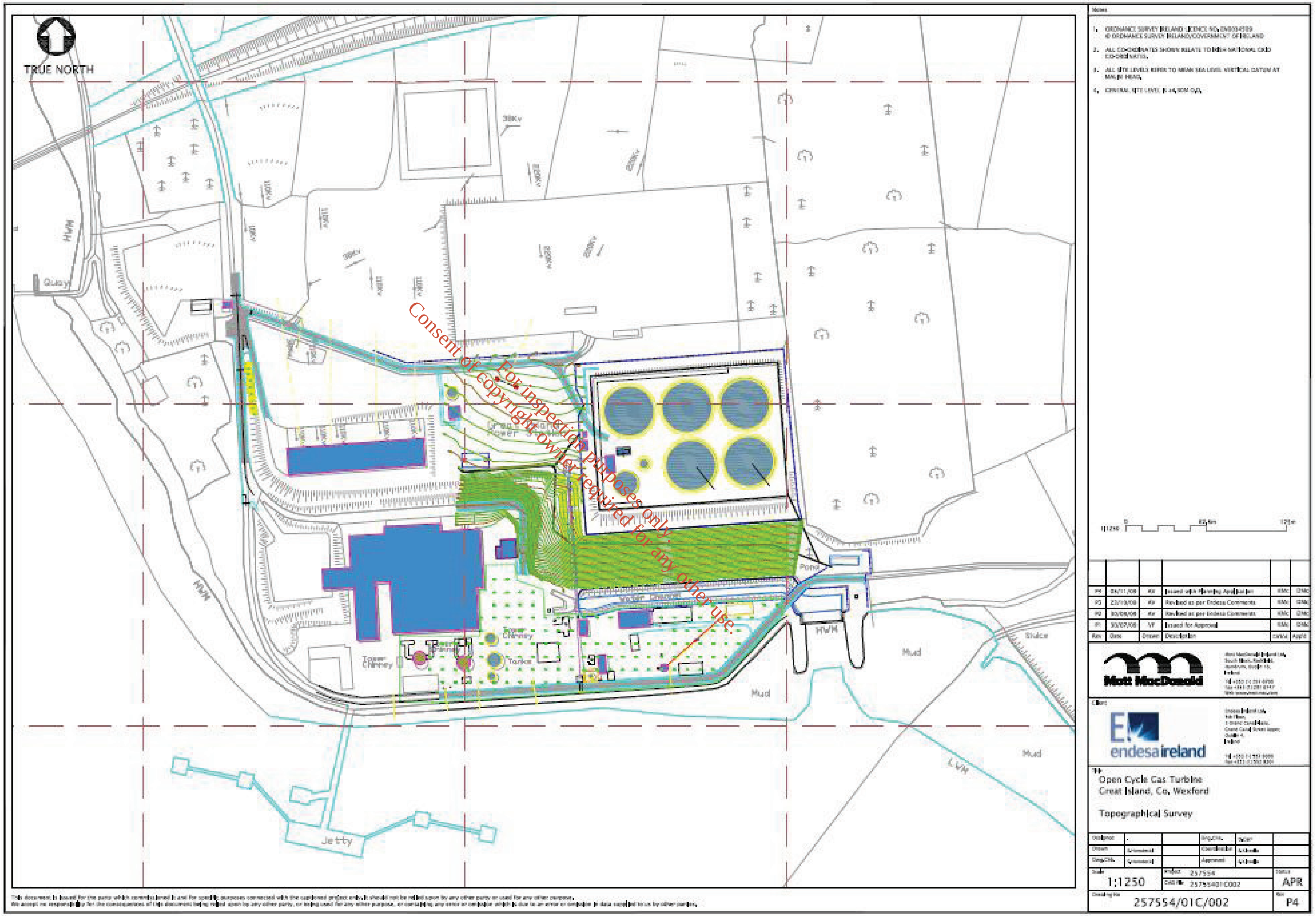
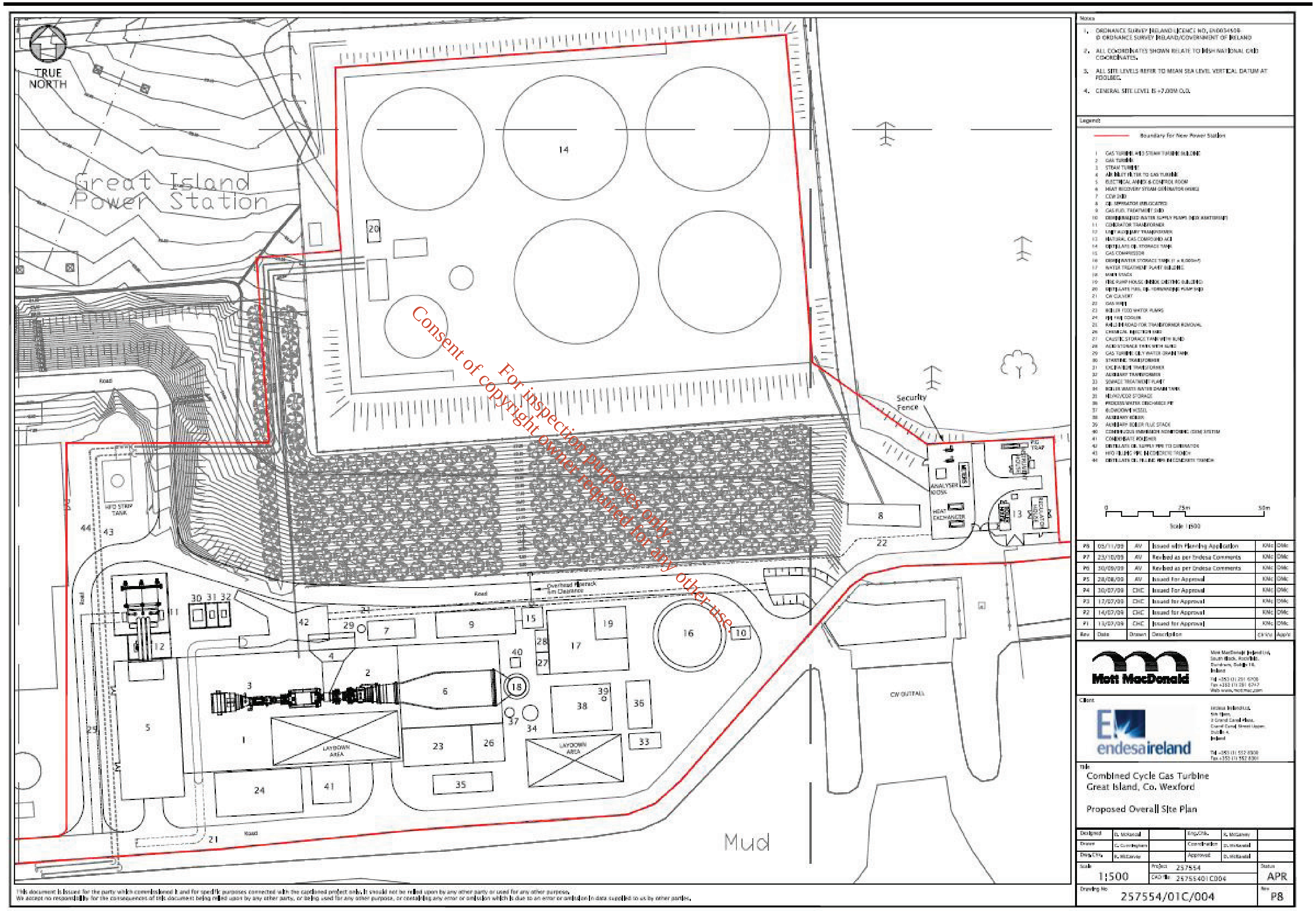


Figure 1.5 Proposed Facility Layout



1.5 *REPORT LAYOUT*

The remaining sections of this report are set out as follows:

- *Section 2* describes how the potential major accident scenarios included in the QRA and MATTE assessment were identified;
- *Section 3* presents the methods and data used in the calculation of the frequency of potential major accidents and MATTEs;
- *Section 4* details the analysis of the consequences of potential major accidents and MATTEs;
- *Section 5* describes risk criteria as used by the HSA;
- The calculation of the fatality risks and results obtained are presented in *Section 6* and the options for reducing environmental damage are presented and discussed in *Section 7*; and
- *Section 8* presents the study conclusions and recommendations.

2 IDENTIFICATION OF MAJOR ACCIDENT SCENARIOS

For the purposes of the QRA, the general approach taken for identification of the hazards has been to consider the loss of containment of hazardous materials for various failure sizes from isolatable sections of the plant facilities. The two main hazardous materials present at the Great Island combined cycle power plant will be natural gas and the distillate fuel oil. The hazardous properties of these materials and the potential outcomes arising from their accidental release are included in *Section 2.1.*

The plant facilities were broken down into a set of 'isolatable' inventories (i.e. sections of plant that could be isolated in the event of an accidental release) that would typically be achieved by the closure of emergency shutdown valves (ESDVs).

As stated, the accident scenarios included in the QRA were then obtained by assuming a range of failure sizes from each of the isolatable inventories, varying from a small hole to complete rupture. The inventories defined are listed in *Table 2.3* and the accident scenarios identified for the analysis are summarised in *Table 2.4*.

Additionally, major accidents involving the release of flammable and combustible liquids and natural gas that have occurred at Buncefield and Ghislenghien, Belgium are outlined. The lessons learned and recommendations arising from these accident events and their implications for the design and operation of the facilities at the Great Island combined cycle power plant are discussed. This is covered in *Section 2.2*.

2.1 PROPERTIES AND HAZARDS OF DISTILLATE AND NATURAL GAS

The principal hazardous materials with the potential to cause major accidents or MATTEs that will be present at the site are distillate and natural gas. Other hazardous materials that will be present but are not considered to give rise to potential major accidents are included in *Table 2.2*.

2.1.1 Distillate

Distillate is a generic name used to describe a complex mixture of hydrocarbons, mainly paraffinic, naphthenic and aromatic in the range C10-C28. Other commonly used names are diesel and gas oil. The distillate which will be used as a backup fuel at Great Island is classified as a Gas Oil Petroleum Product in the Seveso II Directive[3].

The generation of a distillate spray, vapour or mist can be a potential fire or explosion hazard and the thermal decomposition of the distillate may lead to the formation of a multiplicity of compounds some of which may be hazardous. With incomplete combustion smoke and hazardous fumes and gases, including carbon monoxide may be formed.

The distillate is also classified as dangerous for the environment.

2.1.2 *Natural Gas*

Natural gas used as the primary fuel at the power station is a mixture of low molecular weight (typically $\leq C_4$) hydrocarbons (predominantly methane). The physical properties for methane, ethane and propane (the principal constituents of natural gas) are provided in *Table 2.1*[4].

Table 2.1 Properties of Hazardous Materials

Substance	Methane	Ethane	Propane
Chemical Name	Methane	Ethane	Propane
Chemical Formula	CH_4	C_2H_6	C_3H_8
CAS Number	74-82-8	74-84-0	74-98-6
Appearance at 20°C	Colourless Gas	Colourless Gas	Colourless Gas
Atmospheric Boiling Point (°C)	-161.5	-88.6	-42.1
Melting Point (°C)	-182.5	-183.3	-187.7
Liquid Specific Gravity	0.422	0.546	0.59
Vapour Density (air = 1)	0.55	1.1	1.5
Lower flammable limit (vol %)	5	3	2.1
Upper flammable limit (vol %)	15	12	9.5
Flash Point (°C)	-188	-135	-104
Auto Ignition Temperature (°C)	595	504	450
Long term exposure limit	N/A	N/A	N/A
LD_{50}	N/A	N/A	N/A
Eco-toxicity	Unlikely to cause adverse effects	Unlikely to cause adverse effects	Unlikely to cause adverse effects
Degradability	Disperses rapidly	Disperses rapidly	Disperses rapidly

The principal hazards of the natural gas arise from its flammability; ignited releases can result in a jet flame, flash fire and explosions.

2.1.3 *Toxicity and Asphyxiation*

Methane, or natural gas, is not toxic or a carcinogen. There is no occupational exposure limit value (OELV) for methane in Ireland or immediately dangerous to life or health (IDLH) value in the United States. Methane is a simple asphyxiant gas. However, the risk of harm to personnel due to asphyxiation from releases of the natural gas (which comprises mostly methane) is deemed to be negligible and has been discounted from the analysis. This is because losses of containment of the gas would be at high pressures that would mix rapidly with air as it is released into the atmosphere and being lighter than air would disperse in an upward direction. Furthermore, the open nature of the site minimises the risks of accumulation in confined areas.

A fire involving distillate can produce a multiplicity of compounds some of which may be hazardous from a distillate fire. Furthermore, with incomplete combustion smoke, hazardous fumes and gases, including carbon monoxide, may be formed. However, the smoke and combustion products generated from the large fires at Buncefield did not cause any serious harm to people and on this evidence the risks from exposure to any toxic products generated in a distillate fire were considered to be negligible.

2.1.4 *Fire Hazards*

Pool Fire

When a flammable liquid is released from a storage tank or pipeline, a liquid pool may form. As the pool forms, some of the liquid will evaporate and, if flammable vapour finds an ignition source, the flame can travel back to the spill, resulting in a pool fire. However, since the distillate is not classified as a flammable liquid, a pool fire is only likely if there is a strong ignition source, such as from a jet flame or from hot work activities such as welding or cutting. A pool fire involves burning of vapour above the liquid pool as it evaporates from the pool and mixes with air.

Jet Fire

If gases are released from pipework under pressure, the material discharging through the hole will form a gas jet that entrains and mixes with the ambient air. If the material encounters an ignition source while it is in the flammable range, a jet fire may occur. Larger jet fires could occur from ignited releases from the high pressure (approximately 70 barg) import gas lines. Such fires could cause severe damage, but associated consequences are highly dependent on the direction of release (i.e. not omni-directional).

Flash Fire

When a volatile, flammable material is released to the atmosphere, a vapour cloud forms and disperses (mixing with air as it does so). If the resultant vapour cloud is ignited before the cloud is diluted below its lower flammable limit (LFL), a flash fire may occur. The combustion normally occurs within only portions of the vapour cloud (where mixed with air in flammable concentrations), rather than the entire cloud. A flash fire may burn back to the release point, resulting in a pool or jet fire but is unlikely to generate damaging overpressures (explode) when unconfined.

A gas jet release that loses its momentum, such as if directed towards the ground and/or on impact with surrounding equipment and structures is considered to form a flammable vapour cloud, which, if ignited would result in a flash fire.

Explosions

As discussed in the previous section, a flash fire can occur if the natural gas is released into the atmosphere and ignited. If ignited in open (unconfined) areas, pure methane is not known to generate damaging overpressures (explode). However, if some confinement of the vapour cloud is present, methane can produce damaging overpressures. Areas congested with equipment and structures can facilitate damaging overpressures if a vapour cloud is ignited within such an area. For example, if a vapour cloud infiltrates a process plant area with various vessels, structures and piping, and the cloud ignites, the portion of the cloud within that congested area may generate damaging overpressures.

2.1.5 Other Hazardous Materials

Other materials, some of which are categorised as being hazardous that are currently present at the Great Island combined cycle power plant site are listed in *Table 2.2*. An indication of their annual usage is also given.

At present, 1.5 tonnes of 4% hydrazine solution is stored on site. Although Hydrazine is a listed substance under Seveso with a lower tier threshold of 0.5 tonnes and an upper tier threshold of 2 tonnes, its concentration is such that the Seveso requirements do not apply. However, the hydrazine will be replaced by carbohydrazide, which is non-hazardous and has also been included in *Table 2.2*. Therefore, hydrazine has not been included in the hazard analysis.

Table 2.2 Other Materials Present at Great Island Combined Cycle Power Plant Site

Material/ Substance	CAS Number	Hazard	Amount Stored	Annual Usage	Nature of Use	Risk Phrase, R	Safety Phrase, S
Acetylene	74-86-2	Explosive	10 bottles	9 bottles	Welding	5, 6, 12	9, 16, 33
Amino Acid F Reagent	None	Corrosive	15 litres	15 litres	Silica monitor reagent	36,	
Ammonia solution	7664-41-7	Corrosive	1.5 tonnes	3tonnes	Boiler treatment	34, 36/37/38	7, 26, 45
Argon	7440-37-1	None	9 bottles	15 bottles	Welding		
Carbohydrazide	497-18-7	None	1.5 tonnes	3 tonnes	Boiler treatment		
Carbon Dioxide	124-38-9	Asphyxiant	50 bottles	45 bottles	Generator purging		
Citric Acid / Surfactant Reagent	5949-29-1	Irritant	15 litres	15 litres	Silica monitor reagent	36	24/25
Fluorescein	05/07/2321	None	5 kg	5 kg	Condenser leak detection		
Hydrazine solution	302-01-2	Toxic	1.5 tonnes	3 tonnes	Boiler treatment	10, 23/24/25, 34, 43, 45	45, 53

Material/ Substance	CAS Number	Hazard	Amount Stored	Annual Usage	Nature of Use	Risk Phrase, R	Safety Phrase, S
Hydrogen	1333-74-0	Extremely flammable	105 bottles	510 bottles	Generator cooling	12	9-16-33
Ion Exchange Resins		None	None	As required	Water treatment		
Molybdate 3 Reagent		Irritant	15 litres	15 litres	Silica monitor reagent		
Nesslers Reagent (1.25% HgCl)4		Toxic	5 litres	5 litres	Laboratory analysis	35, 26-27-28-33	
Nicerol 3% protein foam concentrate			1000 litres	As required	Fire suppression		
Nitrogen	7727-37-9	None	60 bottles[3]	465 bottles[3]	Boiler waterside protection		
Oxygen	7782-44-7	Oxidising	10 bottles[3]	20 bottles[3]	Mechanical use	8	17
Propane	74-98-6	Flammable	1 tonne	2 tonnes	Ignition fuel	12	9, 16, 33
Propane	74-98-6	Flammable	6 Bottles	6 Bottles	Mechanical use	12	9, 16, 33
Sodium Hydroxide solution (30%)	1310-73-2	Corrosive	1 tonne	2 tonnes	WTP regeneration	35	26, 37/39, 45
Sodium Hydroxide solution (47%)	1310-73-2	Corrosive	30 tonnes	100 tonnes	WTP regeneration	35	26, 37/39, 45
Sodium Hypochlorite solution	7681-52-9	Corrosive	2 tonnes	5 tonnes	Cooling water treatment	31, 34	2, 28, 45, 50
Sulphuric Acid (Bulk)	7664-93-9	Corrosive	40 tonnes	100 tonnes	WTP regeneration	35	2, 26, 30
Sulphuric Acid	7664-93-9	Corrosive	1 tonne	2 tonnes	Neutralisation sump	35	2,26,30

The loss of containment of the other materials is also not considered to give rise to a major accident event. For instance, although some of the materials, such as the sodium hydroxide and sulphuric acid will be stored in large quantities of up to 30 and 40 tonnes, they are classified as being corrosive and their loss of containment would not constitute a major accident. The quantities of other materials, such as the hydrogen and acetylene, which are classified as extremely flammable and explosive respectively, will be stored in bottles well below their threshold levels of 10 and 5 tonnes respectively for lower tier Seveso sites.

2.2 HISTORICAL MAJOR ACCIDENTS

In the past there have been a number of fires and explosions that have occurred at major hazardous installations and pipelines conveying flammable materials. Two examples of accident events are outlined here – explosions and fires that resulted from the overflow of petroleum from a storage tank at the Buncefield Oil Terminal in the UK and a gas pipeline rupture that occurred in Belgium. The lessons learned from these accidents and the implications for the design and operation of Combined Cycle Power Plant at Great Island are then discussed.

2.2.1 *Buncefield Oil Storage Terminal, United Kingdom*

In the early hours of Sunday 11th December 2005, a number of explosions occurred at Buncefield Oil Storage Depot, Hemel Hempstead, Hertfordshire, UK. At least one of the initial explosions was of massive proportions and there was a large fire, which engulfed 23 large fuel storage tanks over a high proportion of the Buncefield site. The incident caused injuries to 43 people and although no one was seriously hurt, the fires and explosions resulted in significant damage to both commercial and residential properties near the Buncefield site. The fire burned for several days, destroying most of the site and emitting large clouds of black smoke into the atmosphere that dispersed over southern England and beyond. About 2000 people were evacuated from their homes and sections of the M1 motorway were closed. The fire burned for five days, destroying most of the site and emitting a large plume of smoke into the atmosphere.

Late on Saturday 10 December 2005 a delivery of unleaded petrol started to arrive at Tank 912 in bund A. The safety systems in place to shut off the supply of petrol to the tank to prevent overfilling failed to operate. Petrol cascaded down the side of the tank, collecting at first in bund A. As overfilling continued, the vapour cloud formed by the mixture of petrol and air, flowed over the bund wall, dispersed and flowed west off site towards the Maylands Industrial Estate. A white mist was observed in CCTV replays. The exact nature of the mist is not known with certainty: it may have been a volatile fraction of the original fuel such as butane, or ice particles formed from the chilled, humid air as a consequence of the evaporation of the escaping fuel.

2.2.2 *Gas Pipeline Rupture, Belgium*

In July 2004, an accident occurred involving a high pressure gas pipeline at Ghislenghien, Belgium. A high pressure natural gas pipeline ruptured and the leaking gas ignited, causing 25 fatalities and over 150 injuries, together with extensive damage to nearby factory buildings. Investigations revealed that the pipeline had been damaged by construction work taking place in the vicinity.

Accounts of the accident indicate that an odour of gas was first detected at around 07:30, but that the 'explosion' of the pipeline did not occur until 08:56. It seems possible that the incident started as a relatively small leak that later propagated into a rupture of the pipeline (the 'explosion' referred to by observers). The sudden rupture of the pipeline, coupled with ignition to give a fireball, would seem to account for the observations recorded.

A 'burn radius' of around 400 m (equating to a burn area of 502,655 m^2) is quoted in one source, although other sources give lower values of around 200 to 300m (equating to burn areas of 125,664 m^2 and 282,743 m^2 respectively).

2.2.3 *Implications for the Great Island Establishment*

The main explosion at Buncefield was unusual because it generated much higher overpressures than would usually have been expected from a vapour cloud explosion. The mechanism of the violent explosion is not fully understood and further scientific investigation has been commissioned to explain what occurs in large flammable vapour clouds [(7)].

However, the distillate stored in bulk at Great Island has a low volatility and so an explosion arising from a loss of containment similar to the one caused at Buncefield is considered to be very unlikely. In order to prevent overfilling, a robust shut-off system will be installed to stop the flow if distillate oil from the jetty in the event that the liquid level in the tank reaches a specified level. Furthermore, the operating envelope will be clearly defined in that the filling levels, temperatures, pressures and flow rates, for example, will remain within defined limits. An inspection regime will also be developed to ensure that the integrity of the storage tank is maintained.

The magnitude of the consequences of an accident similar those arising from the high pressure gas pipeline rupture at Ghislenghien, Belgium is deemed unlikely to occur at Great Island. This is because the natural gas onsite will be conveyed in smaller diameter pipelines and will be at lower pressures than the Belgium transmission pipeline.

2.3 *MAJOR ACCIDENT SCENARIOS*

Information about the distillate and natural gas contained within the isolatable sections of the plant at Great Island are reported in *Table 2.3*. The QRA performed by ERM included releases from all of the plant areas listed in *Table 2.3* and therefore potential accidental releases from all parts of the site have been considered in the analysis.

The pressure of the gas arriving at the site can be up to 70barg. However, it should be noted that the incoming gas pipeline has not been included in the analysis. This is because it will be owned and operated by Bord Gáis, who will have their own measures in place to minimise the risks from accidental releases.

Table 2.3 Process and Inventory Information

Node	Description	Information	Notes
A01	AGI	Pressure of gas delivered to AGI normally at 40 barg..	The Bord Gáis pipeline will normally deliver gas at a pressure of around 40barg. The pressure may however at times be higher or lower than this. The maximum pressure would be 70 barg and it is guaranteed that the pressure of the gas supplied would not be less than 19 barg. When necessary, the pressure will be reduced at the AGI to the pressure required by the gas turbine.
G01	Gas pipeline from AGI to gas compressor	250 mm underground flowline, at 40barg	
GCB01	Gas compressors	Pressure of compressed gas up to 50 barg depending on gas turbine generator selected.	If necessary, the gas is compressed before being fed the gas turbine generator.
G02	Gas pipeline from gas compressor to gas turbine	300 mm above ground flowline, up to 50 barg depending on turbine selected.	
TR01	Transformers	Oil-filled	Overheating of transformer oil.
J01	Jetty unloading arms		Backup distillate fuel will be delivered to the site via the jetty for the primary filling but will be tankered by road for annual refills of minor volumes infrequently (no more than once per year).
T01	Distillate storage tank	17,000 m³ capacity	No more than 11,000m³ of distillate fuel will be stored in the refurbished storage tank at any one time. The tank will be fitted with an automatic trip during filling when the capacity of the tank has reached 11,000m3.
DP01	Distillate flowlines	Ambient conditions	Flowlines convey distillate fuel from jetty to storage and from storage to power plant.

The accident scenarios considered in the QRA are summarised in *Table 2.4*. The impact of these potential major accidents on both personnel safety and the environment has been assessed.

Table 2.4 Major Accident Scenarios

Section	Scenario
AGI and gas line from AGI to gas compressor (40 barg)	
	4mm diameter hole leading to jet fire
	25mm diameter hole leading to jet fire
	1/3 diameter hole (approximately 80mm) leading to jet fire
	250mm rupture leading to jet fire
Gas compressors	
	Release of gas into compressor building leading to a VCE
Gas line from gas compressor to gas turbine (up to 50 barg)	

Section	Scenario
	4mm diameter hole leading to jet fire 25mm diameter hole leading to jet fire 1/3 diameter hole (approximately 80mm) leading to jet fire 300mm rupture leading to jet fire
Gas Turbine Building	
	Release of gas into gas turbine building leading to a jet flame
Distillate storage tank	
	Full bund fire Overtopped bund fire
Jetty unloading arms	
	Large release of distillate into the marine environment
Distillate flowlines	
	1/3 diameter hole (approximately 80mm) leading to jet fire 300mm rupture leading to jet fire
Transformers	
	Overheating of oil leading to fire and explosion

However, for the purpose of calculating the risk levels, the pressure of the gas in the line from the AGI to the compressor was also assumed to be at 50 barg, which is considered to be conservative.

2.3.1 *Causes of Major Accidents*

There can be a number of different causes leading to losses of containment from the AGI, distillate storage, gas pipelines and jetty facilities. The typical causes of potential major accidents for the various hazardous areas of the site are set out in *Table 2.5.*

In addition there are potential external causes that are common to all sections of the plant. These include for instance extreme weather conditions, lightning strikes, seismic activity, aircraft impact and sabotage/vandalism.

One other cause that is considered when assessing the risks from major accidents arises from the consequences of an accident at an adjacent facility (i.e. an escalated event). However, there are no other hazardous installations in the vicinity of the Great Island site and so the risks of escalation from accidents at an adjacent facility were discounted from the analysis. Similarly, the potential for escalation at other establishments caused by releases of gas and distillate at Great Island were also considered no further.

Table 2.5 Summary of Causes of Potential Major Accidents

Plant Section	Causes of Failure
AGI and gas lines from AGI to compressor and from compressor to gas turbine Distillate oil flowlines	• Impact from dropped object • Vehicle impact • Third party activities • Overpressure • Defective/wrong materials used during construction • Corrosion • Failure of gas line supports • Human error • Incorrectly fitted gasket/ defective gasket installed
Compressor failures	• Impact from dropped object • Overpressure • Low suction pressure • High/low temperature beyond design limits • Corrosion • Excessive vibration • Human error
Jetty unloading arms	• Poor connection • Loading arm failure due to excessive movement of moored vessel • Overpressure • Incorrectly fitted gasket/ defective gasket installed • Human error
Distillate storage tank	• Impact from dropped object • Overfilling • Overpressure • Defective/wrong materials used during construction • Corrosion
Transformer	• Overheated transformer oil

The failure rates considered in the frequency analysis in *Section 3* encompass all causes.

2.3.2 *Screening of major accident Events*

A number of potential major accident scenarios identified above were discounted from further detailed assessment. This was done on the basis that they were judged to not lead to a major accident event or the risks were deemed to be insignificant in terms of their impact on land use planning in the vicinity of the installation.

It is expected that the transfer of the distillate oil from the jetty to bulk storage would only take place once and it is expected that the operation would take less than 24 hours. Since the distillate oil flowlines would be purged and maintained in a dry condition once transfer has been completed, they are only likely to contain any distillate for around 0.3% of the time. Therefore, the scenario of a pipeline failure leading to a significant loss of distillate has not been included in the analysis because it is judged to have a very low likelihood.

One of the major accident scenarios considered in the analysis is overheating of the oil in the transformers giving rise to a fire and possible explosion. However, there are protection systems incorporated into the design of modern transformers that would activate their shutdown in the event of overheating. Therefore, fires and explosions arising from an overheated transformer are considered to be extremely unlikely and if there were such an accident event, the extent of the consequences would not extend to offsite areas where people would be present. The transformer bund is designed to minimise contamination across the site.

3 FREQUENCY ANALYSIS

3.1 RELEASE FREQUENCIES

The frequency of releases from equipment has been determined by high level parts counting and application of generic frequency data. The parts count was performed using the Process Flow Diagrams (PFDs).

The frequency data have been taken from the Health and Safety Executive Failure Rate and Event Data (FRED), contained within their Planning Case Assessment Guide (2). Where appropriate, event frequencies quoted in the recently published Policy & Approach of the Health & Safety Authority to COMAH Risk-based Land-use Planning(1) have also been considered in the frequency analysis. With respect to the frequency of releases of the distillate at the jetty, the frequency of failure of unloading arms have been derived from work performed by the Advisory Committee on Dangerous Substances (ACDS) in the UK(8).

3.1.1 Pipes

The failure frequencies for conventional single-walled pipework are a function of pipe diameter and length. The values used are shown in *Table 3.1* (the highlighted column indicates the set of frequencies applicable to the gas line from the AGI to the gas turbine).

Table 3.1 Failure Frequencies: Pipework

Release Hole Size (mm)	Failure Frequency (per metre year) for Pipe Diameter (mm)				
	<50	50-149	150-299	300-499	500-1000
3	1×10^{-5}	2×10^{-6}			
4			1×10^{-6}	8×10^{-7}	7×10^{-7}
25	5×10^{-6}	1×10^{-6}	7×10^{-7}	5×10^{-7}	4×10^{-7}
1/3 pipe diameter			4×10^{-7}	2×10^{-7}	1×10^{-7}
Full bore	1×10^{-6}	5×10^{-7}	2×10^{-7}	7×10^{-8}	4×10^{-8}

3.1.2 Tanks

The HSA Policy & Approach to COMAH Risk-based Land-use Planning does not give failure rates specifically for tank failures. For large scale flammable storage, a frequency of 1×10^{-3} per year is quoted for pool fires, which cover the entire surface of the bund. Also, a frequency of not less than 1×10^{-4} per year should be used for a major uncontained pool fire extending up to 100m from the bund wall. These frequency figures are higher than the failure rates in FRED for single walled storage tanks that are shown in *Table 3.2*. Furthermore, the probability of ignition would then need to be applied to the figures given in *Table 3.2* to obtain the frequency of a pool fire.

Table 3.2 *Failure Frequencies: Single Walled Storage Tanks*

Scenario	Frequency (per tank year)
Catastrophic failure	4×10^{-5}
1000 mm hole at base	1×10^{-4}
300 mm hole at base	8×10^{-5}

It should be noted that the frequency figures given in the HSA policy document relate to a storage area containing 10 tanks. The pool fire frequencies quoted by the HSA, which have been used in the analysis, are regarded as being conservative since there are only 5 storage tanks at the Great Island site.

3.1.3 Compressor

The release of gas from the compressor has been derived from figures quoted in the E&P Forum (9) and for release sizes greater than 1 kg/s the failure frequency would be 9.45×10^{-4} per annum. In order to account for gas releases within the compressor enclosure from associated valves, piping and fittings beyond the first flange the failure frequency has been doubled. However, since the compressor enclosure would be a zoned area, the probability of ignition would be low, and if a figure of 0.07 is assumed (10), the frequency of an ignited gas release within the compressor enclosure would be:

$0.07 \times 2 \times 9.45 \times 10^{-4} = 1.325 \times 10^{-4}$ per annum.

3.1.4 Unloading Arms

The failure rates used in the analysis have been based on work performed by the Advisory Committee on Dangerous Substances (ACDS) in the UK (8). This study considers the risks from the transport of dangerous substances, including the transfer of hazardous cargoes from ship to shore.

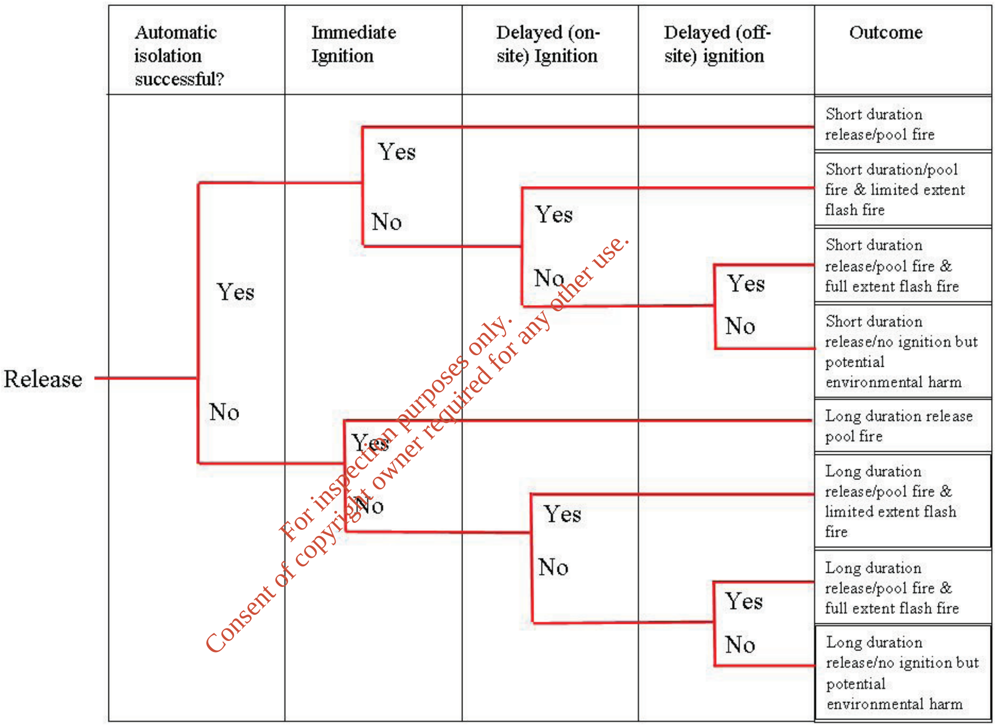
The ACDS Port Study gives the spill frequency per cargo transferred from historical data of ports in the UK and quotes frequencies of: 7.6×10^{-5} and 1.8×10^{-4} for LPG and low flash products respectively. For the purpose of predicting the frequency of a release, the distillate is considered to be represented by low flash products. Therefore, the spill frequency used in the analysis was 1.8×10^{-4} per transfer. Since there will only be a once-off transfer (assuming a one in ten year potential emergency use of all distillate and subsequent refill from the jetty), this equates to a failure frequency of 1.8×10^{-5} per year.

3.2 RELEASE OUTCOME FREQUENCY

A given release of flammable or combustible material may ultimately result in a variety of outcomes, depending on a number of factors, including whether automatic isolation is successful, whether ignition of the release occurs immediately or whether it is delayed. Ordinarily event outcome frequencies are calculated using a simplified event tree and *Figure 3.1* is typical for a release of flammable liquid. In the event of a distillate release, which is not classified as a flammable liquid, the generation of a flammable vapour, and hence a flash fire is considered to be very unlikely.

With respect to pool fires, the ignition probabilities are accounted for in the frequencies quoted in the HSA Policy & Approach to COMAH Risk-based Land-use Planning.

Figure 3.1 Simplified Event Tree



All gas releases are assumed to ignition; an immediate ignition probability of 0.5 and a delayed ignition probability of 1 have been used.

3.3 FATALITY PROBABILITY

Fatality probabilities have been specified for the purposes of calculating individual risk and the societal risk of fatality to the population surrounding the proposed installation. The risk to people, both outdoors and indoors from exposure to thermal radiation from fires and the blast effects from VCEs have been considered in the analysis.

The relationship between the level of consequence and the probability of fatality is generally characterized by a probit relationship that can be used to estimate the proportion of the population that may be affected by exposure to a particular harm.

The Probits referenced in the HSA Policy & Approach document were used in determining the fatality probabilities from the exposure to the effects of fires and blast overpressures generated by VCEs.

3.3.1 Thermal Radiation

Fatality Probability - People Outdoors

The Probit most commonly used to determine the risk from thermal radiation is the Eisenberg Probit (11), i.e.

Probit = -14.9 + 2.56 ln ($I^{1.33}$ t) with I in kW/m^2 and t in seconds

This relationship applies to people exposed outdoors. However, it can be reasonably applied for most exposed population.

For long duration fires, such as pool fires and jet fires, it is generally reasonable to assume exposure duration of 75 seconds (to take account of the time required to escape). Hence, based on the above, the fatality probabilities for people outdoors are listed in *Table 3.3*.

Table 3.3 Fatality Probabilities from Thermal Radiation, People Outdoors

Thermal Flux ($kW.m^{-2}$)	Fatality Probability
13.4	0.5
9.23	0.1
6.8	0.01

Fatality Probability - People Indoors

In order to estimate the fatality probability of people indoors, it is necessary to determine the effect that different levels of thermal radiation will have on the building. A British Code of Practice on fire precautions in chemical plant (BS 5908:1990) suggests that spontaneous (non-piloted) ignition of wood could occur at fluxes of 25 $kW.m^{-2}$, with piloted ignition of wood occurring at 12.5 $kW.m^{-2}$. Ignition of wood, textiles or other combustible materials in a building would result in secondary fires in the building, potentially causing direct harm to the occupants or forcing them to escape and be exposed to the incident thermal radiation as a result.

It is conservatively assumed that a building would catch fire quickly if it becomes exposed to a thermal flux of more than 25.6$kW.m^{-2}$ and is considered to result in a high probability of fatality. Between thermal flux levels of 12.7 and 25.6$kW.m^{-2}$ people are assumed to escape outdoors, and the probability of fatality is assumed to correspond to that for people outdoors. At thermal flux levels below 12.7kWm^{-2} building occupants are assumed to be protected.

Taking these factors into consideration, the fatality probabilities for people indoors were established, as shown in *Table 3.4*.

Table 3.4 ***Fatality Probabilities from Thermal Radiation, People Indoors***

Thermal Flux (kW.m^{-2})	Fatality Probability
>25.6	1.0
12.7 to 25.6	As for people outdoors
<12.7	0.0

3.3.2 Blast Overpressure

One of the most commonly used Probits to determine the risk from blast overpressure is the relationship put forward by Hurst, Nussey and Pape (12):

Probit = 1.47 + 1.35 ln (P) with P in psi (NB 1 psi = 68.947573 mbar)

This relationship only applies to people exposed outdoors, and implies the fatality probabilities set out in *Table 3.5*:

Table 3.5 ***Fatality Probabilities from Blast Overpressures, People Outdoors***

Blast Overpressure		Fatality Probability
psi	mbar	
2.44	168	0.01
5.29	365	0.10
13.66	942	0.50

People outdoors could either be more or less vulnerable to the effects of overpressures generated by a VCE, depending on the type of structure. The Chemicals Industry Association (CIA) has published relationships between fatality probabilities for people inside four different categories of building (13), namely,

- Category 1: hardened structure building
- Category 2: typical office block;
- Category 3: typical domestic building; and
- Category 4: portacabin type timber construction

The CIA Category 3 Curve (typical domestic building: two-storey, brick walls, timber floors) provides a reasonably conservative basis for assessing the risk of fatality to most residential populations. The table below gives the fatality probabilities associated with various levels of overpressure for people inside a category 3 type building.

Table 3.6 Fatality Probabilities from Blast Overpressures, People Indoors

Blast Overpressure		**Fatality Probability**
psi	mbar	
14.5	1000	1.0
8.70	600	0.70
4.35	300	0.50
1.45	100	0.05
0.725	50	0.01
0.145	10	0

4 CONSEQUENCE MODELLING

Losses of containment of the hazardous substances present at the Great Island site have the potential to harm both people and the environment. The QRA carried out for the site has used the DNV *Phast* (Process Hazard Analysis Software Tool) suite of consequence models (version 6.53). Also, the Jo and Ahn method was used for assessing the risks associated with natural gas pipelines. A number of methods for predicting bund overtopping volumes and their application are described. The results in terms of the distances to specified fatality probabilities from jet fires, thermal flux levels from pool fires and overpressure levels from gas explosions are presented. The percentage overtopping of the storage tank bund using different methodologies and arrangements are also given together with the environmental cost liabilities.

4.1 RELEASE DURATIONS

4.1.1 Releases from Pipes

Releases from pipes have been assumed to continue for:

- one minute plus the time taken to empty the contents of the inventory for isolated cases (the valves have been designed to close 60 seconds after being activated); and
- 10 minutes plus the time taken to empty the contents of the inventory for non-isolated cases.

These estimated release durations are based on judgements around the closing time of emergency valves. The detection systems to be provided at the facility would enable leaks to be detected rapidly.

4.1.2 Releases from Distillate Storage Tanks

The duration of a release from a storage tank has been assumed to be equal to the time taken to empty the tank contents.

4.2 HUMAN IMPACT MODELLING SOFTWARE

The impact of the outcomes from losses of containment of the hazardous materials on people has been assessed by using the DNV *Phast* (Process Hazard Analysis Software Tool) suite of consequence models (version 6.53). *Phast* is a comprehensive hazard analysis software tool for all stages of design and operation.

Phast examines the progress of a potential incident from the initial release to far-field dispersion including modelling of pool spreading and evaporation, and flammable and toxic effects.

Phast is designed to comply with the regulatory requirements of many countries. For example, specific modules have been included to ensure compliance with the Dutch Yellow Book, US EPA and UK HSE regulations.

Phast contains models tailored for hazard analysis of offshore and onshore industrial installations. These include:

- Discharge and dispersion models, including a Unified Dispersion Model (UDM);
- Flammable models, including resulting radiation effects, for jet fires, pool fires and BLEVEs; and
- Explosion models, to calculate overpressure and impulse effects. Available models include the Baker Strehlow, TNO Multi-Energy and TNT explosion models.

4.3 *DISPERSION OF FLAMMABLE VAPOURS*

Dispersion of natural gas can be dependent on several parameters, including: surface roughness, averaging time, material properties, wind speed and weather conditions. However, the gas delivered to the site will normally be at a pressure of 40 barg, with a minimum guaranteed supply pressure of 19 barg, but on occasions, could be as high as 70 barg. The pressure of the gas discharged from the compressor and fed to the gas turbine would normally be in the order of 50 barg. For the purpose of the analysis, the pressure in all of the gas pipeline from the AGI to the gas turbine, via the compressor was taken to be 50 barg. Any releases would not therefore be strongly influenced by the meteorological conditions.

A flammable vapour cloud is considered only to be formed in the event of a natural gas release losing its momentum from impact with the ground or surrounding structures and equipment, which then disperses as a low density gas.

Averaging Time

When using gas dispersion models the 'averaging time' is a description of the time over which a gas concentration is averaged. At a particular point in space the concentration of a gas cloud at equilibrium will vary for two reasons. Firstly, as the wind direction is not perfectly constant the plume will meander about a mean value. Secondly, there are 'in-cloud' fluctuations due to the turbulence inherent in the atmosphere. As dispersion models aim to show a 'time averaged' concentration at a particular point, this average will depend on the length of time over which the concentration was 'sampled'. The situation is made more complicated because the different types of dispersion model assume different definitions of 'averaging time'.

The use of a short averaging time will maximise the recorded concentration at a given point, whereas a longer averaging time will give a lower value. This is because the use of a short averaging time captures the concentration 'peaks' at a location.

In this study an averaging time of 18.75 s has been used (this is the *Phast* recommended value for flammable gases).

The concentrations of interest for gas dispersion outputs are 5% v/v and 2.5% v/v methane in air; corresponding to the lower flammable limit (LFL) and ½LFL respectively.

Meteorological conditions

Within a risk assessment, weather conditions are usually described as a combination of a letter with a number, such as 'F2'. The letter denotes the Pasquill stability class and the number gives the wind speed in metres per second.

The Pasquill stability classes describe the amount of turbulence present in the atmosphere and range from A to F. Stability class A corresponds to 'unstable' weather, with a high degree of atmospheric turbulence, as would be found on a bright sunny day. Stability class D describes 'neutral' conditions, corresponding to an overcast sky with moderate wind. A clear night with little wind would be considered to represent 'stable' conditions, denoted by stability class F.

Wind speeds range from light (1-2 m/s) through moderate (around 5 m/s) to strong (10 m/s or more). The probability of the wind blowing from a particular direction is commonly displayed graphically as a 'wind rose'.

Event consequences have been modelled in 2m/s and 5m/s wind speeds with the largest being applied in the risk model.

4.4 HUMAN IMPACT CRITERIA

The impact criteria for thermal radiation from fires were discussed in *Section 3.3*.

4.5 BUND OVERTOPPING

Tanks used for bulk storage of hazardous liquids are often completely surrounded by a wall or earth embankment with the aim of providing secondary containment for any spillage from the tank. If the walls of the bunded area have been designed, built and maintained in line with current standards then they will provide full containment of the more likely spills, but they will not contain the surge of liquid that would follow a catastrophic failure of the tank; even if the surge does not destroy the bund wall, the flood wave is likely to overtop it.

The bunds or earth banks that commonly surround tanks used for storing hazardous liquids are often designed with a capacity equal to 110% of the capacity of the largest storage tank within the bund, the excess height being claimed in part to prevent liquid surging over the top of the bund following sudden failure of a tank. In reality, whilst a 110% capacity bund will contain the release for less extreme modes of failure, it is unlikely to do so for more extreme modes. A series of experiments reported in HSE Contract Research Report 405/2002, in which the contents of a model storage tank were released gently into a 110% bund over a period of 30 seconds, showed that the bund was overtopped in almost every case. More severe modes of release would clearly give more overtopping.

Whilst catastrophic failure of bulk storage tanks is rare, the consequences for site personnel, any local community and the environment can be severe. Such failures have occurred in the USA, in Greece and in Lithuania, for example. Specific examples include the following:

- Floreffe, January 1988 – failure of a 4 million gallon tank of fuel oil at Ashland Oil released a wave of oil that surged through the bunded area damaging another tank and overtopping the bund.

- Iowa, March 1997 – failure of a 1 million gallon tank of ammonium phosphate.

- Michigan, July 1999 – a 1 million gallon tank of ammonium polyphosphate ruptured and damaged three other tanks.

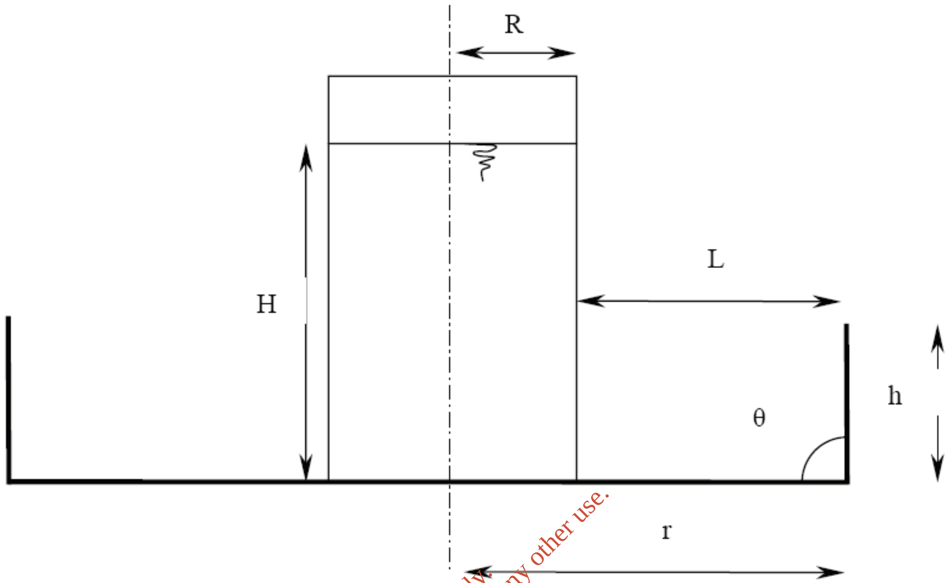
- Ohio, August 2000 – a 1 million gallon tank of liquid fertilizer ruptured and damaged nearby tanks. The resulting wave of liquid broke through a concrete bund and hit five tractor-trailer rigs, pushing them into the Ohio River.

- Ohio, August 2000 – later that month a 1.5 million gallon tank of ammonium phosphate ruptured at the same storage facility. It damaged three other tanks causing them to leak, with liquid overflowing the bund. A total of 450,000 gallons of contaminated water was reclaimed from the sewers and the public drinking water system was feared contaminated, resulting in the widespread use of bottled water as reported by the United States Environmental Protection Agency (2001).

There have been a number of research projects investigating bund overtopping; Greenspan and Johansson carried out experiments and published papers in the early 1980s and Liverpool John Moores University completed a Research Report for the UK Health and Safety Executive in 2005.

All of the experimental projects applied the nomenclature shown in *Figure 4.1*.

Figure 4.1 ***Tank and Bund Nomenclature for Circular Geometry***



4.5.1 *Greenspan and Johansson*

The major finding from Greenspan and Johansson indicated that the overtopping was dependant mainly on h/H, the ratio of the height of the barrier to the height of the fluid released from the tank with little dependence on L/R, the ratio of tank wall/barrier separation and the distance from the back of the tank to the sliding wall. This was found to be true for all combinations of barrier and tank heights in the range $0.33 \le L/R \le 4$. It was also determined that the height of the fluid plume exceeded the initial height of fluid in the tank with the flight of particles from the leading edge of the surge reaching three times the height of the tank fill level.

Greenspan and Johansson (1981) (14) stated that the manner in which the wave overtops the barrier depends upon the shape of the dyke or bund. The fluid may vault an inclined embankment or accumulate rapidly behind a vertical bund and then overtop.

The tests were axisymmetric in nature with an instantaneous release of fluid from the storage tank, whereby a stationary column of fluid was allowed to fall and spread under the action of gravity. The Greenspan and Johansson experiments, led to a conclusion that simple formulae to estimate the overtopping fraction could probably be based on dimensionless combinations of parameters:

$$Q = Q\,(h/H,\, r/H,\, R/H,\, \theta)$$

Two sets of researchers have proposed functions based on the small-scale test data of Greenspan and Johansson. Clark put forward the following relationship to predict the overtopping fraction, Q_C:

$$Q_c = e^{[-p.(h/H)]}$$

Where, p = 3.89, 2.43 or 2.28 when θ = 90˚, 60˚ or 30˚.

Generally, it was found that the overtopping fraction Q_C and the relationship with h/H held true over the range $0.33 \leq (r - R) / R \leq 4$.

Independently, Hirst derived formulae fitted to the same test data to predict the overtopping fraction, Q_H

$$Q_H = A + [B.\ln(h/H)] + [C.\ln(r/H)]$$

Where A = 0.044, B = –0.264 & C = –0.116 for θ = 90˚
A = 0.287, B = –0.229 & C = –0.191 for θ = 60˚
A = 0.155, B = –0.360 & C = –0.069 for θ = 30˚

Both Clark's and Hirst's correlations gave good fits to the data of Greenspan and Johansson on which they were based.

4.5.2 *Liverpool John Moores' Correlation*

The Methodology and Standards Development Unit of the United Kingdom Health and Safety Executive (HSE) contracted Liverpool John Moores University (LJMU) to construct a laboratory facility and to conduct a series of tests simulating the sudden failure of a tank such as is used industrially for the storage of hazardous liquids. Such failures are rare. However, history has shown that when they occur a large proportion of the liquid is likely to escape over the surrounding bund wall or embankment, even if the force of the wave impact does not damage the retaining structures.

This research was entitled "an experimental investigation of bund wall overtopping and dynamic pressures on the bund wall following catastrophic failure of a storage vessel".

The LJMU results are separated into three groups corresponding to different levels of tank fill called "squat", "medium" and "tall". The researchers found that the Clark correlation seems to be in keeping with most of the LJMU test results when the plot of overtopping fraction against h/H is considered for squat tanks. However, at lower ratios of h/H and higher bund containment ratios, the Hirst correlation gives better agreement.

For medium tanks, both correlations show general agreement with the test results.

For tall tanks, the Clark correlation most closely fits the test results, with both Clark and Hirst correlations approaching the test results at smaller values of h/H.

New correlations were derived by LJMU to fit the LJMU test results. The following base function was derived:

$$Q = A \times \exp\left[-B \times (h / H)\right]$$

This is of the same form as the Clark correlation. The range of validity is 0.66 ≤ (r – R) / R ≤ 5.32. It should be noted that high-collar bunds are excluded from the range of validity, as the overtopping fraction is negligible, usually less than 5%. Omitting the high-collar bunds improves the quality of fit for the smaller bunds at greater radii, where frictional forces start to affect the result.

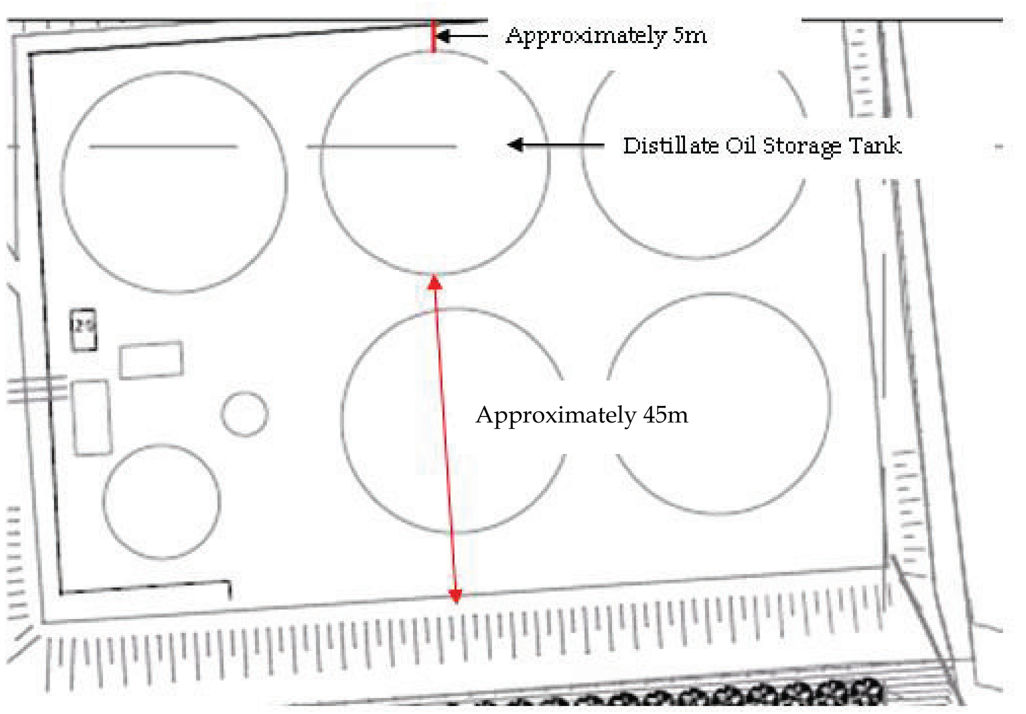
The refurbished tank at Great Island would be classed as 'squat' because of the ratio of liquid height to diameter. Values of A and B for squat tanks are shown in *Table 4.1*.

Table 4.1 LJMU Parameters

Tank Type	Bund Capacity (%)	A	B
Squat	110	0.5789	2.0818
Squat	120	0.5193	1.9671
Squat	150	0.3978	2.0051
Squat	200	0.1824	0.4972

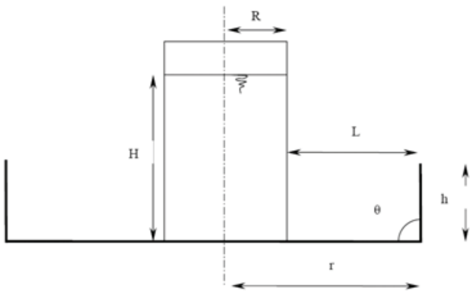
The storage tank area at Great Island is provided with a bund for the purpose of providing secondary containment of any releases that may occur from tanks and process equipment. The bund has the approximate dimensions of 140m x 100 m x 2.5 m deep.

Figure 4.2 *Layout of Great Island Tank Bunds*



The facility at Great Island will be required to store enough backup fuel to meet at least five days operating capacity; this equates to approximately 10,000 tonnes or 11,000m³. It will be Endesa Ireland's policy to store no more distillate fuel than this legal minimum amount.

Based on a distillate volume of 11,000m³



H = 9.7m
R = 19m
h = 2.5m
L_{min} = 5m
L_{max} = 45m

4.5.3 *Codes used by the UK HSE*

The UK HSE has two codes available for estimating the volume of material that may overtop a bund following catastrophic tank failure; OVERTOP and LSMS. Both OVERTOP and LSMS estimate the fraction of the liquid released that overtops a surrounding bund following catastrophic failure of an atmospheric storage vessel which is surrounded by a concentric circular bund.

OVERTOP

HSE internal guidance[14] states that "*the results and the graphs* [from Greenspan and Johansson] *must be treated with caution. A major uncertainty is the applicability of the results to full-scale industrial facilities. In addition, the combinations of parameters investigated in the tests were limited, and the form of presentation of the results does not allow easy interpolation between them.*"

To overcome the latter problem the full test results were reconstructed using the graphs and other information, and a fitting algorithm derived and encoded in the OVERTOP computer program. The algorithm developed by HSE is that presented above by Hirst. The HSE goes on to say that the algorithm "*reproduces the test data on which it is based extremely well, and gives plausible results when applied to real storage tanks*".

LSMS

LSMS (Liquid Spill Modelling System) is a computer code developed by Cambridge Environmental Research Consultants Ltd to calculate the spreading and vaporisation of a liquid pool, with sponsorship by BG, Gaz de France, the US Gas Research Institute and HSE. It solves the hydrodynamic shallow-layer equations in one (x or r) dimension and includes interaction with a vertical retaining bund wall, including overtopping and further spreading of liquid beyond the bund. It allows a solid, porous or liquid substrate.

All of the methods described above have been used to estimate the volume of material overtopping the bund following catastrophic tank failure. The most appropriate model to represent the Great Island bund case is the Hirst method (implemented by HSE as the OVERTOP model). This is because at lower ratios of h/H and higher bund containment ratios, the Hirst correlation gives better agreement than Clark and it also allows the slope of the bund embankment to be modelled.

4.5.4 *Environmental Cost Estimation*

The US Environment Protection Agency (EPA) Basic Oil Spill Cost Estimation Model (BOSCEM) was developed to provide the EPA Oil Program with a methodology for estimating oil spills costs, including response costs and environmental and socioeconomic damages, for actual or hypothetical spills.

EPA BOSCEM was created as a custom modification to the proprietary cost modelling program, EPC BOSCEM, created by extensive analyses of oil spill response, socioeconomic, and environmental damage cost data from historical oil spill case studies and oil spill trajectory and impact analyses(15).

The model requires the specification of oil type and amount and primary response methodology and effectiveness to determine base costs. Cost modifiers based on location medium type, location-specific relative socioeconomic/cultural value category, location-specific freshwater use, location-specific habitat and wildlife sensitivity category are then applied to the base costs.

The following assumptions were made when estimating costs using the EPA BOSCEM.

Oil Type:	Light Fuel
Response Method:	Mechanical with 90% effectiveness
Location Medium Type Category:	Open Water/Shore giving a cost modifier of 1.0
Socioeconomic and cultural value ranking:	Very High (e.g. national park/reserves for ecotourism/nature viewing; historic areas) giving a cost modifier of 1.7
Freshwater vulnerability category:	Wildlife use giving a cost modifier of 1.7
Habitat and wildlife sensitivity category:	River/stream giving a cost modifier of 1.5

4.6 *RELEASES ON THE JETTY*

The unloading lines run from the jetty head and along the jetty before reaching land. Clearly, in the case of a release from the unloading line on the jetty, there is the potential for at least a proportion of the release to fall on to water.

In the event of a leak, it would be necessary for the escaping liquid to make its way through the hole in pipework and through the surrounding insulation. In this process the release would lose momentum and fall to the surface beneath rather than be projected as a jet. Hence smaller leaks from these pipes have been treated as falling on to the jetty surface (considered to be concrete) rather than on to water.

However, in the event of a large failure or rupture, it is considered that the emerging liquid would retain significant momentum and that at least some of the liquid would spill on to the water.

In view of the above discussions, the following approach has been adopted:

- Smaller leaks have been modelled as falling on to the jetty surface (considered to be concrete); and
- Large leaks and ruptures have been modelled as falling on to water.

The quantity of distillate released into the water arising from jetty failures is estimated from the transfer rate of 7.64m^3/min (assuming that 11,000m^3 is transferred over a period of 24 hours) and the duration of the release, which is determined from the time taken to identify that there is a release and stop the transfer.

4.7 HUMAN CONSEQUENCE RESULTS

The results obtained for the consequence analysis are presented in *Table 4.2*, *Table 4.3*, and *Table 4.4* for pool fires, jet flames and flash fires respectively and in *Table 4.5* for overpressures arising from gas explosions within the compressor enclosure.

Table 4.2 ***Pool Fire Consequence Results***

Scenario	Distance to Thermal Flux Level (m)				
	25.6 KW m^{-2}	13.4 KW m^{-2}	12.7 KW m^{-2}	9.23 KW m^{-2}	6.8 KW m^{-2}
Bund Fire	Not reached	47	48	65	89
Overtopped poolfire	Not reached	51	53	70	96

Table 4.3 ***Jet Fire Consequence Results***

Release Scenario	Distance to Fatality Probability (m) 0.99	0.50	0.10	0.01
AGI and gas line from AGI to gas compressor (40 barg, but assumed to be 50 barg for analysis)				
4mm hole	1	2	2	2
25mm hole	9	12	14	17
1/3 diameter	29	45	52	60
Rupture	85	122	148	172
Gas line from gas compressor to gas turbine (50 barg)				
4mm hole	1	2	2	2
25mm hole	9	12	14	17
1/3 diameter	29	45	52	60
Rupture	85	122	148	172

Table 4.4 ***Flash Fire Results***

Release Scenario	Hazard Distances (m) LFL		0.50LFL	
	Downwind	Crosswind	Downwind	Crosswind
AGI and gas line from AGI to gas compressor (40 barg, but assumed to be 50 barg for analysis)				
4mm hole	Not reached	Not reached	Not reached	Not reached
25mm hole	Not reached	Not reached	36	1
1/3 diameter	77	2	158	6
Rupture	235	10	346	16
Gas line from gas compressor to gas turbine (50 barg)				
4mm hole	Not reached	Not reached	Not reached	Not reached
25mm hole	Not reached	Not reached	36	1
1/3 diameter	97	4	185	7
Rupture	270	12	386	19

Although the downwind distances to the LFL and 0.5LFL could reach up to 270 and 385m respectively, the flammable clouds would only be 'thin' in that the corresponding crosswind distances would only be 12 and 19m.

Table 4.5 ***Overpressure Consequence Results***

	Distance to Fatality Probability (m)					
	1.0	**0.70**	**0.50**	**0.10**	**0.05**	**0.01**
Outdoors	Not reached	-	Not reached	15	-	32
Indoors	Not reached	3	18	-	55	100

Domino effects are the effects arising from an event at one establishment which could initiate a major accident at another establishment in the vicinity. Since the distances to consequence levels quoted in the above tables do not extend to any other establishments in the vicinity, there is no escalation potential.

4.8 ENVIRONMENTAL CONSEQUENCE RESULTS

4.8.1 *Bund Overtopping*

Overtopping results have been generated using each of the methods described above. The percentage overtopping (of 11,000m^3) and corresponding volumes predicted by each method are reported in *Table 4.6* and *Table 4.7* shows the BOSCEM cost liabilities estimated using the parameters described in *Section 4.5.4*. The angle of the bund for the storage tanks at Great Island is 60^0 and was used to determine the overtopping fraction (except for the LSMS method which only considers vertical bunds).

Table 4.6 ***Base Case Overtopping Volumes***

Method	Distance to Bund Wall	Bund Wall Angle (°)	Percentage Overtopping	Overtopping volume (m3)
Clark	Not a variable	60	53.5%	5880
Hirst (OVERTOP)	Long	60	23.7%	2608
	Short	60	24.4%	2683
LJMU*	Not a variable	60	23.7%	2608
LSMS*	Long	90	7.5%	825

* these methods are based on a vertical bund wall only

As shown in *Figure 4.2* the storage tank being considered for storage of distillate is not located in the centre of the bund. Also, the height of the bund wall on the northern side is 5.5m and 2.5m on the southern side of the bund. The 'long' and 'short' distances in *Table 4.6* relate to the nearest and furthest distances between the storage tank and bund wall. The results in *Table 4.6* show that the overtopping fractions determined using the Hirst method are similar on the northern and southern sides of the bund and are also similar to the amount of overtopping calculated using LJMU, which assumes a vertical wall only.

However, the Clark and LJMU methods do not take the distance between the tank and bund wall into account in determining the overtopping fraction and therefore are not considered appropriate in this case, but are presented for comparison.

The LSMS method assumes that the spread of a spill is the same in all directions (i.e. a circle) and originates in the centre of the bund. The storage tank identified for conversion (middle tank on the northern side of the storage area) is not positioned within a circular bund and not located at the centre of the bund. The short separation between the tank and the north bund wall could not be modelled directly because the subsequent circular bund would have a volume less than the volume of the material being released. The furthest distance from the tank to the bund wall was modelled to represent overtopping over the southern side of the bund, using a separation distance which gave a bund volume equal to the actual bund volume. The results obtained using the LSMS method are perceived to be overly optimistic when compared with overtopping volumes calculated using the other methodologies.

Table 4.7 ***Base Case Environmental Cost Liability***

Method	Spill Response and Cleanup (€)	Socioeconomic (€)	Environment (€)	Total Cost Liability (€)
Clark	€40,388,644	€237,671,636	€62,136,375	€340,196,655
Hirst (OVERTOP)	€43,943,972	€120,491,537	€34,021,1407	€198,456,648
LJMU*	€42,746,653	€117,208,565	€33,094,183	€193,049,401
LSMS*	€13,512,403	€37,050,137	€10,461,215	€61,023,755

* these methods are based on a vertical bund wall only, 2.5m high

The Hirst methodology is considered to be the most relevant for Great Island. This is because it accounts for the different separation distances between the storage tank and the bund wall and because the overtopping results are within the highest and lowest estimated volumes using the other methods. Therefore, the results obtained using Hirst were used to assess the benefits of the considered options for reducing the overtopping risks.

4.8.2 Jetty Releases

The ACDS document states that transfer spill incidents are often quite minor and so it can be interpreted that most of the releases arising from transfer spills would not have a significant environmental impact. ACDS also gives probabilities of different release durations for large and small leaks. *Table 4.8* gives the spill volumes for the durations for the large releases, assumed to be equivalent to full bore.

Table 4.8 Distillate Spill Sizes (Full bore releases)

Release duration (mins)	Spill Volume (m^3)
2	15.3
5	38
10	76
20	153

The volumes of the distillate spillages at the jetty are considerably less than those obtained for bund overtopping resulting from the catastrophic failure of a distillate storage tank.

5 RISK CRITERIA

5.1 INDIVIDUAL RISK CRITERIA FOR LUP

The HSA policy in relation to proposals for new major hazard establishments is as follows [(1)]:

- Individual risk of fatality not to exceed 5×10^{-6} per year for non-residential neighbours;
- Individual risk of fatality not to exceed 1×10^{-6} per year at nearest residential property.

In addition, the HSA will also consider the existing land use within three concentric zones around the proposed establishment. The zone boundaries are established as follows:

- Innermost Zone (Zone 1): within 1×10^{-5} per year individual risk of fatality contour;
- Middle Zone (Zone 2): between 1×10^{-5} and 1×10^{-6} per year individual risk of fatality contours;
- Outermost Zone (Zone 3): between 1×10^{-6} and 1×10^{-7} per year individual risk of fatality contours.

The acceptability of different land uses within these zones is summarised in the HSA advice matrix for different PADHI sensitivity levels shown in *Table* 5.1. Typical developments for each of the PADHI sensitivity levels are set out in *Table 5.2*.

Table 5.1 Acceptable Land Uses within Risk Zones

Sensitivity	Zone 1 (Inner)	Zone 2 (Middle)	Zone 3 (Outer)
Level 1	√	√	√
Level 2	**X**	√	√
Level 3	**X**	**X**	√
Level 4	**X**	**X**	**X**

Table 5.2 PADHI Sensitivity Levels

Sensitivity level	Development Type	Examples
1	Work places Parking areas	Offices, factories, farm buildings, non-retail markets Car parks, truck parks, lock-up garages
2	Housing Hotels/ holiday accommodation	Houses, flats, residential caravans Hotels, motels, youth hostels, halls of residences, holiday caravan and camping sites.

Sensitivity level	Development Type	Examples
	Transport links	Motorway, dual carriageways
	Indoor use by public	Restaurants, cafes, shops, libraries, colleges of further education, bus and train stations, leisure centres, conference centres
	Public outdoor use	Picnic areas, markets, theme parks, playing fields
3	Institutional accommodation and education	Nursing and old people's homes (with warden on site or on call), schools for children up to school leaving age
	Prisons	Prison, remand centres
4	Institutional accommodation	Large hospitals, convalescent homes, nursing homes
	Very large outdoor use by public	Large sports stadia, pop festivals, open air markets

5.2 *SOCIETAL RISK OF FATALITY*

Societal risk can be defined as the relationship between the frequency and the number of people exposed to a specified level of harm, such as thermal radiation from fires, explosion overpressures, and doses of toxic gas in a given population.

The risk integral (RI) concept can be used when assessing major hazard installations and is able to provide an indication of the level of societal risk without the need for detailed analysis. It is defined as:

$$RI = \sum_{N=1}^{Nmax} f(N).N^{a}$$

Where, f(N) is the frequency in chances per million (cpm) of events leading to N fatalities and 'a' is a constant, which is usually set at 1.4. RI values of 2000 are judged to be broadly acceptable and are interpreted as being significant if the value is 500,000 or greater.

One estimation of the level of societal risk, which is best used as an initial screening tool, is to calculate the Societal Risk Index (SRI);

SRI = (P x R x T)/A
Where,

P = population factor, defined as $(n + n^2)/2$
n = number of people at the development
R = average level of individual risk (cpm)
T = proportion of time that the development is occupied by n persons
A = area of the development in hectares

A more detailed analysis for calculating societal risk is by determining the number of fatalities by each accident event and summing all the frequencies that give a specified number, or more of fatalities. The results are presented in graphical form by plotting cumulative frequencies (F) of giving N or more fatalities against N and is often referred to as the F/N curve.

With regard to societal risk, the HSE document(16) states that:

"…the risk of an accident causing the death of 50 people or more in a single event should be regarded as intolerable if the frequency is estimated to be more than one in five thousand per annum."

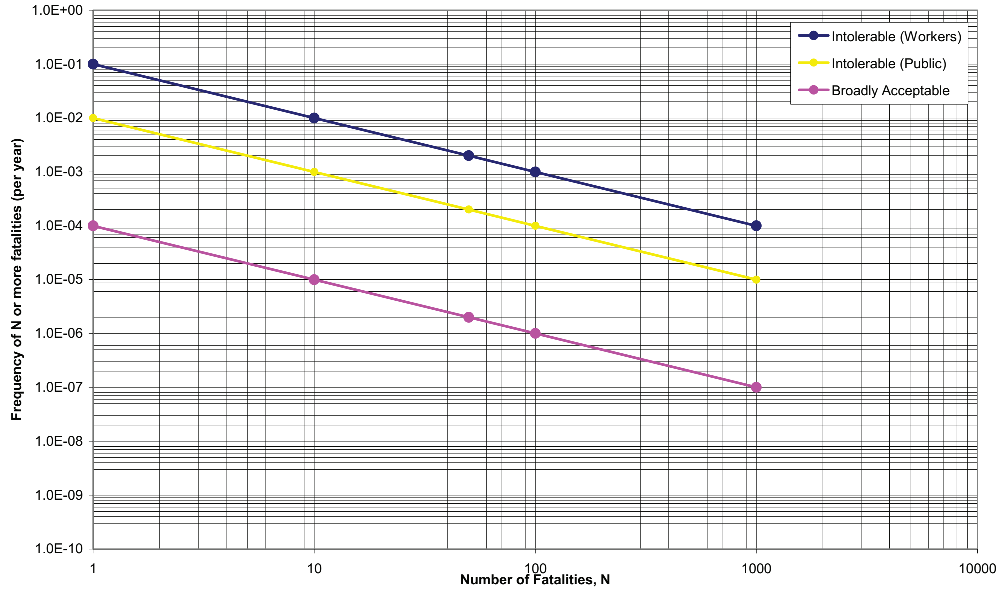
This gives a criterion 'point' from which intolerable, tolerable and broadly acceptable regions can be extrapolated when considered in conjunction with individual risk criteria. It should be noted that:

- taken in context, the criterion refers to fatalities among members of the public from accidents at a 'single major industrial activity'; and
- the criterion appears to be referring to a cumulative frequency (since it refers to '50 people or more') rather than the single value associated with a single release outcome.

With this in mind, the following extrapolations have been performed:

- the criterion for workers at the site is taken to be ten times higher than that for members of the public, i.e. – the risk of an accident causing the death of 50 workers or more should be regarded as intolerable if the frequency is greater than one in five hundred per annum;
- the broadly acceptable region is taken to be two orders of magnitude lower than the criterion point for members of the public, i.e. - risk of an accident causing the death of 50 people or more is taken to be broadly acceptable if the estimated frequency is less than one in 500,000 per annum; and
- each individual point is plotted on a graph and criterion lines extrapolated through them, to give the Cumulative Frequency (F) – Number of Fatality (N) criteria lines shown in *Figure 5.1*.

Figure 5.1 Cumulative F-N Criteria Lines



5.3 ENVIRONMENT IMPACT CRITERIA

The HSA Policy and approach for COMAH risk-based LUP makes reference to EPA's 'Guidance Note on the Storage and Transfer of Scheduled Activities' (available from EPA website http://www.epa.ie/) that provides a detailed approach for conducting an environmental risk assessment.

The major concern at Great Island generally relates to whether a distillate spill (or contaminated firewater) could escape and pollute the surrounding land and the damage the marine environment.

The assessment criteria are based on using water hazard classes (WHCs), which are:

- Non hazardous;
- WHC 1 – low hazard;
- WHC 2 – hazardous; and
- WHC 3 – severe hazard

The risk category table presented as *Table 5.3* is based on four levels of risk classification. Generally, category A equates to low risk, B to medium risk, while categories C and D equate to higher risk. It should be noted that the nature of dangerous substances and their associated volumes stored at petroleum bulk stores is likely to classify such sites as category C or D inasmuch that there is a high potential for pollution in the event of a major release.

Table 5.3 Risk Category Matrix

Vol. (m3) or mass (tonnes)	**Risk Category**		
	WHC 1	**WHC 2**	**WHC 3**
<0.10	A	A	A
0.10 – 1.0	A	A	B
1.0 -10	A	B	C
10 - 100	A	C	D
100 – 1000	B	D	D
>1000	C	D	D

Based on the quantity of distillate that would be present at the Great Island combined cycle power plant, and assuming WHC 1 it would be classified a category C site as a minimum.

6 *RISK CALCULATION*

Individual and societal risk calculations have been performed using ERM's *ViewRisk* software, combining the frequency and consequence information. The development of *ViewRisk* was funded under contract to the UK Health and Safety Executive (HSE) and is regularly used for calculating risks from major accident hazard installations.

6.1 *RISK TO HYPOTHETICAL HOUSE RESIDENTS*

Since, in the event of a major accident, the likelihood of harm to a person indoors differs from that for a person outdoors (see *Section 3.3*) it is necessary to consider the proportion of time individuals may spend indoors and outdoors. To account for time spent indoors and outdoors, the HSA employs the concept of a 'hypothetical house resident'. The hypothetical house resident is present all of the time at their dwelling, spending 90% of their time indoors. The calculation of individual risk has therefore used these 'hypothetical house resident' assumptions.

6.2 *POPULATION DATA*

For the purposes of calculating societal risk, it is necessary to define the population distribution around the proposed facility. However, since the hazard distances predicted for potential major accidents at the Great Island site do not extend to areas where people would normally be present, it has therefore not been necessary to include the population data in the analysis.

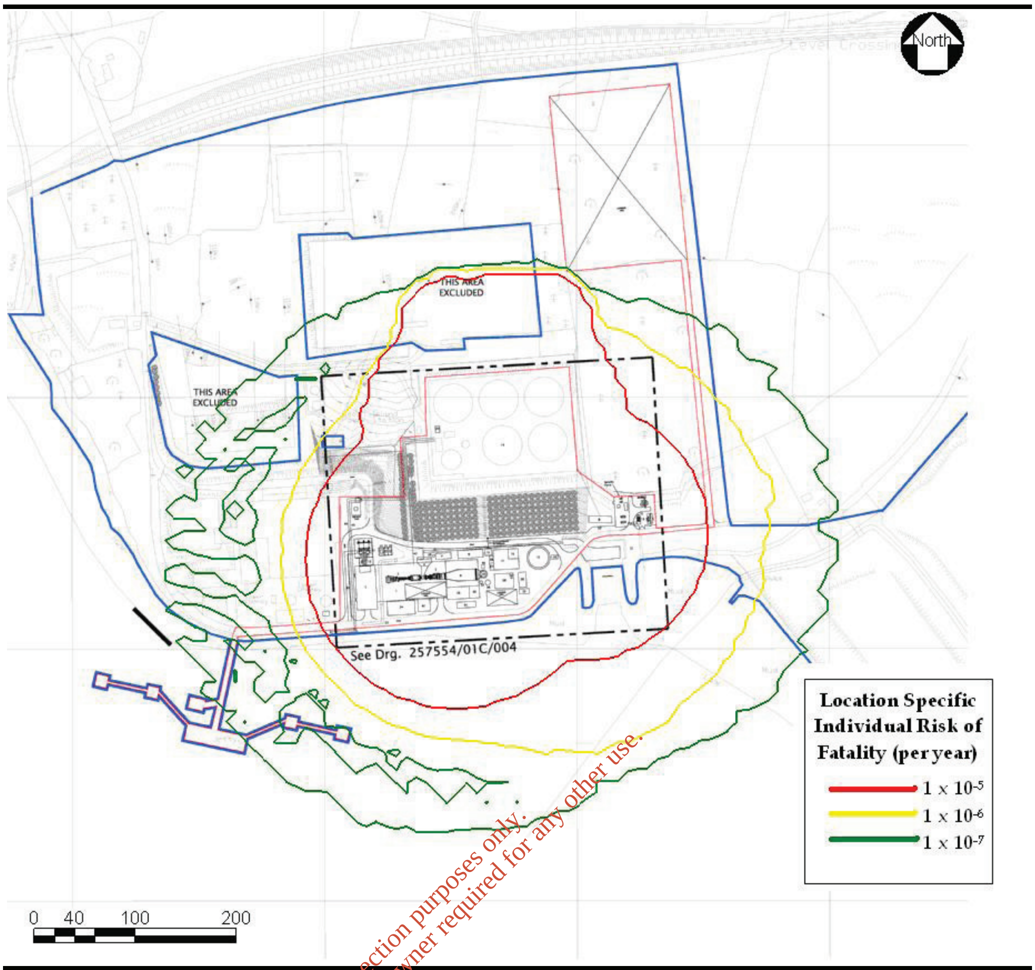
6.3 *INDIVIDUAL RISK RESULTS*

The individual risk of fatality contours displayed in *Figure 6.1* are based on an individual being present outdoors for 10% of the time and indoors for 90% of the time.

The inner zone (1×10^{-5} /yr risk contour) covers virtually all of the Great Island power plant facilities and extends beyond the site boundary over the coastal area to the south.

Whilst each of the zones extends outside the site boundary, with the outer zone (1×10^{-7} /yr risk contour) extending to the eastern unloading berths at the jetty area, they only cover a small area beyond the coastline, where no people would be present. The middle and outer zones also cover a small offsite area of vegetation to the east, but do not encompass any developments where people would normally be present.

Figure 6.1 *Individual Risk of Fatality Contours for People Outdoors*



6.4 SOCIETAL RISK RESULTS

Only the 1×10^{-7} /yr risk contour extends to locations offsite where people could be present, which would be at the eastern berths at the jetty. However, the societal risk can be deemed to be negligible if the probability of people being present at this location is taken into account. No member of the general public would normally be encompassed by any of the zones. The jetty is used for unloading oil, and although there is no scheduled use of the jetty for passengers, it is sometimes used by cruise liners as a contingency arrangement and occurs with a frequency of less than once per year since the early 1990's.

On site, the distribution of personnel is assumed to be similar to that presented in the assessment of major accident hazards for the Toomes Power Station[17] and summarised in *Table 6.1*.

Table 6.1 Occupancy Levels

Building	Normal	
	Day	Night
Turbine Hall	1	1
Canteen	3	1
Admin building	8	0
Gatehouse	1	1
Central Control Room	3	3

The F-N data obtained for personnel on site is summarised in *Table 6.2* and so the societal risks are interpreted as being in the broadly acceptable region (see *Figure 5.1*).

Table 6.2 F-N Data

N	**F**
1	6.38×10^{-5}
2	6.34×10^{-5}
4	4.29×10^{-5}

7 RISK OF MAJOR ACCIDENTS TO THE ENVIRONMENT

7.1 BUND OVERTOPPING

7.1.1 Methods for reducing overtopping risks

Methods for reducing the volume of material overtopping the bund and entering the environment following catastrophic tank failure considered for the Great Island establishment are listed below.

1. Construction of a double-walled tank;
2. Maintaining the height of the bunding, but increasing the angle of the embankment to 90^0;
3. Maintaining the slope of the embankment, but increasing the height of wall by 2m;
4. Installation of tertiary containment and drainage system outside the bund;
5. Increasing the height of the existing bund wall to ensure complete containment;
6. Construction of a baffle wall within the existing bunded area at the toe of the dyke; and
7. Construction of a 2.5m baffle wall within the existing bunded area at the base of the dyke, increase height of bund by 2m, same slope.

The overtopping risks have considered for one tank only. The distillate will be stored in the tank located in the middle of the three tanks to the north. This tank will have its own dedicated filling pipe from the jetty and no piping will be installed that would make it possible for distillate to be transferred to any of the other tanks.

The fraction of liquid overtopping the bunded area following catastrophic failure of the distillate tank will depend on the direction in which the liquid is released, which in turn will be governed by the section of the tank which fails.

The land rises steeply by about 5.5m from the floor of the bund to the level of the surrounding ground at the northern side of the Great Island storage tank bund. For the purpose of estimating the overtopping fraction at the northern boundary, the bund is considered to be a 5.5m embankment at an angle of 60^0. The amount of distillate overtopping the bund was calculated to be $2683m^3$, which corresponds to 24.4% of the tank inventory. However, there would be some ground contamination beyond the 2.5m concrete section of bunding.

If the release were directed to the south, the overtopping volume over the southern embankment is estimated to be $2608m^3$ (23.7%), which is similar to the fraction that would overtop the bund on the northern side. Any impact from the presence of the tanks on the south side of the storage area have not been taken into account in the analysis.

Therefore, various bund containment options need to be considered around the entire perimeter of the tank storage area.

7.1.2 *Analysis of Measures*

The effectiveness of the proposed measures in terms of the volume and fraction of distillate that would overtop the bund on the north and south side of the storage is given in *Table 7.1.*

Table 7.1 Effectiveness of Measures to Control Bund Overtopping – Catastrophic Tank Failures

Measure	**Potential Overtopping North side of Bund**		**South side of Bund**	
	%	**Volume (m3)**	**%**	**Volume (m3)**
1. Double walled tank	24.4	2683	23.7	2608
2. Increased embankment angle to 90⁰ but maintain bund wall height	8.9	976	18.3	2014
3. Maintaining the slope of the embankment, but increasing the height of wall by 2m	17.3	1902	10.2	1128
4. Tertiary containment (beyond existing bunded area)	0	0	0	0
5. Increase embankment angle to 90⁰ and increase bund wall height to 7.7m (north) and 5m (south), which ensures containment	0	0	0	0
6. Construction of a 1.5m baffle wall within the existing bunded area at the base of the dyke, maintain height of bund	22.3	2495	26.2	2879
7. Construction of a 2.5m baffle wall within the existing bunded area at the base of the dyke, increase height of bund by 2m, same slope.	6	673	7.6	837

The figures in *Table 7.1* show that there are clear differences in the effectiveness of the measures considered for reducing the risk of bund overtopping from a catastrophic failure of a distillate storage tank. Furthermore, there are differences in the effectiveness of the measures on the north and south sides of the bunded storage area. Therefore, it may be appropriate to incorporate different measures on different sides of the bund.

One approach to assess the reasonableness of these proposed measures is to compare the cost of implementing the measure with the reduction in environmental spill liability across the lifetime of the plant, referred to as the threshold cost.

The threshold cost is calculated by:

Total liability cost x spill frequency (per year) x 30 years x disproportionate factor (5).

The threshold costs for a single tank containing 11,000m³ distillate are reported in *Table 7.2*.

Table 7.2 Cost Benefit Threshold Costs – Catastrophic Tank Failures

Measure	**North side**		**South Side**	
	Potential Residual Cost Liability (€)	**Threshold Cost (€)**	**Potential Residual Cost Liability (€)**	**Threshold Cost (€)**
1. Double walled tank	€198,456,648	€267,916	€192,909,034	€260,427
2. Increased embankment angle to 90⁰ but maintain bund wall height	€72,192,951	€189,396	€148,971,931	€74,227
3. Maintaining the slope of the embankment, but increasing the height of wall by 2m	€140,687,494	€86,654	€83,436,116	€172,531
4. Tertiary containment (beyond existing bunded area)	0	€297,685	0	€297,685
5. Increase embankment angle to 90⁰ and increase bund wall height to 7.7m (north) and 5m (south), which ensures containment	0	€297,685	0	€297,685
6. Construction of a 1.5m baffle wall within the existing bunded area at the base of the dyke, maintain height of bund	€184,550,629	€20,8549	€212,954,413	-€20,8549
7. Construction of a 2.5m baffle wall within the existing bunded area at the base of the dyke, increase height of bund by 2m, same slope.	€49,1780,591	€223,014	€61,911,373	€204,818

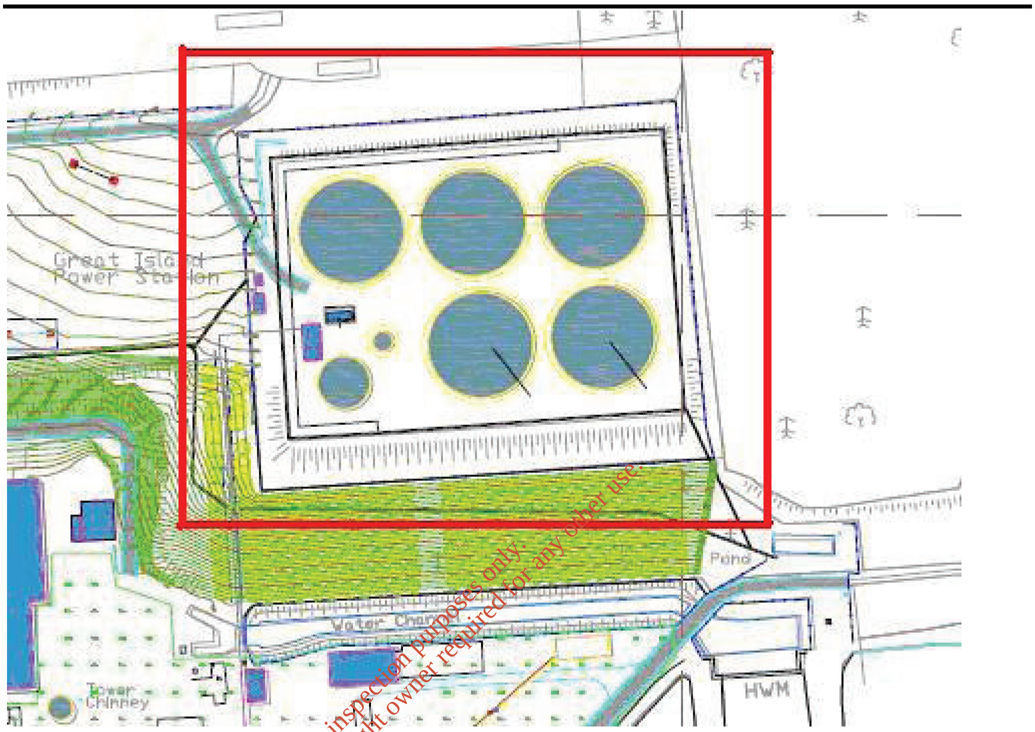
The threshold costs are based on a catastrophic tank failure of 1 x 10^{-5} per year. However, if the probability of the tank failing in a particular direction were taken into account, then the threshold costs would be lower. For instance if it were assumed that failure of the tank on the north and south sides were equally likely then the above threshold costs could be halved.

It can be deduced from a straightforward examination that some of the considered measures can be discounted from the cost benefit analysis.

The construction of a double walled tank (No. 1) would not reduce the overtopping fraction if it were to fail, but the likelihood of its failure would be reduced. Since the estimated cost for a double-walled tank would be in the region of €3.34 million, it is more than an order of magnitude higher than the threshold cost. Therefore, this measure is deemed not to be economically viable and was therefore dismissed as an option.

An indication of the extent of tertiary containment beyond the existing bunded storage area (No. 4), which would be designed to prevent any of the liquid released from reaching the marine environment is shown in *Figure 7.1,* However, this is perceived to be an impractical option and very costly incorporating measures to seal the area encompassed by the tertiary containment to prevent ground contamination.

Figure 7.1 Tertiary Containment



In order to contain all 11,000m^3 of liquid released from a catastrophic tank failure, the bunding would need to comprise a 7.7m vertical wall along the northern boundary and a 5m vertical wall on the south side of the bund (No. 5). This is not considered to be a practical option and so was not examined further.

Increasing the embankment angle to 90^0 but maintain bund wall height (No. 2) would reduce the overtopping fraction on the north side from 24.4% to 8.9%., but would be less effective on the south side when the overtopping fraction would be reduced to 18.3%.

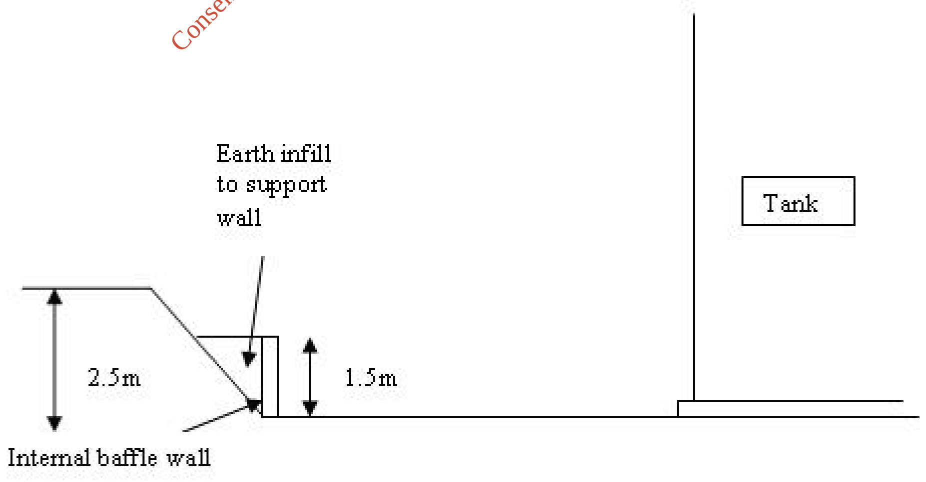
Installing a 1.5m vertical baffle wall at the base of the dyke, such as shown in *Figure 7.2* (No. 6) would not be effective. The construction of a 2.5m baffle wall within the existing bunded area at the base of the dyke and increasing the height of bund by 2m and maintaining the 60^0 slope (No. 7) would reduce the overtopping fraction to 6% and 7.6% on the north and south sides respectively.

A less expensive, but less effective option would be to increase the height of bund by 2m and maintaining the 60^0 slope (No. 3), which would decrease the overtopping fraction by 7.1% to 17.3% on the north side and by 13.5 % on the south side. The cost to implement this measure on the east west and south sides has been estimated to be €740,000, but is still considerable higher than the threshold costs. Furthermore, whilst credit has been taken for a 5.5m sloping bund on the northern side, only 2.5m has been concreted and so there would be a need to seal the bund to the full height, otherwise there would be ground contamination form the distillate.

In all the cases considered the expected cost of implementing the mitigation measures exceeds the calculated threshold cost.

The most cost effective way of controlling overtopping of the bund is to consider different measures on different sides of the bund. On the basis that the middle tank on the north side will be used to store the distillate, it is proposed that that the height of the dyke on the south, east and west sides is increased by 2m, maintaining the slope at 60°. On the north side, increasing the embankment angle to 90° but maintain bund wall height at 5.5m would be effective in reducing the overtopping fraction to 8.9%, but would be very costly to implement. It is expected that some of the overtopping on the northern side would flow back into the bund. As stated, if the frequency of the tank failing catastrophically on a particular side were taken into account, then the threshold figures would be lower than those presented in *Table 7.2* and it can be argued that the cost to implement measures on the northern side of the bunded area would be grossly disproportionate to the benefit gained.

Figure 7.2 Proposed Baffle Wall Arrangement



7.2 JETTY RELEASES

The ACDS, Major Hazard Aspects of the Transport of Dangerous Substances[8] quotes an accident frequency figure of 1.8×10^{-4} per cargo transferred for low flash and high flash products, and so was considered appropriate for distillate. There will be a requirement to use the distillate for start up, but the quantities involved would only be low. Replenishment of the distillate used during start-up could therefore be supplied from road tanker deliveries. Large volumes of distillate would only be used in the event of the gas supply not being available and is assumed that such occurrences would arise once in 10 years. Therefore there would only be a requirement to transfer distillate from the jetty once every 10 years and the frequency of a release is therefore estimated to be 1.8 x 10^{-5} per year.

The spill sizes were calculated for release durations of 2, 5, 10 and 20 min and the probability and frequencies of the various spill volumes for full bore releases are set out in *Table 7.3* together with the potential cost liabilities and threshold costs. The total potential liability and threshold costs were estimated to be €40,615,193 and €2,287 respectively.

Table 7.3 Cost Benefit Threshold Costs - Jetty Releases (Full Bore)

Release duration (mins)	**Spill Volume (m3)**	**Probability**	**Frequency (/yr)**	**Potential Cost Liability (€)**	**Threshold Cost (€)**
2	15.3	0.101	1.82 x 10^{-6}	€4,219,674	€1,152
5	38	0.037	6.66 x 10^{-7}	€5,179,887	€518
10	76	0.012	2.16 x 10^{-7}	€10,359,773	€3,578
20	153	0.005	9.00 x 10^{-8}	€20,855,859	€282
Total				**€40,615,193**	**€2,287**

8 CONCLUSIONS AND RECOMMENDATIONS

A quantitative risk assessment (QRA) and environmental assessment of the proposed facilities at the Combined Cycle Gas Turbine (CCGT) power plant establishment at Great Island has been conducted. For the purposes of the QRA, the facilities were considered to be:

- the AGI;
- gas line between the AGI and the gas compressor;
- gas compression;
- gas line between the gas compressor and gas turbine;
- the jetty unloading arms; and
- distillate storage tank.

The jetty unloading lines (from jetty head to distillate storage); and transformer fires and explosions were also considered, but were not included in the quantified analysis as the associated risk levels were not deemed to be significant.

8.1 FATALITY RISKS

The inner, middle and outer zones, corresponding to individual risk levels of 1×10^{-5}, 1×10^{-6} and 1×10^{-7} respectively were computed. None of these contours extended to areas offsite where members of the general public would normally be present. The inner zone covered most of the plant facilities and whilst the zones extended outside the site boundary, they only covered a small area beyond the coastline to the south and an area of vegetation to the east where members of the general public would not be expected to be present. The hazards distances do not extend other offsite buildings that could result in escalation. Although the flammability envelope and the effects from jet flames could extend to the jetty area, the risk of escalation to any ships refuelling would be negligible on the basis of the low risk of occurrence and the probability of a ship being present.

The HSA guidance document for COMAH based land use planning states that with respect to new establishments the individual risk of fatality should not be greater than 5×10^{-6} (per year) to their current non-residential type neighbours or a risk of fatality greater than 1×10^{-6} (per year) to the nearest residential type property. Since the individual risk of fatality contours do not encompass any offsite developments, it can be demonstrated that the risks are acceptable.

No societal risks were calculated for offsite personnel because none of the risk zones encompassed areas where people would normally be present. The societal risks therefore only related to members of the workforce and these were determined to be broadly acceptable.

8.2 ENVIRONMENTAL RISK

The environmental risks were considered to arise from spills of distillate being released into the marine environment from failures during unloading and catastrophic failure of a storage tank.

A number of proposed measures were assessed for reducing the environmental risks through containing and preventing distillate from reaching the marine environment following catastrophic failure of a storage tank. For a single distillate tank, the calculated threshold costs ranged from €74,227 for increasing the embankment angle (on the south side) so that it is vertical to €297,685 for tertiary containment or increasing the embankment angle to 90^0 and increasing the bund wall height so that all the distillate released would be contained.

There was a considerable variation in the estimated costs for implementing the measures, which ranged from €300,000 for constructing a 1.5m baffle wall within the existing bunded area at the base of the dyke to around €3.34 million for the installation of a single doubled-walled tank. In all cases the estimated costs exceed the calculated threshold cost. The recommended measure for implementation is to increase the height of the bund wall by 2m, but maintain the slope of the embankment at 60 degrees, on the south, east and west sides of the storage area. This is estimated to cost €740,000.

Bearing in mind that some of the liquid overtopping the bund on the northern side is likely to flow back into the bund and that the cost to implement measures on the northern side would be significantly greater than the threshold cost, it can be argued that there is no need to implement measures in terms of increasing the bund angle or height on the northern side. The upper 3m of the dyke should be sealed to prevent any ground contamination in the event of a spillage. This is estimated to cost €45,000.

9 REFERENCES

1. Policy and Approach of the Health and Safety Authority to COMAH Risk-based Land Use Planning, HSA (2009)
2. HSE (2000). Risk Assessment Methodology for Storage of Refrigerate Flammable Liquids. Planning Case Assessment Guide Chapter 6K.
3. Council Directive, 96/82/EC on the control of major accident hazards involving dangerous substances.
4. G. Weiss, Hazardous Chemicals Data Book, Second Edition (1986).
5. National Authority for Occupational Safety and Health (2002). Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations (2001).
6. NTIS Publication No. PB-94-195047: Documentation for Immediately Dangerous to Life or Health Concentrations (IDLH): NIOSH Chemical Listing and Documentation of Revised IDLH Values
7. The Buncefield Incident 11 December 2005: The Final Report of the Major Incident Investigation Board (2008). Available at: http://www.buncefieldinvestigation.gov.uk/reports/volume1.pdf [Accessed 27 August 2009]
8. ACDS, Major Hazard Aspects of the Transport of Dangerous Substances, (1991).
9. The Oil Industry International Exploration and Production (E&P) Forum, 1992, Hydrocarbon Leak and Ignition Data Base. Report No. 11.4/180.
10. A W Cox, F P Lees and M L Ang, Classification of Hazardous Locations, IChemE, (1990).
11. Eisenberg, N.A., Lynch, C.J. and Breeding, R.J., 'Vulnerability Model. A Simulation System for Assessing Damage Resulting from Marine Spills', NTIS report AD-A015-245, 1975.
12. Hurst, N.W., Nussey, C. and Pape, R.P., 'Development and Application of a Risk Assessment Tool (RISKAT) in the Health and Safety Executive', Chem. Eng. Res. Des., Vol. 67, (July 1989).
13. Chemical Industries Association, 'Guidance for the Location and Design of Occupied Buildings on Chemical Manufacturing Sites', Second Edition, (2003).
14. UK HSE PCAS Chapter 5A
15. Modelling Oil Spill Response and Damage Costs Dagmar Schmidt Etkin, 2004. Environment Research Consulting Cortlandt Manor, NY, USA
16. HSE (2001). Reducing Risks, Protecting People. HSE Books, C100

17. Mott McDonald, Toomes CCGT Power Station, Major Accident Hazards, February 2008

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