Kilcolgan Residents Association
Protecting the Shannon Estuary

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March 7th 2008

Re: Serious New Information on Höegh LNG and Irish Sea Offshore Gas Storage for PA0002 post oral hearing into the proposed LNG terminal in County Kerry.

Since the fast-track oral hearing into the proposed LNG terminal at Tarbert, County Kerry held from January 21st to 30th 2008, profoundly-serious new information has come to light which is so important that it will have to be taken into consideration if a fully-informed decision is to be made.

This information covers the following 8 areas:

1. The Norwegian LNG company, **Höegh LNG**, has announced its intention to develop another **Offshore LNG terminal** 35 Kilometres also off the coast of Blackpool in Morecambe Bay – in the ***Irish Sea***. The project – called "Port Meridian Offshore Morecambe Bay"[1]- will use SRV technology, which is an LNG vessel with onboard LNG vaporisers.

Separately, a new ***offshore*** gas storage facility, also in the ***Irish Sea*** 24 Kilometres off the coast of Britain and approximately 100 miles from Dublin is at an advanced planning stage and is expected to come on stream by 2011. This real, tangible example of an offshore gas storage facility so close to Ireland proves categorically that the offshore alternative proposed by us at the oral hearing and planned by Exxon Mobil off the coast of New York, is able to be put into practice in Irish waters and cannot now be ignored as a viable and safe alternative to the proposed LNG terminal at Tarbert.

The "Gateway Gas Storage Project"[2] is being project-managed by Stag Energy Development Company Ltd for Gateway Storage Co. Ltd. **Gateway** is building a natural gas storage facility to store natural gas offshore in 20 man-made underground caverns, created specially in the salt strata underlying the Irish Sea. Gateway has stated that, once commissioned, the facility will help to substantially improve the security of energy supplies for both the UK and the Irish Markets.

Both Gateway and Höegh LNG have highlighted the benefits of their projects as having no negative visual impact and especially of enhancing safety to the general public. Once completed, a permanent 500 metre safety zone, representing a total ***12 square kilometre exclusion zone***, will be created around the whole facility. This is therefore setting an extremely serious precedent which the Health and Safety Authority should now be made

[1] APPENDIX 2: PORT MERIDIAN OFFSHORE LNG TERMINAL by Höegh LNG
http://www.hoegh.com/lng/business_development/focus/
[2] APPENDIX 1 – GATEWAY GAS STORAGE PROJECT by STAG ENERGY
(http://www.stagenergy.com/Gateway/index.html)

aware of in its evaluation of the Hess LNG project at Tarbert and which An Bord Pleanála should take into account in its evaluation of the sterilisation of the remaining Landbank and risk to the residents and landowners of Kilcolgan. This offshore exclusion zone in the Irish Sea does not even have to consider the general public meaning that any onshore exclusion zone would obviously have to be larger than that.

An Executive meeting of Blackpool Council took place on February 13th, 2008 to consider both the Gateway Gas Storage and Höegh LNG Port Meridian Terminal projects[3]. The Executive meeting recommended acceptance of the project by the Council subject to receiving assurances from the Health and Safety Commission that there will be no risks of explosion from that facility to Blackpool residents or visitors. Both projects, although not connected, can operate in parallel.

Rudall Blanchard Associates, a specialist environmental and planning consultancy, completed the Environmental Impact Assessments[4] and is acting on behalf of both Gateway and Höegh LNG.

2. Exxon Mobil has decided to press ahead with its drilling commitment on its giant Dunquin prospect in Porcupine basin off the west coast of Kerry. On February 21st 2008 it announced that it is looking for farm-in partners to allay the cost of drilling. ExxonMobil said two prospects have been identified, Dunquin North and Dunquin South. Both are anticipated to hold gas or gas/condensate with the estimated potential to hold over 18 trillion cubic feet of gas; Corrib holds only one trillion cubic feet.[5] Throughout the oral hearing into the proposed Hess LNG terminal at Tarbert it was claimed that Ireland was running out of gas because Corrib was only expected to provide 40% of national gas needs at most when it comes fully on stream. This means that in the medium term, Ireland will be a net exporter of Gas, as Norway and the UK currently are. This issue on whether or not Ireland will become a net exporter of gas in the medium term needs to be reassessed as this would bring into question the stated need for an onshore LNG terminal – supplying gas to Ireland. It would seem now that the aim in the medium term will be to use the terminal for even more export of gas via the pipelines to the UK and Continental Europe from Ireland. Why put our lives at risk if that is the case?

3. Shannon LNG and Hess LNG stated throughout the oral hearing that Ireland is running out of gas, yet Hess Exploration Ireland have just taken a 42% share in two exploration licences from the Norwegian group Statoil, in partnership with Shell Ireland, in the Slyne-Erris Basin[6]. This proves that even HESS itself is really of the opinion that there are huge quantities of gas in Ireland and the firms are expected to start drilling in 2008.

4. Marathon Oil announced on February 20th 2008 that it is selling its Irish operations. The depleted reservoirs could therefore be bought out by the Irish state and used as a natural

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[3] APPENDIX 3: CONSULTATION ON THE GATEWAY GAS STORAGE PROJECT AND THE PORT MERIDIAN OFFSHORE LNG TERMINAL By BLACKPOOL COUNCIL
http://www.blackpool.gov.uk/Services/M-R/MeetingsMinutesandAgendas/Agenda.htm?ID=51697433
http://www.blackpool.gov.uk/democracy/agenda/viewdecision.aspx?guid=7836eb7d-ed26-4a24-814e-5e3e47285346

[4] APPENDIX 4 Gateway Gas Storage Project – Offshore Environmental Impact Statement
http://www.stagenergy.com/News/Gateway_ES_Non_Technical_Summary_Oct_07.pdf

[5] APPENDIX 5 – Dunquin prospect off the Kerry Coast has 18 times more gas than Corrib. "Irish Indpendent", February 22nd 2008 http://www.independent.ie/business/irish/exxon-woo-new-partners-to-allay-dunquin-drilling-costs-1295318.html

[6] APPENDIX 6 – Hess take 42% share of Slyne-Erris prospect off the Donegal Coast
http://www.rte.ie/business/2007/0614/statoil.html?rss

gas storage facility as proposed by the Gateway Gas Storage facility in the Irish Sea. Indeed, within hours of the Marathon announcement, Bord Gáis Éireann chief executive, John Mullins, said the State-owned gas company would be taking a serious look at acquiring some, or all of Marathon's Irish assets[7]. Bord Gáis would be interested in Marathon's stake in the Corrib gas field and the strategic undersea storage facilities owned and operated by Marathon. Bord Gáis has the resources and access to funds to comfortaly buy some or all of the assets on offer. This therefore brings into question the need for a dangerous onshore LNG terminal at Tarbert.

5. We believe that serious misrepresentation by Shannon Development has taken place at the Oral Hearing in Tralee from January 21st -30th 2008. Shannon Development has ***NO REMIT*** for attracting industrial development since this role was taken off them in 2005 following an announcement by Micheal Martin TD that "the existing enterprise support functions carried out by the Company in relation to both the indigenous and overseas enterprises will be assumed by the national agencies, Enterprise Ireland and IDA Ireland"[8]. This means that all expert opinion given by Shannon Development at the Oral Hearing had no value as they are no more than property owners and in our opinions completely misrepresented their actual areas of expertise throughout the eight days of the oral hearing. Shannon Development misrepresented their organisation as an inward investment facilitator, we believe. They should have outlined their remit clearly so anything they had to say could be taken in context. We are now of the opinion that the IDA and Enterprise Ireland should answer the questions that were originally posed to Shannon Development on how they expect a top-tier Seveso II LNG site with an exclusion zone around it to attract new industry to an area which is designated in the County Development Plan as lands "for a premier deep-water port and for major industrial development and employment creation".

6. An earthquake measuring 5.2 on the Richter Scale hit the UK on February 27th 2008 – the largest in over a quarter of a century. No account has been taken of the consequences of an earthquake on the proposed development.[9]

7. The "Planning (Location of Hazardous Sites) Bill [Number 55]" was introduced in the British House of Commons by Mr. Bob Spink MP (Castle Point) on January 15th 2008[10]. The Bill will require the introduction of binding guidance regarding minimum distances between developments classified as Control of Major Accident Hazard sites and other specified types of building; and for connected purposes: The Bill was ordered to be read a Second time on Friday 6 June 2008, and to be printed. We believe that in the absence of specific legislation in Ireland on exclusion zones around top-tier Seveso II sites, the HSA should await the outcome of this Bill for the precedent of best practice it will set for Ireland.

   When introducing the Bill, Mr. Spink stated that "the Bill seeks to improve protection for communities across Britain from the new development of potentially dangerous industrial sites. It will ensure increased safety by giving the Health and Safety Executive a

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[7] APPENDIX 7 – Bord Gais to Consider Marathon Fields for strategic undersea storage
http://www.examiner.ie/story/?jp=OJOJIDAUEY&cat=Business

[8] APPENDIX 8: Minister Martin announces new Mandate for Shannon Development
http://www.entemp.ie/press/2005/20050728.htm

[9] http://www.guardian.co.uk/uk/gallery/2008/feb/27/1?picture=332720554

[10] APPENDIX 9: Planning (Location of Hazardous Sites) Bill [55] setting precedent for mandatory exclusion zones around Seveso II sites
http://www.publications.parliament.uk/pa/cm200708/cmhansrd/cm080115/debtext/80115-0004.htm
http://www.epolitix.com/EN/Legislation/200801/4e63f2df-4a95-48c0-9962-dd5545ad463b.htm

framework for COMAH plant siting decisions, thereby improving the consistency of such decisions and affording a predetermined level of protection for communities." He argued that his Bill "would increase and formalise the protection afforded to communities" and that it would "give clarity and certainty to applicants, the HSE and planning authorities, saving time, expense and much community anguish." He stated that the "Planning Bill fails conspicuously to give the necessary procedural rigour for the infrastructure planning commission (IPC) to deal with the location of hazardous sites." He argued that the Planning Bill "will cause more difficulties" as "the location of a dangerous plant will be decided by an unelected quango". We feel that the Bill deals with the same issues as we are faced with in Ireland and would like both the HSA and An Bord Pleanála to take cognisance of the issues raised therein.

8. Recent reports in the media since the oral hearing took place have raised issues that we feel ought to be considered by An Bord Pleanála and the HSA in its consideration of the LNG planning application:
   a. Calls have been made for an inquiry into alleged profiteering by energy giants following the announcement, on January 21st 2008, by British Gas of a 500% increase in profits.[11].
   b. Dr. Jerry Havens and Dr. James Venart have had another peer-review article accepted for publication by "The Journal of Hazardous Materials" on 7 February 2008 entitled "Fire Performance of LNG Carriers Insulated with Polystyrene Foam"[12].

   The Irish Constitution – Bunreacht na hEireann – states in Article 40 (1) that "All citizens shall, as human persons, be held equal before the law". It states in Article 40 (3)(1) that "The State guarantees in its laws to respect, and, as far as practicable, by its laws to defend and vindicate the personal rights of the citizen". And in Article 40(3)(2) it states that "The State shall, in particular, by its laws protect as best it may from unjust attack and, in the case of injustice done, vindicate the life, person, good name, and property rights of every citizen."

   We expect that An Bord Pleanála and the HSA, as an organ of the state should uphold these aforementioned constitutional rights in our interest. As residents of a sparsely-populated area we want to be treated with the same degree of protection from danger as residents of a more densely populated area, such as Dublin would be as obliged by Article 40(1).

   Our right to life is being threatened by the siting of an LNG terminal close to our homes and properties where world-renowned LNG expert Dr. Jerry Havens clearly stated in the oral hearing how people within a three-mile radius would be in danger in the case of an accident. Under Article 40(3)(1) and 40(3)(2) we now formally request that our lives and property be protected and that the consequences of an LNG accident be taken into considerations as opposed to the purely probability-based (and, in our opinion, unconstitutional) approach of the Health and Safety Authority – especially since an

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[11] APPENDIX 10: Calls for Inquiry into alleged profiteering by Energy Giants following 500% increase in profits at British Gas. http://www.independent.co.uk/news/uk/home-news/calls-for-inquiry-into-alleged-profiteering-of-energy-giants-784918.html

[12] APPENDIX 11 – New Safety Concerns raised on LNG Marine Incident Consequences. "Fire Performance of LNG Carriers Insulated with Polystyrene" -The Journal of Hazardous Materials" 7 February 2008 http://www.sciencedirect.com/science?_ob=ArticleListURL&_method=list&_ArticleListID=700699788&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=352f79060b0cb41cfefab5cdeedab92a

example of a perfectly safer alternative is now being put into practice in the Irish Sea. We equally ask, for the same constitutional reasons, that this new information be taken on board in the decision-making process because we are of the opinion that we, as a country, had best be careful about the freedoms of individuals that we take away in order to benefit a larger group or organisastion.

APPENDIX 1 – GATEWAY GAS STORAGE PROJECT by STAG ENERGY

Gateway Storage

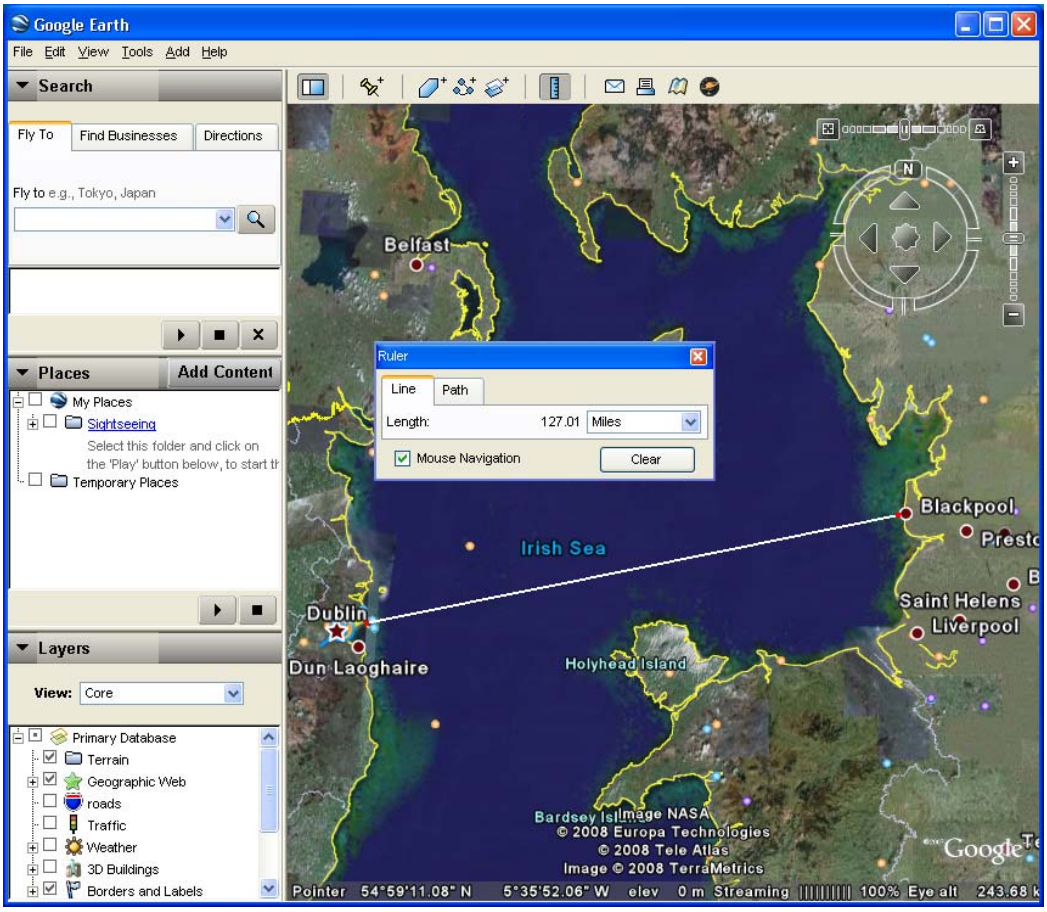
http://www.stagenergy.com/Gateway/index.html
Gateway Storage is the first major initiative in Northern Europe to provide an offshore underground gas storage facility.

The Gateway project is located in the East Irish Sea, approximately 24 kms offshore of the coastline of Fylde in north-west England.

The salt cavern storage facility will improve security of energy supply through the development of a low cost, flexible, high capacity asset
The storage facility will be created by a solution mining process (leaching) in the salt strata beneath the Irish Sea, and will be connected by pipelines to an onshore gas processing plant that is linked to the National Transmission System.

The development of the offshore gas storage facility and the proposed onshore terminal in Barrow-in-Furness are both subject to planning consent.
Subject to receiving the necessary consents, the construction of the salt caverns is expected to begin in 2008 and completed in 2011. The construction of the gas reception terminal in Barrow is expected to commence in 2009.

The Gateway Storage project will have the potential to operate in tandem with an offshore LNG terminal regasification facility, though there are no immediate plans to take forward this as part of the gas storage facility.



Rationale

http://www.stagenergy.com/Gateway/rationale.html
The Gateway project will the security of energy supply for the GB and Irish markets through the development of a low cost, flexible, high capacity asset.

As the GB gas market moves from self-sufficiency to a rapidly increasing dependency on imports (80% by 2015), gas supply companies require competitive pricing and a high level of reliability and security.

To ensure future supply diversity and security, the British and Irish Governments are supportive of:

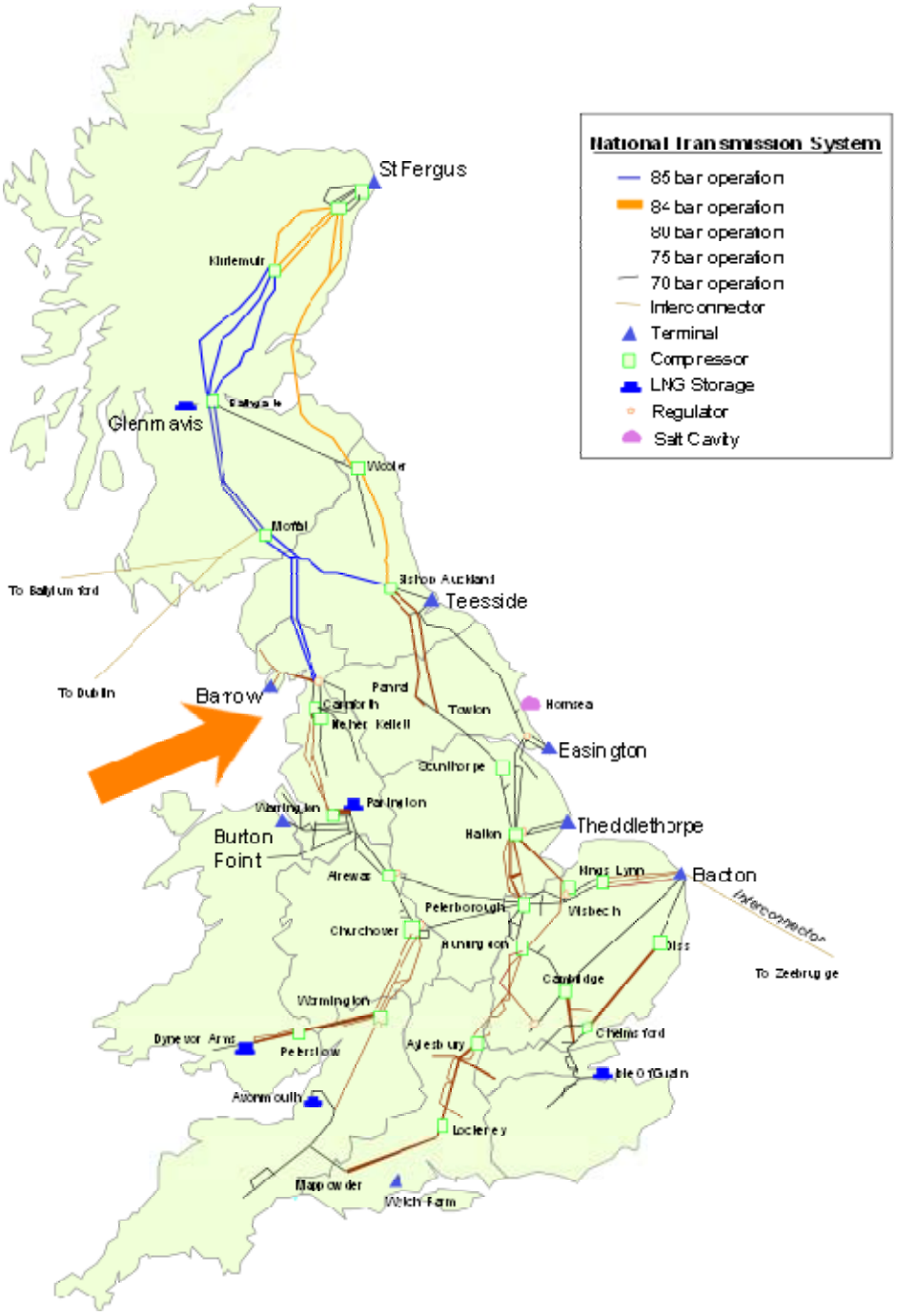
- Expansion of import capacity to re-establish the GB as a net gas exporter and "Gateway to Europe", on the basis of:
  - Increased pipeline gas from Norway and Russia
  - Greater LNG imports through a number of new LNG import terminals
  - A more diversified source of LNG supplies
- Development of additional offshore gas storage, where economies of scale enable:
  - Support for gas trading/arbitrage between the EU and North America
  - Competitive gas pricing and flexible supplies
  - Increased security. Northern European countries generally hold more than 20% of annual gas consumption in storage, while the UK currently has storage capacity for just 4% of annual gas demand

Location

http://www.stagenergy.com/Gateway/location.html

Gateway is located in the East Irish Sea ~25km south-west of the gas terminal at Barrow-in-Furness. The location provides the best salt structure that has been identified in Britain to support the development of salt cavern gas storage facilities. Gas pipeline capacity is available at the Barrow terminal, due to the decline in production from Morecambe Bay gas fields, resulting in minimal new investment requirements to connect the proposed facility. The area also currently hosts a number of offshore oil and gas operations which are ideally situated to provide operational infrastructure, facilities and personnel.

The location is in close proximity to a number of conventional gas reservoirs which have the potential for conversion to further gas storage capacity. The water depth, and sea conditions, in the vicinity of the storage caverns are suitable to support the development of an offshore LNG terminal which would have obvious synergies with a gas storage facility.



Key Features

http://www.stagenergy.com/Gateway/key_features.html

Strategic:

- The British Government and DTI have acknowledged the importance of this type of facility to support their twin policy objectives of future security and diversity of energy supply

- The Joint Energy Security of Supply Working Group (JESS), an organisation responsible for GB energy security of supply, is encouraging new gas storage, pipeline interconnectors and LNG terminals over the next decade that can contribute to managing winter demand

- Offshore underground storage is more secure than onshore facilities, far less susceptible to accidents or terrorist acts, and likely to be much more acceptable to the general public

Commercial:

- Economies of scale ensure cost competitiveness with conventional onshore facilities

- Cost effective incremental expansion through additional salt caverns or the addition of a depleted gas reservoir

- Low cost mid-range and seasonal gas storage products in a market with substantial demand growth

- Planning & Permitting requirements for the Project governed by DTI and DEFRA with limited scope requiring Local Authority consent

Technical:

- Salt has been proven in the East Irish Sea with suitable thickness, depth, and purity for salt cavern construction

- The project will utilise conventional oil and gas technology for onshore and offshore elements of the Project

- Depleted reservoirs are located in the East Irish Sea with potential for conversion to seasonal gas storage

Planning & Consultation

http://www.stagenergy.com/Gateway/planning%20&%20consultation.html

The gas storage facility requires planning consent and environmental permitting. As a first step in the consenting process, detailed engineering design and environmental studies for the project are being undertaken. Part of this work includes the completion of Environmental Statements for:

- Offshore elements of the project, including the gas storage caverns and associated infrastructure as well as the offshore pipelines that will connect the facility to land
- Onshore pipelines across Walney Island to the mainland
- The proposed gas terminal at Barrow-in-Furness

The Environmental Statements will detail the potential impacts that the project could have on the environment and how Gateway intends to minimise these impacts. The Environmental Statements will consider a wide range of issues including any potential impacts on marine and bird life, the fishing industry, shipping movements, the ecology of the land, and local habitats. A specialist environmental and planning consultancy, Rudall Blanchard Associates Ltd (www.rbaltd.co.uk) has been commissioned to carry out this work.

An important first part of RBA's work is consultation with the relevant statutory authorities and other key civic and commercial organisations about the project's Environmental Impact Assessment (EIA). In April 2007, RBA issued its Environmental Impact Consultation Document to more than 20 different local and national organisations, and a further 50 have been sent a letter informing them of the project and that the Environmental Impact Consultation Document is available on request, or can be downloaded from this web site. The deadline for responses to the EIA document from these organisations is May 31st 2007.

For a copy of the Environmental Impact Consultation Document, please click here ie. http://www.stagenergy.com/News/Gateway_Environmental_Statement_April_07.pdf

Gateway Storage is wholly committed to public consultation and as part of the planning process will hold local information seminars in order to share its plans with local people and listen to their views about the project, and for local people to meet the development team. Details of such meetings will be advertised locally closer to the event. In the meantime, any questions about any aspect of the Gateway Storage project, please contact us via email at info@stagenergy.com or by phone on 0131 718 4258

For media enquiries, please contact Paul Taylor at Taylor Keogh Communications:

00 44 20 8487 8288 / 00 44 7966 782611; paul@taylorkeogh.com

Press Release

http://www.stagenergy.com/news.html

22/02/2006 - "Irish Sea Offshore LNG Import Terminal and Gas Storage Project will improve Security of Gas Supply for the UK & Ireland"

Apr 07 - Gateway Environmental Impact Consultation Document
08/10/2007 - "Public Exhibitions for Gateway Offshore Gas Storage Project"

Dec 07 – Onshore Gateway Environmental Statement – Non Technical

Oct 07 - Offshore Gateway Environmental Statement - Non Technical
Oct 07 - Gateway Brochure
19/12/2007 - "Barrow planning application press release"
29/10/2007 - "Gateway BERR & DEFRA applications release"
16/10/2007 - "Gateway post exhibition press release"

GATEWAY GAS STORAGE PROJECT BROCHURE:
http://www.stagenergy.com/News/Gateway_Brochure_Oct_07.pdf

GATEWAY GAS STORAGE PROJECT OFFSHORE ENVIRONMENTAL STATEMENT NON TECHNICAL SUMMARY October 2007:
http://www.stagenergy.com/News/Gateway_ES_Non_Technical_Summary_Oct_07.pdf

GATEWAY GAS STORAGE PROJECT ONSHORE ENVIRONMENTAL STATEMENT NON TECHNICAL SUMMARY December 2007:
http://www.stagenergy.com/News/Gateway_Onshore_Non_Technical_Summary_Rev_FINAL.pdf

Home

http://www.stagenergy.com/
http://www.stagenergy.com/home.html

Stag Energy is an independent UK based energy company involved in the development and management of innovative projects in the rapidly evolving electricity and gas sectors.

Our primary business focus lies with gas-fired power generation, underground

gas storage, LNG import terminals and hybrid power generation technologies.

Stag Energy works with partner companies wishing to invest in the UK and European energy markets, and who wish to ensure assets are structured to manage commercial risk.

Projects

http://www.stagenergy.com/projects.html

Stag Energy is focused on developing projects in the UK and continental Europe, in the following areas:

- Power Generation: Building on extensive experience in this sector, Stag Energy is involved in new gas-fired development prospects at a number of sites
- Gas Storage & LNG: Facilities both onshore and offshore in recognition of the increasing role of gas in the European energy mix
- Alternative Energy: With knowledge and experience in power generation and underground storage, Stag Energy is progressing forward initiatives to assist in modulating energy supply from intermittent renewable resources
- Transmission Systems: Stag Energy brings project development expertise to ensure a secure infrastructure is available to convey produced energy to the point of use

About Us

http://www.stagenergy.com/about_us.html

Stag Energy was founded in 2002. Stag's senior management have worked together for many years, and have an established track record of project origination, development, execution and portfolio management within the mid-stream energy sector.

Stag Energy draws on a depth of experience with a team that has created and delivered over 10,000 MW of power generation and related infrastructure projects, raising over $6 billion in commercial debt to support the investments. The company's extensive commercial experience has ensured well structured, secure investments that have created value for investors in:

- Gas-fired power generation
- Gas storage – salt cavern and depleted reservoir
- Associated transmission systems – electricity, gas, water and oil

George Grant

George has worked in the power generation and gas infrastructure sectors for over two decades. Prior to the establishment of Stag Energy, George was Regional Executive for InterGen's activities in Europe, Middle East and Africa, responsible for investments totaling nearly $6bn. George also spent 4 years based in Hong Kong as Regional Executive for Asia-Pacific following the establishment of a UK business and was based in the US as the independent power sector began to evolve. George has established a track record of establishing and building businesses in new markets to create and deliver value to investors and shareholders

Andrew Stacey

Andrew spent 12 years running ASEC energy sector consultants following 15 years global experience with BP, Britoil and BNOC. Most recently Andrew has specialised in bringing forward developments in the electricity and gas markets, having managed gas storage and power projects from early stage development through to financial close. His foresight and innovation over the past ten years has succeeded in securing projects with a combined value in excess of $1.5bn.

Mark Rigby

Mark has combined energy marketing and trading management roles with corporate strategic analysis work for the past 25 years. Mark joined the newly privatised Powergen in 1992 where he was head of Corporate Strategy and subsequently went on to set-up and lead their UK commodity trading activity. In 1998 he joined InterGen to set-up the company's new trading and risk management activities in support of the company's gas fired generation portfolio. Prior to entering the power sector, Mark spent 15 years with Shell International involved in trading industrial gases, and corporate strategy for the Shell Group.

Norman Campbell

Norman has worked within design, construction and operations in the energy sector for over 20 years. Before joining Stag Energy, Norman was Director of Brindisi LNG for BG Group and responsible for the execution of a €500m LNG terminal. From 1995 to 2003 Norman was Vice President Construction and Operations, where he oversaw the establishment of a 2,500MW portfolio in the UK, the negotiation of 3,500MW of projects in Turkey along with groundbraking projects in the Netherlands and Egypt. Prior to joining InterGen, Norman worked as General Manager with John Brown Engineering following a number of years as contract manager with Babcock & Wilcox.

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APPENDIX 2: PORT MERIDIAN OFFSHORE LNG TERMINAL by Höegh LNG

Focus

http://www.hoegh.com/lng/business_development/focus/

The global market for LNG transportation is very strong, and the market is dominated by a few, large operators, either in close connection with the major energy companies or as independent shipping operators. In this competitive market, Höegh LNG must position itself such that it can find new ways to add value to its customers, and thereby remain competitive and profitable.

The best example of the success of this strategy for standard LNG shipping is the two new vessels constructed for the Snøhvit LNG project. The vessels in the Snøhvit fleet are the only LNG vessels specifically designed for trading in North Atlantic and Arctic conditions currently in operation.

As for success with our Floating Regas Solutions, we made a major breakthrough in this segment when Höegh LNG and its longtime partner MOL in April 2006 placed orders for 2 Shuttle and Regasification Vessels (SRV) at Samsung Heavy Industries in Korea, for servicing the Neptune LNG terminal project offshore Boston in the US.

Based on the experience gained from the Neptune project HLNG is now developing our own DWP terminals , PD Offshore Tampa on Florida's west coast and PM Offshore Morecambe Bay in the Irish Sea.

Demand currently outstrips supply of LNG and this shortage is expected to increase the coming years. The market situation, economics and availability of stranded gas are the main reasons why HLNG chose to enter into the production segment. HLNG are currently performing a pre-feed for an LNG FPSO . Höegh LNG's strategic focus going foreward will therefore be to continue to build on recent success and explore new segments where we can offer added value to our customers by offering a complete package of Floating LNG Services by pursuing activities that are based on:

a) Production: Floating Production Storage and Offloading (FPSO)
b) Maritime Transport: Shuttle and Regas Vessel/standard LNG carrier
c) Regasification: SRV/Floating Storage Regas Unit (FSRU)
d) Market Access: Deep Water Port (DWP)/FSRU (offshore/key moored

About Höegh LNG

http://www.hoegh.com/lng/about_hlng/

Höegh LNG is an independent, privately held provider of maritime LNG transportation and regasification services. The company structure consists of Höegh LNG Limited, which is the shipowning company based in Bermuda, and Höegh LNG AS, which is the company in charge of all management, technical and commercial activites, based in Oslo, Norway.

Höegh LNG is a pioneer in LNG transportation with over 30 years experience dating back to the delivery of Norman Lady in 1973. Currently, five LNG carriers are operated by Höegh LNG, with two Shuttle and Regasification Vessels on order at Samsung Heavy Industries in Korea. With a strong emphasis on technological development and operational excellence, Höegh LNG is one of the LNG shipping companies with the most versatile operational experience and substantial know-how, in addition to an impeccable safety record.

Höegh LNG's core product is LNG transportation services, with the in-house ship management based in Oslo. The two LNG carriers Arctic Lady and Arctic Princess, both dedicated to the Snøhvit project, are the latest contribution to our fleet, and they are on charter for Statoil and Total. The arctic environment calls for distinctive vessel characteristic, and they have both gone through extensive winterization to secure safety and operational sustainability.

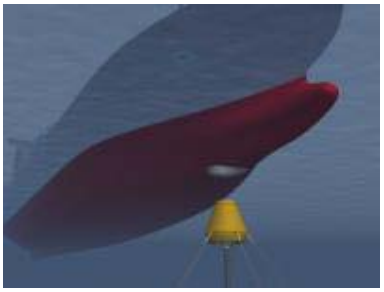
Höegh LNG is actively pursuing new and enhanced ways of natural gas transportation services. The Deep Water Port project, founded on the SRV technology, will offer our customers a complete service, comprising transportation, regasification, terminal services and market access. Our team is working on sites in the Atlantic basin, currently Höegh LNG is developing the Neptune DWP together with Suez LNG North America, 10 miles off the coast of Massachusetts. Further, Höegh LNG has through its wholly owned company Port Dolphin Energy LLC proposed a deepwater port LNG receiving terminal, Port Dolphin, to import natural gas to Florida's west coast.

Höegh LNG is an active player in the development of vessel features aimed at the exacting requirements of the Arctic environment. In addition, Höegh LNG has played an important role in a joint industry project with the aim to develop the Amplitude LNG Loading System for offshore LNG transfer. Höegh LNG has also developed the Floating Storage and Regasification Unit, a semi-permanent floating offshore LNG receiving terminal. Höegh LNG is actively pursuing to develop technology for transportation of Compressed Natural Gas in the joint venture company CeTech.

Höegh LNG - Floating Regas Solutions

http://www.hoegh.com/lng/business_development/floating_regas_solutions/

Höegh LNG is actively developing new marine transportation and terminal concepts for natural gas, which could also include the conversion of an existing LNG carrier into a terminal.



Höegh LNG's concepts include the Floating Storage and Regasification Unit (FSRU) and Höegh LNG's proprietary system, the "Shuttle and Regasification Vessel" or SRV. The SRV is also a "floating terminal" and can double as an FSRU. We will also offer marine transportation of Compressed Natural Gas (CNG) in co-operation with partners.

Höegh LNG has since early 2001 focused considerable effort in developing and promoting floating LNG regasification terminals, and this was crowned with success when the Neptun vessels were ordered in 2006. It is increasingly difficult for environmental, safety and security reasons to find suitable locations and obtain permissions to build new traditional onshore LNG receiving terminals in several important gas markets around the world.

We are confident that there is a sizeable world-wide potential for such concepts, and we therefore intend to pursue this to its fullest potential.

Midstream LNG value chain

The LNG Floating Storage and Regasification Unit (FSRU)

http://www.hoegh.com/lng/business_development/floating_regas_solutions/fsru/

A Floating, Storage and Regasification Unit or FSRU is a semi-permanent floating offshore LNG receiving terminal that will allow offshore discharge from conventional LNG carriers. The main advantage of the FSRU concept is the short start-up time, reliability and flexibility.

More Pictures...

The concept
An FSRU should be designed and classified as a ship under international rules and regulations. As a ship it will require dry-docking within maximum 5 years intervals, but as ship designed FSRU is less costly and has a shorter construction time than if it was classified as an offshore installation.

The FSRU can be offshore-moored or moored to a jetty. If moored offshore regasified LNG is discharged from the FSRU via a turret and swivel through a mooring and unloading buoy connected to a riser and subsea pipeline, designed by APL and based on their North Sea proven STL technology. (same buoy as the SRV system; which will allow a combination of an FSRU and SRV systems)

LNG is pumped from the tanks and sent to regasification units mounted on the deck of the FSRU. Pressure is boosted by large cryogenic LNG pumps. Steam generated by auxillary boilers in the vessel main engine room produces the heat necessary to regasify the LNG in the regasification unit's heat exchanger. The regasification units design has been developed by Hamworthy Gas Systems Norway.

The FSRU will be capable of disconnecting from the mooring buoy without assistance to move to a dry docking yard and also in case of hurricanes or extreme weather conditions within about 2 hours. It may also be relocated for commercial reasons to a new position, permanently or seasonally.

The FSRU may be a conversion or a newbulding. Conversion studies of our own vessels have been performed and no showstoppers have been identified.

An FSRU is also very flexible, it can be moved to new locations and it can also be used as a conventional vessel.

The benefits
The FSRU can be constructed within 36 months. With a 12 months permitting and design process and 2 months transit time from its construction site, a total of 50 months is foreseen from start to finish of such a project.

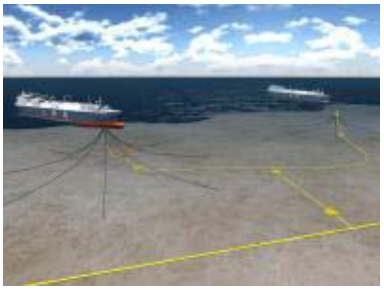
The FSRU will be very cost competitive compared with shore-based terminals and off-shore Gravity Base Structures. The LNG industry is extremely capital intensive however; solutions such as the FSRU and SRV can contribute to lower the overall costs.

In a similar fashion as the SRV, the FSRU has a major environmental advantage compared to shore based and offshore fixed gravity based terminals. The FSRU is cost competitive for medium to large regas volumes and medium to long shipping distances.

LNG Shuttle and Regas Vessel (SRV^{TM})

http://www.hoegh.com/lng/business_development/floating_regas_solutions/srv/

The SRV is an LNG vessel with onboard LNG vaporisers. The SRV system has been designed and developed by Höegh LNG, and normally encompasses a twin mooring and unlading buoy system and at least three SRVs to allow for continuous delivery of regasified LNG. Höegh LNG has two SRVs on order from Samsung Heavy Industries for delivery in 2009 and 2010 for the Neptune LNG deepwater port terminal project offshore Boston in the USA. The DWP projects Höegh LNG is developing - uses either SRVs.



More Pictures...

The concept
The SRV is a modified standard LNG vessel. The main additions to a standard LNG vessel will be:

- A cylindrical trunk forward of tank no 1. to accommodate the submerged turret mooring buoy and swivel system
- Skid-mounted regasification units on deck
- Bow- and stern thrusters
- Supplementary electrical power supply
- Supplementary steam production for regasification

The SRV can be a conversion or a newbuilding, and will also be capable of traditional delivery of LNG. Conversion studies of our own vessels have been performed and no showstoppers have been identified.

LNG is pumped from the tanks and sent to regasification units mounted on the vessel's deck. Pressure is boosted by large cryogenic LNG pumps. Steam generated

by auxillary boilers in the vessel main engine room produces the heat necessary to regasify the LNG in the regasification unit's heat exchanger. The regasification units design has been developed by Hamworthy Gas Systems Norway.

Regasified LNG is discharged via a turret and swivel through a mooring and unloading buoy connected to a riser and subsea pipeline, designed by Advanced Production Loading (APL) and based on their North Sea proven STL technology. Two separate buoys will ensure continuous send-out by overlap between arriving and departing SRVs.

The containment system can be either reinforced membrane type, Moss spherical tank type or SPB type. The important issue is to ensure that the containment system is designed to allow for maximum operational flexibility with regards to filling levels to ensure that sloshing does not occur during operation in exposed offshore locations with partially filled cargo tanks.

The benefits
By discharging the LNG through a SRV the need for a land based receiving and regasification terminal will be redundant. This has many obvious benefits, some of which are:

- No land or port requirements for the receiving terminal
- No physical encroachment to the local land based environment
- No visual impact from shore
- Shorter overall time to market
- Enhanced safety
- Higher delivery regularity, even in harsh weather conditions

Normally one additional SRV is required to deliver the same volume as a traditional solution due to the regasifiaction time of each vessel on the buoy. In spite of this, the economics of the SRV system compares very favourably to traditional LNG receiving terminals for small- to medium re-gasification volumes and short- to medium shipping distances (up to 4000 nmiles). The SRV system may be used in harsh- (and benign) environment world-wide.

SRV video

The FPSO project
http://www.hoegh.com/lng/business_development/fpso/

Höegh LNG has entered into agreements with CB&I Lummus and Aker Yards with intention to design and construct the world's first LNG FPSO (Floating Production Storage and Offloading) Unit.

The project will be managed and owned by Höegh LNG, with Aker Yard performing the work for the FPSO hull, containment and utility systems and CB&I Lummus doing the design work for the gas treatment and processing plant as well as the liquifaction and LPG plant.

The proposed project will consist of a ship shaped offshore classed structure with the capacity to treat and liquefy a well stream of approximately 2.5 billion cubic meters per year. This will give an annual production of approximately 1.6 million tons of LNG and approximately 0.5 tons of LPG.

The LNG FPSO will have storage capacity of 190,000 cubic meters of LNG and 30,000 cubic meters of LPG/condensate. The first delivery is stipulated to end 2011.

The strategy is to further develop Höegh LNG's business model from pure LNG transportation into offering also solutions for LNG production and floating regasification terminals.

Regas Unit

http://www.hoegh.com/lng/business_development/technology/

The onboard regasification units are skid-mounted and placed on deck. The regas units are very compact and can easily be arranged on deck in the required number between the spherical cargo tanks.The plant is designed to comply with IMO rules and will be delivered with appropriate certificates issued by the approving classification society. Three units will provide a regasification capacity of 750 million standard cubic feet per day and empty a 145 000 cubic meter tanker in approximately 4 days. By selecting the appropriate number of units the send-out capacity can be adopted to the specific needs of a project. Additional units and an additional flexible export riser will allow a doubling of the capacity and cutting down the regasification time.

The regas units design has been developed by Hamworthy Gas Systems Norway

The Unloading Buoy

http://www.hoegh.com/lng/business_development/technology/apl_buoy/

Natural gas (CNG or regasified LNG) at 80-120 bar is discharge via a trunk in the forward part of the vessel which houses the turret buoy mating cone and swivel system adapted for high pressure natural gas.The SRV or FSRU is capable of staying moored to the transfer system at a location offshore and perform its send-out function in severe weather conditions.

Photo: Advanced Production and Loading AS

More Pictures...

Offshore LNG Transfer

http://www.hoegh.com/lng/business_development/technology/lng_transfer/

Through the participation in a Joint Industry Projects (JIP) with, among others BP, ChevronTexaco, Eni Agip division, Gaz de France & Co and Total, Höegh LNG is contributing to the development of the Amplitude LNG Loading System (ALLS) which is pushing the frontier of offshore LNG transfer.

More Pictures...

Side-by-side loading and discharge of LNG carriers from or to an offshore floating or fixed terminal is considered feasible in benign waters, but not currently undertaken. Currently Chiksan type loading arms consisting of fixed pipes and swivels with relatively limited operating envelope are available for regular loading and discharge operations. The offshore terminals under development are all proposed with a marine version of such loading arms but flexible hoses is currently being developed for

commercial use. A tandem or bow-to-stern transfer system should increase regularity and operability even further, in particular for more exposed locations.

Höegh LNG believes that finding a reliable solution to this “missing link” is of crucial importance, and a concerted industry effort should be made to develop and standardise such equipment. Developments such as the flexible hose by Technip and the hose connectors by Amplitude LNG, should advance a reliable bow-to-stern transfer system.

The ALLS JIP aims to develop a system for transfer of LNG through a flexible hose (Technip) with specially designed end-connectors. The possibility for a reliable stern-to-bow transfer system will greatly improve the operating envelope of loading and discharge of LNG in open sea conditions. The equipment will also have an important safety function, allowing emergency transfers of cargo at sea, improving the already high safety standars of the industry.

A full scale test plant at Gaz de France’s Montoir de Bretagne receiving terminal is under construction.

Höegh LNG is also participating in JIP Programme for a floating version of the Technip flexible hose. The aim of this JIP is to develop a floating fexible hose which can be used for offshore transfer of LNG where the hose is connected either to the LNG carriers midship manifold or to a specially design bow manifold.

APPENDIX 3: CONSULTATION ON THE GATEWAY GAS STORAGE PROJECT AND THE PORT MERIDIAN OFFSHORE LNG TERMINAL By BLACKPOOL COUNCIL

Blackpool Council
Customer First Centre
Municipal Building
Corporation Street
Blackpool
FY1 1NF

Tel: (01253) 477477
Mon - Fri 8am to 6pm
Sat 9am to 2pm

BlackPool Council - Agenda Information for Executive meeting

http://www.blackpool.gov.uk/Services/M-R/MeetingsMinutesandAgendas/Agenda.htm?ID=51697433

BLACKPOOL COUNCIL

EXECUTIVE

Members of the Executive are hereby summoned to attend a meeting as follows:-

Wednesday, 13th February 2008 at 5.00 p.m.
in Committee Room A, Town Hall, Blackpool

A G E N D A

ADMISSION OF THE PUBLIC TO MEETINGS
The Head of Legal and Democratic Services has marked with an asterisk (*) those items where he has reason to believe that consideration may need to be given as to whether or not a resolution excluding the public should be passed.

CONSULTATION ON THE GATEWAY GAS STORAGE PROJECT AND PORT MERIDIAN NATURAL GAS TERMINAL

Report

For queries regarding this agenda, please contact:
Lennox Beattie, Democratic Services Team Leader
Tel: (01253) 47 7157 or, alternatively, E-mail: lennox.beattie@blackpool.gov.uk

Published: 5th February 2008

BlackPool Council – Decision of Executive Members on the Gateway as Storage Project and Port Meridian LNG terminal

http://www.blackpool.gov.uk/democracy/agenda/viewdecision.aspx?guid=7836eb7d-ed26-4a24-814e-5e3e47285346

REPORT TO:	EXECUTIVE	DECISION NUMBER:	EX/17/2008
EARLIEST DATE FOR DECISION:	13th February 2008		

CONSULTATION ON THE GATEWAY GAS STORAGE PROJECT AND PORT MERIDIAN NATURAL GAS TERMINAL

Matter for Consideration:
To consider the Council's views on the proposed Gateway Gas Storage Project and Port Meridian Natural Gas Terminal within the eastern Irish Sea off the Fylde Coastline.

Information:
The Marine and Fisheries Agency have consulted Blackpool Council on the proposed construction of the Gateway Gas Storage Facility approximately 24 kilometres off the Fylde Coast in the Eastern Irish Sea.

The Project

Gateway Storage Company Ltd plans to develop an offshore underground salt cavern gas storage facility in the East Irish Sea, approximately 24 kilometres offshore of the Fylde coastline. The site was selected following assessment of a number of offshore areas around the U.K.

Natural gas will be stored in 20 man made underground caverns created in the salt strata underlying the Irish Sea. The caverns will each have a diameter of approximately 85 metres and a height of between 100 and 260 metres. The roofs will be at a depth of 750 metres below the sea bed. When completed, the caverns will have a working gas capacity of 1.136 billion cubic metres.

The storage facility will be connected by import and export ring main pipelines to a gas processing plant at a proposed onshore terminal on Walney Island near Barrow-in-Furness. The facility will be connected to the National Transmission system at Barrow.

Above each cavern, there will be a monopod, similar in design to a small oil and gas platform These will be 50 metres in height to deck level and will house the wellhead equipment. These will be the only permanent visible elements of the installation from the Fylde Coast.

Once in operation, there will be an approximately 12 square kilometres exclusion area around the installation.

The Programme

Subject to consent, it is proposed to construct the salt caverns between 2009 and 2013, with the first cavern becoming operational in 2011.

The Regulatory Framework

At present, there is no separate regulatory framework in the UK for the offshore storage of natural gas in this way. The Government is in the process of drafting new regulations as part of the Energy Bill but these are not expected to come into force until the summer of 2008. In the interim, the Department for Business, Enterprise and Regulatory Reform and the Marine Fisheries Agency have decided that the facility can be permitted through existing legislation. However, the nature of the project means that it requires a comprehensive Environmental Impact Assessment and an Environmental Statement to support consent applications. The Council is now being consulted on this Statement.

Impacts

Visual

Being 24 km (15 miles) off the Fylde Coast, the direct impacts on Blackpool during construction and operation will be negligible. A detailed assessment has been undertaken to determine the potential for significant impact on the landscape, seascape and visual environment. Construction shipping and the monopod platforms will be visible on the skyline on a clear day but the Environmental Statement concludes that visual impacts will be small or negligible and that the on going visible elements of the installation should be no more than a curiosity for sea front views.

Ecological

Potential ecological impacts result primarily from increased salination from brine discharges when the caverns are being constructed. It is primarily a matter for environmental and ecological organisations to comment on these issues. However, although there will be minor impacts on fish and shellfish and benthic (seabed) communities, the Environmental Statement does not raise any issues of significant ecological concern unless there is a single catastrophic collision incident during construction (see below).

Air Quality

At the nearest shore locations, calculated levels of exhaust gases from drilling rigs and associated vessels during construction will be consistent with good air quality standards.

We are advised that there will be no emissions from the site when the facility becomes operational.

Health and Safety

Of greatest concern to Blackpool is the potential for any impacts on health and safety arising from the risk during construction or operation.

To mitigate against the potential for oil spills from drilling rigs and vessels involved with offshore construction, Gateway will prepare a full Oil Spill Contingency Plan and an Emergency Procedures Plan will be in place prior to any drilling operations taking place.

The Environmental Statement does not cover risks of explosion. We are advised that if permits are granted for the operation, the Gateway project will be required to operate under the Offshore Installations (Prevention of Fire and Explosion and Emergency Response) Regulations 1995. The arbiter in these matters will be the Secretary of State as advised by the Health and Safety Commission. Notwithstanding this, Gateway has assured us that there is no risk of underground explosion.

Conclusion

The direct impacts of the Gas Storage Facility on Blackpool during construction and operation, as set out within the Environmental Statement, are expected to be minimal.

Assurances have been given that the facility will not present any significant health and safety risk to Blackpool. Oil spills will be a negligible risk. However, officers are satisfied that best practice contingency measures will be put in place to guard against these.

We have also been given assurances that there are no explosive risks. However, this absolute assurance from the Health and Safety Commission would be sought.

Officers therefore recommend that the Council advises the Marine and Fisheries Agency that it has no objections to the proposed Gateway Gas Storage Facility, subject to receiving assurances from the Heath and Safety Commission that there will be no risks of explosion from that facility to Blackpool residents or visitors.

The Council has also been consulted for its initial views on a proposal to develop an offshore natural gas terminal 35 kilometres off the Fylde coastline by Rudall Blanchard Associates on behalf of Hoegh LNG. This will involve gas tankers unloading natural gas into an undersea pipeline for export to shore at Walney Island where it will enter the national transmission system. This is not connected to but could operate in parallel with the Gateway proposal.

There will be no permanent visible elements and any health and safety concerns are only likely to relate to the need to mitigate against the potential for oil spills.

Officers therefore recommend that the Council advises that it has no initial issues of concern but that assessment of pollution risks be incorporated into the proposed Environmental Statement.

Does the information submitted include any exempt information? NO

Legal Considerations:
None

Personnel Considerations:
None

Financial Considerations:
None

Performance Management Considerations:
None

Risk Management Considerations:
None to Council

Relevant Officer:

Tim Brown, Chief Planning Officer

Relevant Cabinet Member:

Councillor M. Callow

Consultation Undertaken:
None

Background Papers:
None

Is this a key decision? NO

Is the decision urgent? NO

Is the decision required in less than 5 days? NO

Recommendations:
That the Council advises the Marine and Fisheries Agency that it has no objections to the proposed Gateway Gas Storage Facility, subject to receiving assurances from the Health and Safety Commission that there will be no risks of explosion from that facility to Blackpool residents or visitors; That the Council advises that it has no initial issues of concern in regard to the proposed Port Meridian Natural Gas Terminal but that assessment of pollution risks should be incorporated into the proposed Environmental Statement.

Reasons for Recommendations:
As set out in the conclusion section of the Information

Is the recommendation contrary to a plan or strategy adopted or approved by the Council?	NO
Is the recommendation in accordance with the Council's approved Budget?	YES

Other alternative options to be considered:
None

Service Development Management Committee Chairman (where appropriate)
Date Informed: N/A
Date Approved: N/A

DECLARATION(S) OF INTEREST (if applicable)
None

Decision:
The Executive resolved as follows:To refer this item without recommendation to the Council for consideration and that the views of Council, be regarded as those of the Executive.

Date: 13th February 2008

Reason for Decision:
To enable full discussion and consideration of all relevant issues.

Date of Publication: 15th February 2008

APPENDIX 4: GATEWAY GAS STORAGE PROJECT – OFFSHORE ENVIRONMENTAL IMPACT STATEMENT

http://www.stagenergy.com/News/Gateway_ES_Non_Technical_Summary_Oct_07.pdf

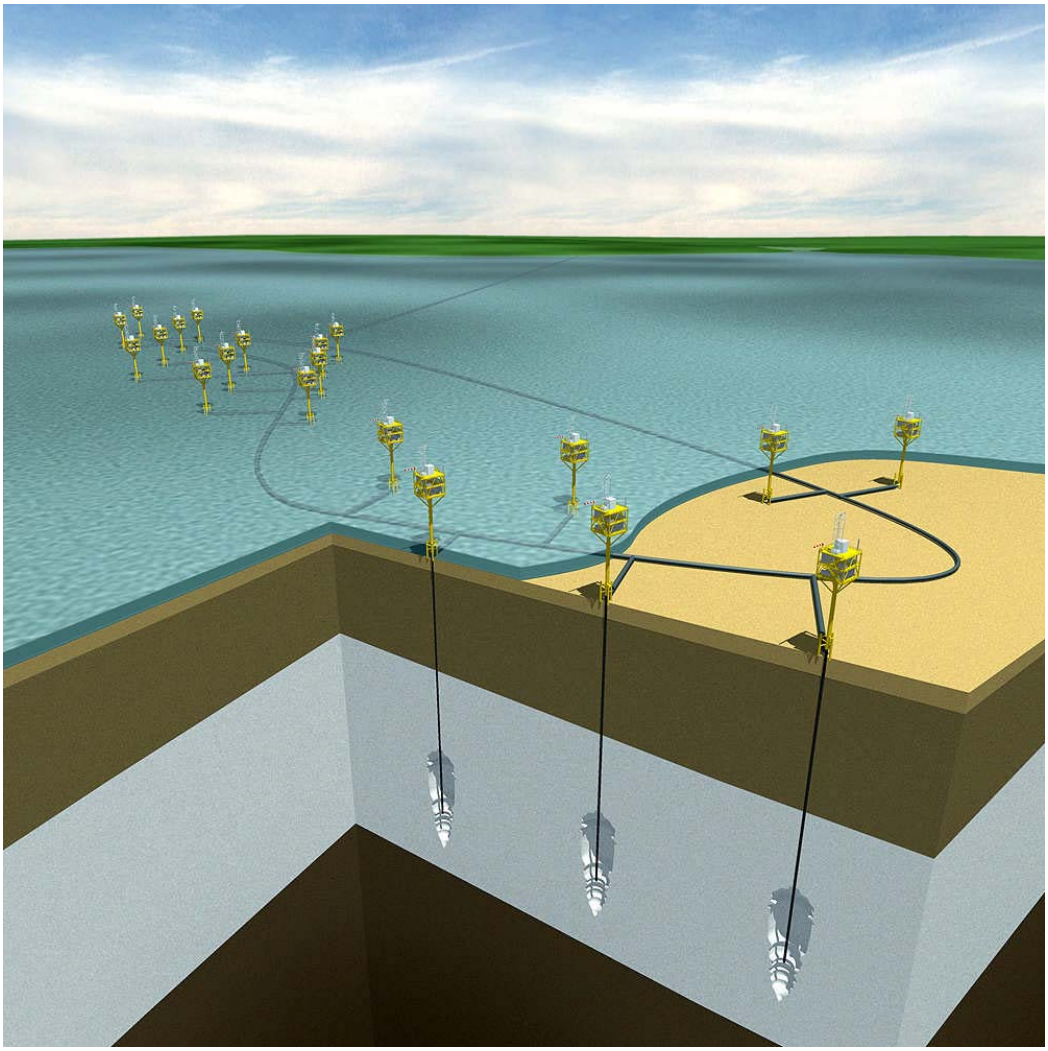
APPENDIX 4: GATEWAY GAS STORAGE PROJECT – OFFSHORE ENVIRONMENTAL IMPACT STATEMENT

http://www.stagenergy.com/News/Gateway_ES_Non_Technical_Summary_Oct_07.pdf

GATEWAY GAS STORAGE PROJECT

OFFSHORE ENVIRONMENTAL STATEMENT

NON TECHNICAL SUMMARY



October 2007

Introduction

An Environmental Impact Assessment (EIA) has been undertaken for the proposed Gateway Gas Storage Project (GGSP). This process analyses the proposed project in relation to the existing environmental conditions, using a combination of field surveys, desktop studies and modeling techniques, to ensure that all potential impacts are identified and appropriately assessed.

It examines in detail the need for the project and its design, construction, operation and decommissioning. For those impacts that have been assessed as being unacceptable, appropriate mitigation measures have been identified. An integral part of the EIA process has been an extensive consultation process undertaken with statutory and non-statutory consultees, interest parties and the general public. This document is the Non Technical Summary of the Environmental Statement (ES), which reports the findings and conclusions of the EIA process.

The Project

The Developer

Gateway Storage Company Ltd (Gateway) is the holding entity for the proposed GGSP. The company was registered in Scotland in 2006.

Stag Energy Development Company Ltd (Stag) provides the Project Management under a Management Services Agreement with Gateway. Stag is an independent UK based company that specialises in the development and management of innovative projects in the rapidly evolving gas and electricity sectors.

Stag has a detailed working knowledge of the offshore energy sector, its working environment, regulatory background and associated contracting industry. Stag organisation includes personnel with UK and international oil industry experience in the exploration and production, and asset management sectors at both senior management and technical management level. Stag also has considerable experience in the development of onshore salt cavern gas storage projects in the UK.

Project Overview

Gateway is proposing to develop an offshore gas storage facility in the eastern Irish Sea. The objective of the development is to store natural gas offshore in underground caverns, created specially in the salt strata underlying the Irish Sea. For ease of reference throughout the remainder of this document, the various components of the Gateway development are referred to as follows:

- Gateway Gas Storage Project (GGSP): refers to all offshore and onshore parts of the development;
- Gateway Gas Storage Facility (GGSF): includes the gas storage caverns, and associated monopods, and pipelines/cables;
- Offshore GGSP: includes the GGSF plus the export/import pipelines and cable from the GGSF to the west coast of Walney Island (low water mark).
- Gateway Gas Compression Station (GGCS) refers to the onshore gas treatment and metering facility located adjacent to the Barrow Gas Terminals.

Over the past 40 years the UK has become reliant on gas for a major portion of its energy supply. This situation evolved as the UK had plentiful, low cost supplies of gas that were easy to access from the North Sea and Irish Sea. These reserves are now declining and the UK is becoming increasingly dependant on gas imports, principally from countries like Norway and Russia. This has implications for security of supply, particularly during periods of peak demand, and it is envisaged that gas storage facilities will play an important role in stabilising future energy prices for the UK.

At present, storage capacity in the UK stands at around five percent of annual demand, compared with an average of around twenty percent in other Northern European countries. The Department for Business Enterprise and Regulatory Reform (BERR – formerly the DTI), has acknowledged the need for additional gas storage in the UK, citing in its 2006 Energy White Paper, the need for additional gas storage facilities to be developed. Given this, Gateway see a clear need for the Gateway Gas Storage Facility (GGSF), which once commissioned, will help to substantially improve the security of energy supplies for the UK and Irish markets. The proposed GGSF will be located approximately 24 kilometres offshore of the Fylde coastline in the eastern Irish Sea, (Figure 1).

Figure 1: Gateway Gas Storage Project Location Map

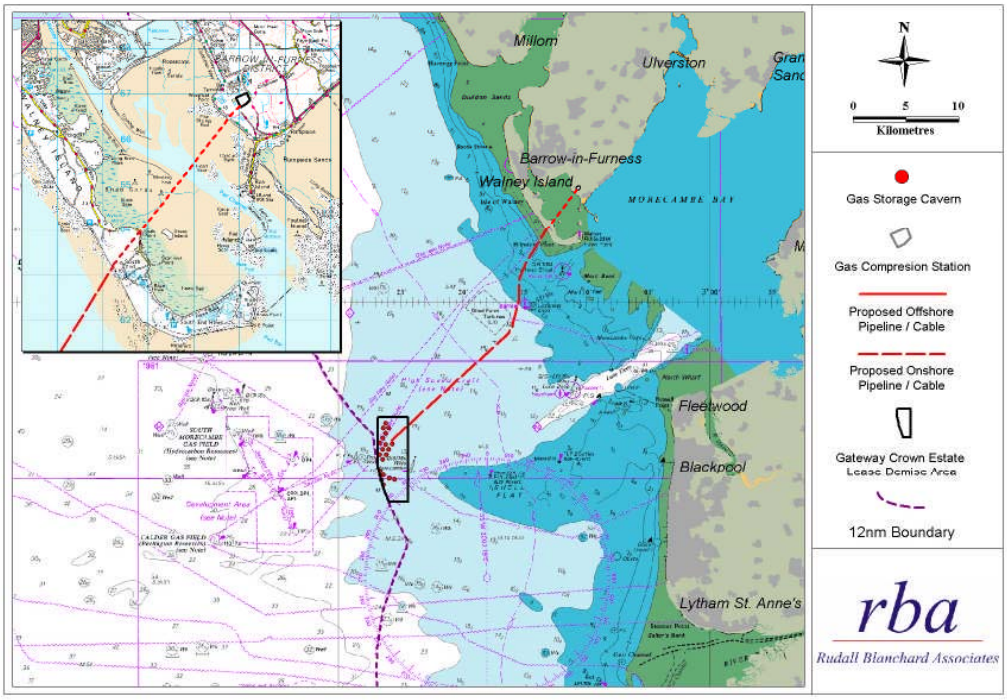
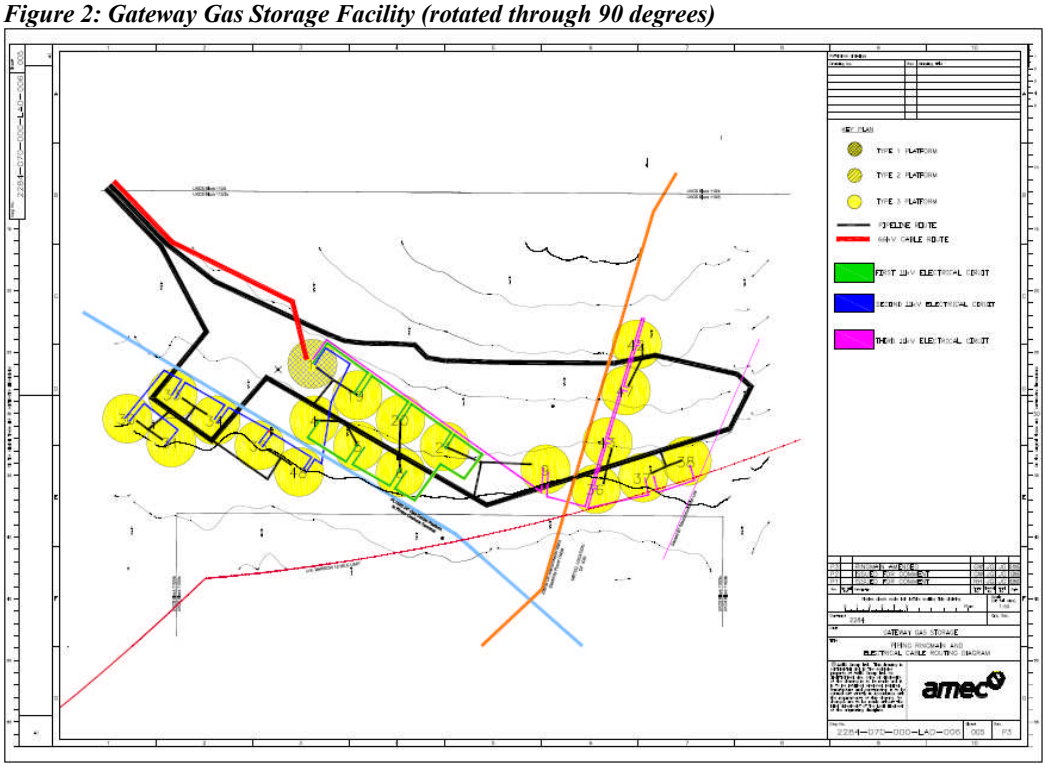


Figure 2: Gateway Gas Storage Facility (rotated through 90 degrees)



Key
Yellow: Caverns
Black Pipeline Ring Main and Feeder Pipes
Red: Main Power Cable
Green, Dk Blue Feeder pipes and cables
and Pink:

The GGSF will comprise 20 man-made underground storage caverns, which will be created by a solution mining process (leaching) in the salt strata beneath the Irish Sea. The technology is well proven and salt caverns have been used for storing gas and liquids for many years. When completed they will have a working gas capacity of 1.136 billion cubic metres (BCM). The caverns will be connected to a 'ring main' by a short pipeline and isolation valve (Figure 2). Two pipelines and a power cable will connect the offshore ring main to a new Gateway Gas Compression Station (GGCS), located onshore at Barrow-in-Furness. A pipeline and metering system will connect the GGCS to the National Grid Gas (NGG) National Transmission System (NTS) adjacent to the GGCS in Barrow-in-Furness.

The GGSF will be powered by a new power cable that will be installed at the same time as the offshore pipelines.

During operation, when demand for gas is low, e.g. during the summer months, gas will be taken from the NTS, compressed at the GGCS and injected into the caverns for storage offshore. When demand for gas is high, e.g. during winter, the gas will be withdrawn from the caverns, processed and routed into the NTS. The gas quality will comply with NGG standards.

Provided that the necessary consents are obtained, the salt caverns will be constructed between 2009 and 2013, with the first cavern becoming operational in 2011. Installation of the pipelines and power cable will take place during 2009/2010. Construction of the onshore gas reception terminal is expected to start in 2008 and be commissioned in early 2010.

Regulation

At present there is no separate regulatory framework in the UK for the offshore storage of natural gas in non-hydrocarbon features such as salt caverns. The Government is in the process of drafting new regulations as part of the Energy Bill, which will enable licensing of gas storage under the Petroleum Act. These regulations, however, are not expected to come into force until the summer of 2008.

As an interim measure, BERR and the Marine and Fisheries Agency (MFA) have jointly decided that the offshore GGSP can be permitted using a combination of existing legislation, namely the Petroleum Act, 1998, the Food and Environment Protection Act (FEPA) 1985 (Section 5) and the Coastal Protection Act (CPA), 1949 (Section 34).

The nature of the proposed GGSF means the project will require a comprehensive EIA and an ES to support consent applications.

The onshore component of the GGSP will comprise the GGCS and the export/import pipelines and power cable from the lower western shoreline at Walney Island to the Barrow Gas Terminals (location of the GGCS). These elements of the project will be consented under the Town and Country Planning Act (1990) and are the subject of a separate EIA process.

Site Selection

Selection of a suitable offshore site for the GSF was initially driven by the following criteria:

- Suitable geology,
- Access to the NTS,
- Health and Safety,
- Environment, and
- Employment.

Of these, suitable geology was the most fundamental. Gateway reviewed a number of offshore areas around the UK concluding that the best geological conditions for salt cavern gas storage lay within the Preesall Halite Formation (Triassic) in the East Irish Sea basin. Given this, two potentially suitable areas were selected: offshore the Fylde coastline and further to the North, offshore Walney Island.

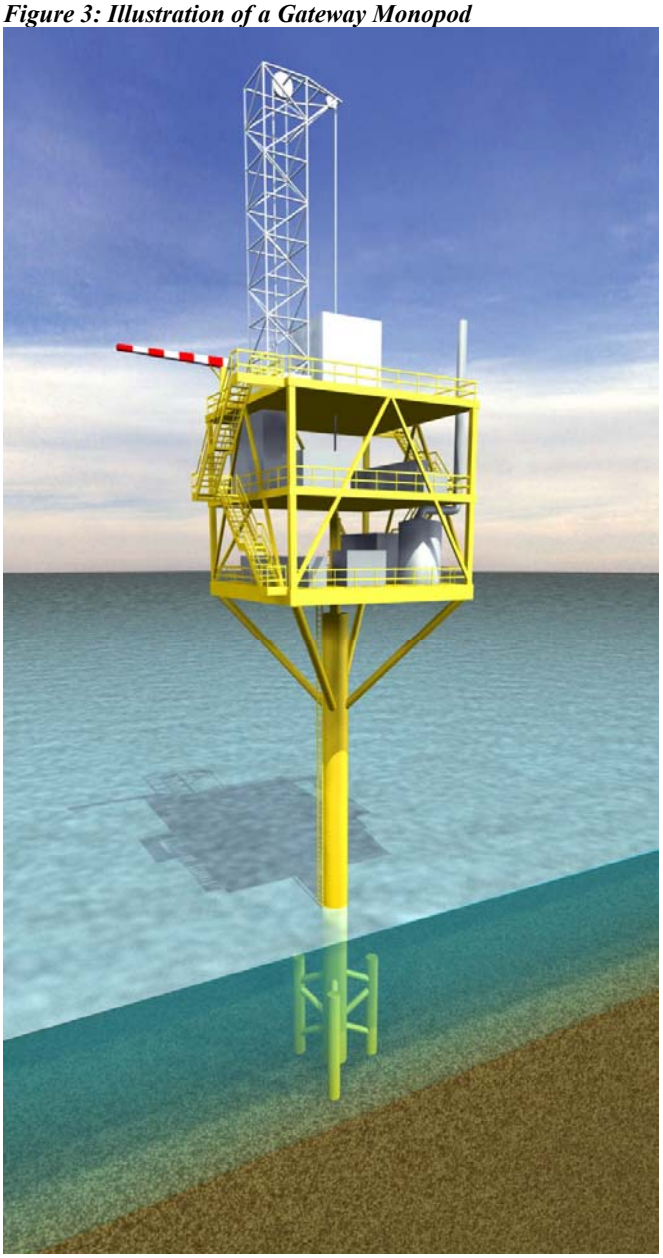
The Walney area was rejected on grounds of potential geological complexity and its proximity to major shipping lanes and two large potential offshore wind farm (OWF) developments. The site adjacent to the Fylde coastline was therefore chosen as the preferred area within which to locate the project, and a lease area was agreed with The Crown Estate (Figure 1).

To confirm the suitability of the salt formation Gateway carried out a test borehole in the centre of the lease area. Results confirmed that the permeability of the rock formation in which caverns are to be constructed is very low, and hence there is an extremely low risk of gas leakage through the cavern walls. Data acquired for determination of cavern gas pressures is very high quality, and therefore provides a high level of confidence in the design of safe caverns.

Monopod Offshore Structures

Above each salt cavern there will be a small offshore structure called a monopod, similar in design to a small oil and gas platform. These will have a dual role; initially to house the cavern leaching equipment, and then on cavern completion, to house the cavern gas well head and associated equipment (Figure 3). The monopod substructure will be installed first and secured to the seabed by piles. It is planned to install the piles by 'screwing' them into the seabed; impact piling methods will be avoided if at all possible due to the adverse environmental impact. The monopod topsides will be installed at a later date, after the cavern well has been drilled (see below), using a crane from a jack-up barge.

Figure 3: Illustration of a Gateway Monopod



Monopod Characteristics

Height above seabed: 50m (to top of Weather deck).
Weight: 150-200 tonnes.
Dimensions: 14m x 14m.
Substructure: Central tower (2.1m diameter).
4 smaller piles (1.0 m diameter).
Utilities: Electrical Power, Hydraulic Power and Nitrogen Generation.

A monopod located over each cavern location allows for individual brine discharge dispersion units, which will dramatically improve the dispersion efficiency of the brine discharges into the sea during cavern construction. This, together with the relatively deep water at the GGSF location, will help to mitigate any potential environmental impact.

Once the cavern has been completed, wellhead equipment will be located on the monopod rather than on the seabed. This will allow for simpler and safer operational maintenance, for example cavern re-entry 'workover' operations and equipment repair become greatly simplified if direct access is possible.

Cavern Creation - Drilling Operations

For the GGSF a total of 20 wells will be drilled into the salt formation, one for each cavern site. This will form the initial phase of the cavern leaching process. The wells will be drilled from a jack-up drilling rig similar to those used to drill oil and gas wells (Figure 4), and each well will take approximately 15 days to complete. The wells will be drilled through the monopod substructures prior to the installing the monopod topsides.

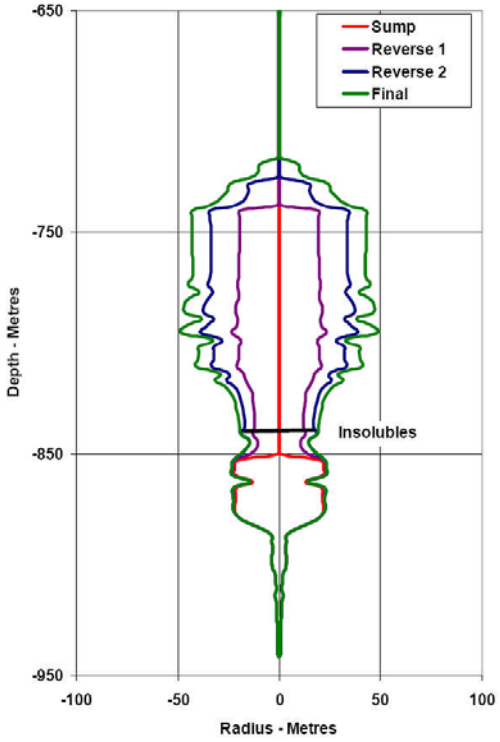
Figure 4: A Typical Jack-up Drilling Rig

Cavern Creation – Leaching Process

Once the vertical well has been drilled into the salt layers the cavern leaching process can commence. The caverns will be formed by injecting water under pressure into the selected halite strata which will form a cavity in the undersea salt bed. This turns the water into brine containing about 30 percent salt. The brine is then discharged to the sea.

Using this process the caverns will slowly be created over a period of about 2 years. When finished, the caverns will each have a diameter of approximately 85 metres (280 feet) and a height of between 100 and 260 metres (330 to 850 feet). The cavern roofs will be at a depth of 750 metres (about 2,500 feet) below the seabed (Figure 5). The leaching equipment will be housed on the monopods and will be controlled remotely from shore.

Figure 5: Illustration of Salt Cavern Evolution



Cavern leaching is programmed to commence in the third quarter of 2009, and be completed in mid 2013. At the peak of operations all 20 caverns will be undergoing the solution mining process; this peak period will occur in late 2010 to early 2011, lasting around seven months.

Offshore Pipelines and Power Cables

The main offshore GGSP pipeline will be arranged in the form of a large loop running to and from the GGCS at the Barrow Gas Terminals. It will comprise a 'ring main' surrounding the GGSF and two 24 kilometre long offshore import/export lines running from Walney Island to the ring main. All of these pipelines will have a diameter of 36 inches. Short lengths of smaller (10 inch diameter) feeder pipes will connect each cavern to the ring main (Figure 2).

The pipelines and cables will be installed using laybarges. The export and import pipelines will be trenched and allowed to backfill naturally – a method which has been successfully used for similar pipelines installed in the area. The majority of the pipeline route will be trenched using a plough, however, when necessary, e.g. at cable crossings, sediment jetting will be employed. The ring main and associated feeder lines may be buried along all or parts of their route, if so this will be undertaken by jetting.

There will also be a small 4 inch diameter methanol line piggy-backed (strapped) to one of the 36 inch pipelines. The methanol will be injected into the pipelines at the monopods to inhibit the formation of hydrates in the gas stream.

In order to supply electricity to the monopods, to power the cavern leaching pumps and gas well controls, a 66 kilovolt (kV) cable will be laid from shore to monopod No 1 (Figure 2). Power will then be distributed via 11 kV cables using three circuits with a maximum of eight monopods per circuit. There will be fibre optic cores within these cables running between the 19 monopods to monopod No 1. These will allow for operational communication and control and remote emergency shut down. As with the pipeline, the main 66 kV cable will be trench by ploughing, and allowed to backfill naturally. If the smaller cables are required to be buried, this will be undertaken by jetting.

Installation of the offshore pipelines and cable, including the landfalls, is anticipated to take approximately 20 months. Cable and pipelay and trenching activities are programmed to take place in 2009 and 2010.

Cavern Testing and Commissioning

When a cavern has reached the correct size the leaching process will be halted and the cavern will be pressure tested using Nitrogen. If the test is successful, then the cavern is ready to receive gas. Firstly the leaching tubing and associated equipment is removed and a gas wellhead is installed on the monopod. The wellhead is hooked up to the ring main via the feeder pipeline.

Prior to injecting gas into the cavern the emergency shut down (ESD) systems on the monopod will be tested, including links to fire and gas detection systems. Once all of the systems are ready a debrining process will be undertaken to remove the residual brine from the cavern. This involves connecting gas, from the ring main, to the wellhead and using the pressure to displace the brine out of the cavern. This process is effectively the 'first fill' of gas into a cavern. When all the brine has been removed, the gas storage cavern will enter normal operation. The de-brining process for each cavern is likely to take around three months to complete.

Operation

There will be two operational modes for the GGSF:

Gas Import - when gas is transported from the NTS. The gas will enter the GGCS at Barrow, where it will be metered and then compressed before exporting to the GGSF and injecting via the well heads for storage in the caverns. When the gas storage capacity of the caverns has been met, the gas flow from the NTS will automatically be stopped.

Gas Export - when gas is transported back to the NTS. Gas will flow from the salt caverns, via the well heads back to the GGCS. It will then be treated to control the flow rate, temperature, pressure and water dew point, thereby making it of a suitable quality for export back into the NTS. Finally, the gas will be metered before entering the NTS.

Operations will be monitored and controlled from a control room in the GGCS. There will be a fibre optic link between the monopods and the control room that will run down the centre of the power cable. Each monopod will be designed with its own independent ESD system that will be automatically triggered in the event of a hazardous event (e.g. gas leak, fire etc.)

The monopods are designed for operation as normally unmanned installations (NUIs) and maintenance philosophies will be developed to minimise the number of personnel visits. The equipment associated with the GGSF will be of high reliability allowing extended durations between maintenance interventions. It is presently anticipated that there will be a requirement for four maintenance visits per monopod per year, each lasting about a day. Each visit would typically involve one vessel, therefore, assuming a worst case scenario this would equate to 80 vessel trips per year.

Decommissioning

The design life for the GGSF has been set at 50 years. When the beneficial life of the facilities comes to an end a detailed Decommissioning Plan will be developed in consultation with the Statutory Authorities that will be fully compliant with legislation in place at the time. The four discrete phases of decommissioning typically entail:

- Shut Down of all facilities over an extended period to minimise any gas being retained within the plant.
- Moth-Balling – removal of all residual chemicals, lubricants etc. and isolation of all services to render the facilities safe for dismantling and demolition.
- Dismantling – any equipment that is still serviceable will be dismantled and re-used elsewhere.
- Demolition – any equipment that is beyond beneficial use elsewhere will be ultimately demolished and the materials re-cycled.

Based on current industry practice, on cessation of operation at the storage site, the caverns will be emptied of any remaining gas by filling with seawater and then plugged and abandoned in line with current UKOOA guidelines for well decommissioning, All surface obstructions, including the monopods will be removed.

Summary of the Results of the Gateway Offshore EIA Process

The Offshore EIA process has identified and assessed a wide range of potential impacts that the proposed Project could have on the local and surrounding physical, biological and socio-economic (human) environment. A summary of the key findings from this process is given below.

Physical Environment

Sediment and Coastal Process

The proposed offshore GGSP is likely to have a very localised impact on the waves, currents and the corresponding sediment transport regime within in the immediate vicinity of monopods but there is not anticipated to be any significant or measurable farfield impacts. Modelling of potential sediment scouring from the presence of monopod substructures indicated that scour depths of 1-2 metres could develop within a few years following installation. It is anticipated that scouring in the fine muddy sediments will likely be a gradual, but episodic process and it was concluded that scour protection is unlikely to be required around the monopods.

The impact on coastal processes in relation to the landfall of the pipelines/cable on the west coast of Walney Island will be discussed in the GGSP Onshore ES, which is being produced to support the planning application submitted to Barrow Borough Council under the Town and Country Planning Act, 1990.

Water Quality

Offshore discharges to sea will include the brine discharge from the cavern leaching process, drilling and completion chemicals and various drainage and personnel wastewater from vessels and the offshore facilities (e.g. rigs and the monopods).

Of these the brine discharge will be the most significant. The leaching process at each cavern will involve cycling large amounts of seawater through the well; thereby dissolving some of the salt in the deposit and discharging the resultant brine mixture into the sea via a disperser unit at a maximum discharged rate of 386 m3/hour. The maximum anticipated discharge salinity, which will occur during the cavern commissioning will be in the order of 7 times that of seawater (ca. 250 parts per thousand (ppt)), although it is anticipated to be much less than this during most of the leaching process. The maximum temperature of the discharge will also occur during the cavern commissioning period and is estimated to be 8.68o Celsius.

In order to assess the impact to the marine environment from the brine discharge HR Wallingford (HRW) were commissioned to undertake a modelling

study to determine the dilution and rate of dispersion of the brine plume around each of the monopods.

The initial dilution (at the point of discharge) was modelled using the CORMIX model. This indicated that the brine effluent would be best discharged through two 0.15 metre diameter horizontal ports located at right angles to the main current direction at about 10 metres above the seabed. This configuration would be expected to give at least a 33 times dilution at the point of seabed impact and a maximum salinity rise at the seabed of less than 7ppt.

Further dilution and dispersion modelling of the saline discharge by the tidal currents was then calculated using the 3D hydrodynamic model TELEMAC-3D. The model was run for spring and neap tide scenarios.

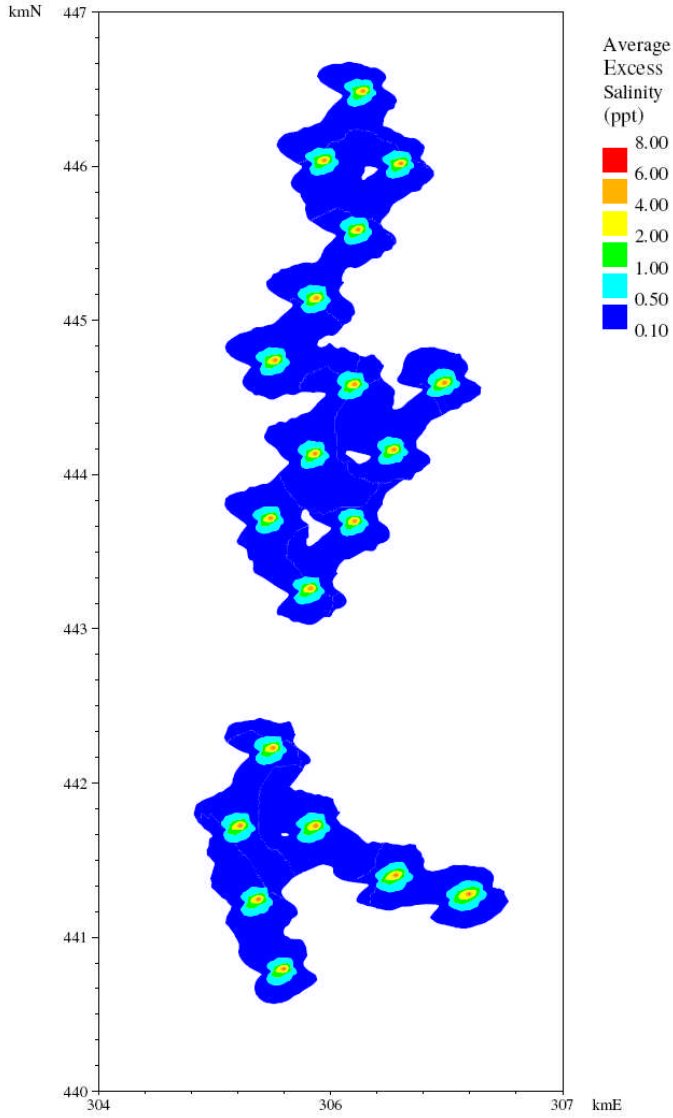
The saline discharge plume was shown to form a rotating pattern, with the plume extending southwest from the monopods at low water. These plumes narrow and rotate anti-clockwise as the current increases to peak flood and then broaden and rotate further to stream northeast at high water. They then narrow and rotate to stream toward the west at peak ebb before returning to the original shape at low water.

In conclusion, the TELEMAC-3D modelling results showed that the dilution and dispersion of the discharge by the tidal currents would result in a number of separate plumes from each monopod. It was predicted that there would be some merging of the plumes, but only at low salinities (less than about 1ppt above ambient) (Figure 6). The saline plumes are expected to be confined to the bottom 0.5 to 1.0 metres of the water column. Central concentrations are about 7ppt, consistent with the initial dilution (i.e. there is no significant build-up that would reduce the dilution efficiency). The average impact at more than 1ppt above ambient is expected to be confined to an area within some 100 metres of each monopod during spring tides and within about 300 metres of each offshore structure during neap tides.

With respect to discharge temperature, it is anticipated that the temperature will reduce to about 2o Celsius above ambient or less within 1 metre of the point of discharge. There will also be an insoluble fraction to the discharge, mainly comprising fine mudstone particles. Modelling of this fraction found that in all cases the suspended sediment concentration that results from the discharge was very low, less than 0.5ppm.

This is negligible compared with natural levels of suspended sediment and would not be expected to result in visible discolouration of the water.

Figure 6: Average Salinity on the Seabed during a Spring Tide



Air Quality

The exhaust emissions from the drilling rig, and other project associated vessels will cause a minor, temporary degradation of the air quality in the immediate vicinity of operations. Modelling of the largest output, from the drilling rig, has indicated that elevated levels of exhaust gases would decrease rapidly with distance. At the nearest shore locations calculated levels of all exhaust gases will be consistent with good air quality standards.

Marine Archaeology

Detailed geophysical and geotechnical surveys have been conducted in and around the offshore GGSP area which have not indicated the presence of any wrecks, prehistoric deposits, land-surfaces or artifacts. Based on the assumption that the site surveys already undertaken have fully assessed the area for the presence of marine artefacts, it is concluded that there will be no disturbance to marine archaeology as a result of the offshore GGSP.

Accidental Oil Spills

The drilling rig and some of the vessels involved with offshore construction operations will have on board large quantities of marine fuel, usually diesel. Although very remote, the possibility exists that an oil spill could take place that could potentially impact the local area.

In mitigation, Gateway will prepare a full Oil Spill Contingency Plan (OSCP) and an Emergency Procedures Plan will be in place prior to any drilling operations taking place to provide guidance on actions to be taken in the event of a release or spill. The OSCP will be supported by personnel trained in oil spill response and emergency management.

Biological Environment

Birds

The coastal area of the eastern Irish Sea is important for over-wintering, summer breeding and migrating bird populations. Of note within the vicinity of the development is the possible designation of Liverpool Bay as a marine Special Protection Area (SPA) for both common scoter and red-throated diver. Although common scoter have not been recorded in significant numbers within the GGSF area, high concentrations are present over Shell Flat during the winter months; particularly in February and March. Red-throated diver are mainly found in coastal waters particularly to the south of the GGSF area.

Birds within the GGSF area are unlikely to be directly affected by the brine discharge, particularly as many seabirds are tolerant of variable salinity conditions and are able to excrete excess salt via nasal glands. There is a possibility, however, that their food source may be impacted.

The main food source of common scoter consists of small fish and invertebrates. The closest aggregation of common scoters is approximately 2 kilometres to the east of the nearest gas storage cavern location. Modelling has shown that, although the discharge plume travels towards Shell Flat at certain times during the tidal cycle, salinity of greater than 1ppt above ambient is confined to a maximum area of 300 metres from each monopod during neap tides Given this, any impact on the common scoter's food source is likely to be negligible.

Scoter are very nervous birds and are easily disturbed by passing vessels. The presence of the Project, and associated vessel activity, are not anticipated to result in a significant impact as vessels will stay within existing well marked shipping channels and have no need to pass over the Shell Flat area on route to the GGSF.

There is also the potential for local seabird populations to be impacted if an oil spill were to occur in the project area. The most likely spill event would be a small spill of fuel oil (diesel). Impacts from small spills, i.e. less than one tonne, are likely to be restricted to the immediate vicinity of the source. Larger spills, as a result of a catastrophic event, e.g. a collision, have the potential to impact wider areas. The worst case would be a large diesel spill during the winter months (September to March) when there are very high numbers of overwintering seabirds, notably common scoter residing on the nearly Shell Flat. These populations could become significantly impacted. It should be emphasized, however, that such an impact is remote and would only be the result of a significant catastrophic collision incident.

In mitigation, Gateway will prepare a full OSCP and an Emergency Procedures Plan will be in place prior to any drilling operations taking place.

Overall, however, the impact to the local bird populations from all aspects of the offshore GGSP is considered to be negligible.

Benthic (Seabed) Communities

No benthic species of particular conservation importance are anticipated within the GGSF area or along the proposed route of the pipelines and cable. The most significant GGSP related impacts to benthic communities will be from:

- Discharge of waste cuttings from the drilling of the 20 cavern wells. Modelling indicates that the benthic communities up to 160 metres from the well will be impacted, mainly by burial from discharged cuttings. As the drilling mud associated with these cuttings will be water based and contain minimal contaminants, recolonisation of the area is likely to be rapid.
- Loss of some soft sediment habitat, due to installation of the monopod substructures, estimated at about 0.2 hectare;
- The brines discharged from the leaching process will sink to the seabed exposing the local benthic communities around each monopod to rapid changes in salinity. Modelling has indicated that this exposure is likely to be transient as a result of the shallow waters and tidal flow. Nevertheless, it is likely that there will be some impact on the benthic communities in the immediate area of the monopods for the duration that the discharge takes place.
- Temporary impact from the installation of the pipelines and cables. Although this will take place over a comparatively large area, any disturbance to the soft sediment faunal communities will be short lived and recolonisation is again expected to be rapid.
- Introduction of hard substrate (monopod substructures) plus any 'hard' material used for scour control will attract a new faunal community thus increasing the overall diversity of the area. The overall impact on the local benthic communities within the project area is considered to be minor.

Fish and Shellfish

Within close proximity of the GGSF area there are spawning areas for a number of fish species including cod, whiting, sole, sprat and plaice, and the area also may act as a nursery area for whiting, sole and plaice. The construction and operation of the GGSP is likely to result in only minor impacts to fish and shellfish populations. Possible impact could occur from:

- Piling activity. Installation of the monopod substructure will not employ hydraulic hammer equipment, if possible, however, this technique may be required depending on sediments in the area. Were it to be used a 'soft-start' procedure would be implemented which would slowly increase the level

of underwater noise prior to piling starting and thus ensure that fish have the opportunity to move away from the noise source.

- Discharges of drill cuttings and leachate brines and the disturbance of sediments during pipeline and cable installation could indirectly impact fish populations by reducing their local food sources, i.e. plankton and benthos. Modelling has shown, however, that impacts to these communities will be limited to the immediate vicinity of the operation. Overall, impacts on fish food sources are therefore considered to be negligible
- Electromagnetic emissions from subsea power cables. Electro-sensitive fish (sharks and rays) are unlikely to be impacted significantly by the subsea cable as the electrical field generated by cables will be minimised by insulation and burial.
- Sediment disturbance from pipe and cable laying operations. Migrating salmon and sea-trout could potentially be affected by sediment plumes from inshore pipeline and cable laying and burial operations. These operations, however, have been timed to avoid the period when adult salmonids are migrating to their natal rivers, which is usually between November and January.

The monopod substructures may result in some form of artificial reef effect, as fish tend to aggregate around objects placed in the sea. In the longer term, this may have a minor beneficial effect leading to an improved habitat biodiversity in the area.

Marine Mammals

Numbers of marine mammals are generally low within the GGSF area and therefore any impacts as a result of the construction and operations are not considered to be significant. Noise and vibration produced by vessel movements, drilling and construction activities, will be similar to those produced by existing offshore traffic.

It is not planned to install the monopod substructure piles using a submersible hydraulic hammer, however, if this is required then mitigation in the form of ‘soft start’ procedures will be carried out prior to piling operations.

Socio-Economic (Human) Environment

Employment

During the construction, installation and commissioning phase of GGSP, it is unlikely that many direct job opportunities will be created as most work will be undertaken by specialist contractors. Due to the technical speciality of the onshore pre-fabrication and construction work, it is considered unlikely that much of this work will be undertaken in the Barrow-in-Furness region.

During offshore installation and construction activities, the port of Barrow will be used where possible as a supply base for project associated rigs/vessels. The project will need to draw on some support services, which will potentially assist in sustaining employment levels or increase employment opportunities locally.

Once the facility is operational a small number of people will be required to operate and maintain the offshore facilities from the onshore control base located at the proposed GGCS in Barrow. With the decline in production from East Irish Sea gas fields, it is anticipated that existing personnel within the area will be used for this purpose, which will help sustain long term employment opportunities at these facilities.

Commercial Fisheries

The East Irish Sea ports have supported a commercial fishing industry since the early 1800s and although the industry has been in decline for a number of years there is still an active local fishery. The GGSF area is currently not heavily fished; however, it is still important to the local commercial fishing community in that it forms part of the wider network of fishing grounds within the eastern Irish Sea. Vessels fishing within the area are primarily demersal trawlers from Fleetwood.

During construction and installation of the monopods, pipelines and cables, and during drilling operations, a 500 metre diameter safety zone will be established around all vessels associated with these activities.

Once a monopod has been installed a permanent 500 metre safety zone will be set-up around the structure, creating a total exclusion area of approximately 12 square kilometres (1200 hectares) around all 20 structures. Fishing will therefore not be permitted within this area for the life time of the project.

Given that the GGSF area is not heavily fished, the EIA concluded that the presence of the facility on its own will probably not greatly impact the value of fishery in the area and is therefore unlikely to significantly impact the local fishing industry. It may, however, lead to some minor changes in local fishing patterns, with vessels having to travel around the exclusion zone in order to fish to the west of the development, outside of the 12 nautical mile limit.

Navigation and Shipping

A review of existing shipping traffic was undertaken for the GGSF area and showed that although there were a number of routes within the general area few would be directly impacted by the presence of the Gateway offshore facilities.

Traffic travelling between Heysham and the South Morecambe gas field will be the route most affected. These supply vessels will not be able to pass directly through the gas storage area and will need to re-route, either to the south-east or to the north-west of the development. Other vessels travelling North/South through the East Irish Sea are expected to move to the west of the GGSF area passing between the offshore structures and the South Morecambe gas field. Given the relatively low volumes of traffic affected, the overall impact on commercial shipping navigation is not considered to be significant.

In addition, it is anticipated that the project will not have a significant impact on recreational vessel activity in the area; given existing routes and the limited activity in the area.

Using modelling, a collision risk assessment has also been undertaken for the project. It was assumed that the worst case collision risk would be during the construction phase of the project when a jack-up rig, and attendant vessels, would be operating at several cavern locations. Assuming that a safety vessel equipped with standard marine radar would be on-site during the construction period the highest annual collision frequency was calculated to be 2.1 x 10-3 (corresponding to a return period of 476 years).
In mitigation, all planned offshore activities will be communicated through the correct notification procedures e.g. through Notices to mariners. Navigational aids will be placed on individual monopods, with additional aids placed on those monopods lying on the edge of the GGSF area. Trinity House is currently reviewing these navigation aid requirements, but it is envisaged that each structure will be fitted with white lights with 15 nautical mile range, and other measures e.g. additional lighting and buoys, are also being considered.

Gateway has committed in principle to contributing to the overall planned Vessel Traffic Service (VTS) for the North West area in order to enhance safety of

navigation.

Tourism

Due to its distance from shore, it is considered that the presence of the GGSF will generate little interest from either the local population or visitors to the area. From shore, the monopods will only just be visible on clear days and should only be of passing interest to people walking along the seafront.

Civil and Military Aviation

There are no identified impacts from the presence of the GGSF with regard to low level operational aviation activities, as none of the proposed offshore sites lie within the takeoff or landing zones of any aerodromes within the area. It is considered that the offshore GGSP will pose no risk to either civil or military radar or high level flight paths.

Offshore Oil/Gas and Wind Farm Operations

The only significant potential impact from the offshore GGSP on the existing oil/gas and wind farm infrastructure will be during construction and installation operations. There will be a requirement for the Gateway pipelines and cables to cross existing gas pipelines and power cables. The exact positioning of these crossings will be determined during the detailed project design stage and once established; crossing arrangements will be agreed with the pipeline /cable owners and operators. The exact type of crossing that will be used has yet to be decided and will be the result of discussions, although the types of crossing method are well defined.

Visual

A detailed assessment has been undertaken to determine the potential for any significant impact on the landscape, seascape and visual environment within a 40 kilometre radius of the proposed GGSP.
The studies included a ‘baseline’ assessment of the proposed GGSP in relation to the current operating offshore wind farm (OWF) at Barrow and other existing offshore gas field infrastructure. Whilst acknowledging that the proposed GGSF is not an OWF development, it is nevertheless in the form of an array of offshore structures therefore, for consistency, the study methodology for this assessment used guidance previously employed for other OWF developments in the East Irish Sea.

The seascape assessments were based on five Regional Seascape Units from the Duddon Estuary in the north to the Ribble Estuary and Sefton Coast in the south. In addition, six landscape character areas were identified within the study area from the West Cumbria Coastal Plain in the north to the Lancashire and Amounderness Plain and Sefton Coast in the

south.

An assessment was made for each seascape and landscape area based on its visual quality and sensitivity; and value and capacity to accommodate change. In summary, the results of the landscape and seascape assessment concluded that overall the construction and operation of the offshore elements of the GGSP development would result in either a small or negligible magnitude of change on the landscape and seascape character and consequently, throughout all areas, the significance of effects were assessed as being slight.

Following consultations with statutory consultees and the relevant Local Planning Authorities, a total of 7 viewpoints were selected to represent a range of the most sensitive viewpoint locations, i.e. those locations where any potential visual impact was greatest. The viewpoints included both coastal and inland locations at low level and elevated locations, ranging from Black Combe in the north, to St Annes Pier in the south.

In summary the results of the baseline visual impact assessment, concluded that from all seven viewpoints together with all other parts of the study area, the anticipated magnitude of change was assessed to be either very small or negligible and as a consequence the resulting significance of visual effect was either minor or negligible

Cumulative Impacts

Cumulative impacts are those that may result from the combined or incremental effects of past, present or future activities. While a single activity may not have a significant impact when treated in isolation, it may, when combined with other impacts occurring at the same time in the same geographical area, result in a cumulative impact that is significant. The most significant potential cumulative impacts are summarised below.

Figure 7 illustrates the past, present, and future developments that may result in a cumulative impact with the GGSF. This includes offshore wind farms (OWF), oil and gas exploration and production activities, other offshore infrastructure (pipelines and cables), marine aggregate extraction sites and spoil dumping sites. Also of note is the proposed Canatxx gas storage facility, which although based onshore has an outfall pipe for brine discharge located approximately 2.3 kilometres offshore of Rossall, near Fleetwood.

Shipping and Navigation

The main cumulative impact on shipping and navigation in the eastern Irish Sea will result from the presence of the OWFs, particularly if all current applications are developed. The physical presence of these developments will result in a cumulative loss of searoom and will, therefore, require a significant amount of vessel traffic to be re-routed.

Figure 8 presents the shipping survey data (one month) overlaid with the proposed location of the GGSF as well as existing and proposed locations of the OWFs. It can be seen that any traffic which is re-routed as a result of the different OWF developments should not be impacted by the GGSF as the majority of the OWF sites lie to the north or east of the GGSF.

Exceptions to this could occur during the construction phases of the various projects where traffic may be visiting from ports further afield.

Figure 7: Existing Offshore Infrastructure and Proposed Projects in the Eastern Irish Sea

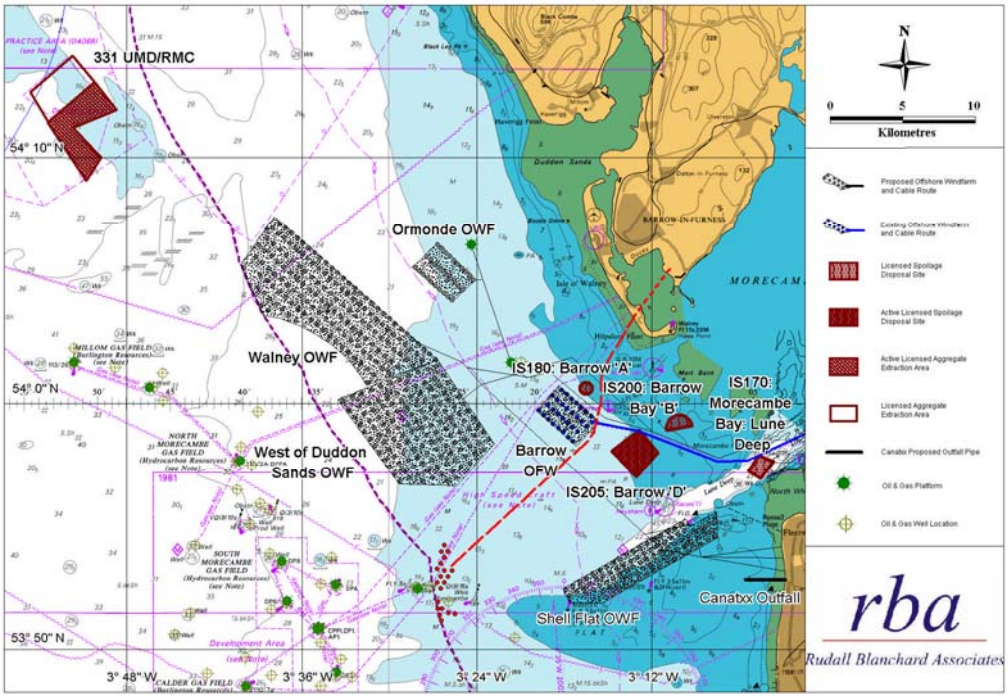
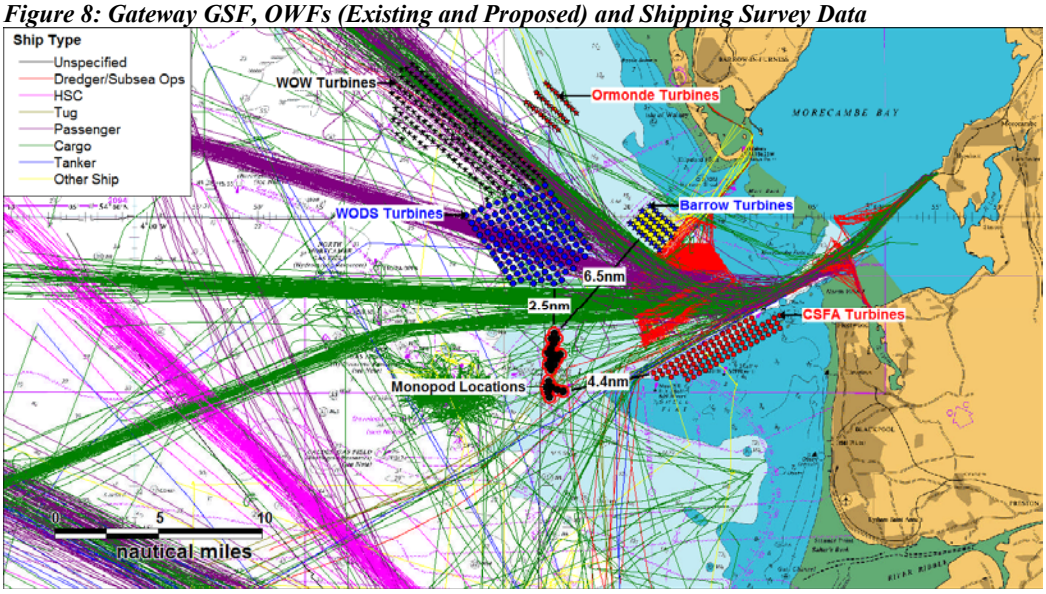


Figure 8: Gateway GSF, OWFs (Existing and Proposed) and Shipping Survey Data



The majority of construction traffic associated with the GGSP will be on-site during 2009 and 2010. As such, given current anticipated construction dates, the only overlap will be with the Ormonde OWF, which is due to begin foundation piling, drilling and cable lay activities in 2009.

With respect to commercial shipping, cumulative impacts will mainly result from the proposed West of Duddon Sands OWF and the associated re-routing which will be required to take place for ferries travelling between the Isle of Man and Heysham. This will increase the density of the traffic immediately to the north of the GGSF. However, these vessels will follow similar routes to the vessels already routeing to the north of the GGSF.

It can be seen that whilst the impact of GGSP on shipping in isolation is not considered to be significant, should all the proposed developments in the eastern Irish Sea area proceed, there will be cumulative impacts based on overall reduced sea room and re-routeing of shipping

Commercial Fishing

The main cumulative impact to commercial fishing will be the loss of available fishing grounds as a result of the GGSF combined with the OWFs and the 500 metre safety exclusion zones set-up around oil and gas installations (including the Millom, North and South Morecambe, Hamilton and Douglas gas fields). The extent of any cumulative impact will be dependent on where individual fishermen operate. There will, for example, be little or no impact on the summer prawn fishery as none of the proposed OWFs extend into the Prawn Ground.

With regard to a cumulative impact during construction of the GGSP (the majority of activity for which is planned for 2009 and 2010) only one OWF, Ormonde, is currently scheduled to be constructed during this period. Drilling activities associated with the Ormonde South gas field are also likely to occur during this period.

Any potential cumulative impacts between the two projects are reduced given that the Ormonde project is located approximately 19 kilometres to the north-east of the GGSF and that the two projects lie within or close-to separate fishing grounds.
In mitigation, Gateway will participate in the ongoing consultation process between the East Irish Sea Developers Group (EISDG) and with local and national fisheries bodies to help minimise any potential cumulative effects of wind farms and other eastern Irish Sea developments on fisheries.

Birds

The physical presence of the GGSF is unlikely to add to

the cumulative impact of the OWFs on birds, particularly as it will not represent a collision risk.

With regard to displacement, it is also anticipated that the cumulative impact of the GGSF will not be significant either alone or in combination with the OWF developments. The combined area of these developments is approximately 192 square kilometres, which is considered to be a relatively small area in relation to the availability of habitat for most species that may be vulnerable to displacements effects (e.g. gannet, auks, manx shearwater etc.).

The other key potential cumulative impact on birds is from Liverpool Bay pSPA, specifically common scoter and red-throated diver. It is unlikely that the GGSF will result in additional disturbance to these species over and above that caused by the Cirrus Shell Flat Area OWF, particularly as all vessel traffic associated with the GGSP will be routed around the Shell Flat area.

Visual

A detailed assessment was undertaken of the potential cumulative visual effects that may arise following the construction and operation of the GGSP in conjunction with other operational and proposed developments in the East Irish Sea. These included offshore and onshore wind farm developments and existing offshore gas field infrastructure.

In summary, the results concluded that the relative significance of the GGSF monopods, given their height and location, was negligible when compared to the number and height of turbines at the various operating and planned OWFs,

From a seascape perspective the visual effect resulting directly from the GGSP construction would be negligible when compared to those potential effects resulting from the closer Round 1, and the more extensive Round 2, OWFs. Indeed, from certain seascape viewpoints, the

view will become dominated by the wind farms and in effect would become ‘wind farm seascapes’. For example, four OWFs will be concentrated in the area to the west and southwest of Walney Island, (Barrow, Ormonde, Walney and West of Duddon Sands). These will dominate the seascape to such an extent that the construction of the GGSP will not detract from their relative ‘dominance’.

In summary therefore, any magnitude of change and significance of visual effects in this area are primarily attributable to the OWF developments proposed in the Eastern Irish Sea and not to the GGSP.

Marine Discharges

The main potential for cumulative impacts arises from the brine discharge if solution-mining at the Canatxx onshore gas storage project occurs at the same time as the GGSP.

Modelling of the Gateway brine plume however has shown that salinity of greater than 1ppt above ambient will be confined to a maximum area of 300 metres from each offshore structure during neap tides. Similarly, modelling of the brine plume from the Canatxx outfall shows that the discharge reaches 10 percent of ambient concentration within 250 metres from the discharge point. Given the distance between the GGSF and the Canatxx outfall pipe, approximately 22 kilometres, it is not anticipated that two plumes will overlap, therefore, there will be no significant cumulative impacts.

It is recognised that other offshore developments are likely to reduce water quality from activities such as marine aggregate extraction, waste disposal and discharges from oil and gas activities. Given the distance between projects, however, no significant cumulative impacts are anticipated.

Quantifying the predicted emissions from drilling the Gateway cavern wells, combined with knowledge of previous similar activities within the general area, allows a simple assessment of the additional or cumulative ‘loading’ of discharged material into the marine environment caused by the proposed activity.

Drilling at the 20 cavern locations will take place within an area covering about 6 kilometres by 2 kilometres, with each cavern typically separated by a distance no less than 500 metres. Drilling will be a sequential and continuous operation from Q2 2009 to Q1 2010, with each well taking about 15 days to complete.

Modelling indicated that the majority of the drill cuttings will fall within 165 metres of each discharge point. Given that the closest distance between any two drilling locations is approximately 500 metres, any potential cumulative local impact on the surrounding sediments is unlikely.

Regarding the wider cumulative effect within the Irish Sea, 58 wells were drilled in and around the area between 2000 and the end of 2006, around three percent of the total wells drilled on the UK Continental Shelf. In the case of Gateway, an estimated 335 tonnes of cuttings are expected to be discharged to the seabed at each location. Based on the past seven years drilling history in the Irish Sea, this is likely to form a significant contribution to the total drill cuttings that will be discharged to the seabed during the proposed drilling period. Overall, however, the consequences of the cumulative impact are anticipated to be negligible, particularly as previous evidence has shown that any cuttings will soon become mixed with the natural sediments and will eventually be dispersed.

Noise

Development of the offshore GGSP will generate noise, both above and below the sea surface. Significant sources of noise will be generated from construction and installation activities, although all such noise will be restricted to a relatively localised area.

The main potential for cumulative noise impacts arises if construction activities of nearby developments occur at the same time as those for the GGSF. The closest OWFs to the GGSF are West of Duddon Sands, approximately 4 kilometres to the north and CSFA, approximately 8 kilometres to the east. Construction of West of Duddon Sands OWF is anticipated to commence in 2011, although the project has yet to be officially consented. The CSFA OWF has been subject to a planning re-application and, therefore is unlikely to be built prior to West of Duddon Sands.

Given the above, it is unlikely that there would be significant overlap with the GGSP as the majority of construction and installation work is programmed for 2009/2010. In addition, an assessment undertaken for the CSFA wind farm (Cirrus Energy, 2007) indicated that anticipated airborne noise from construction and installation activities, principally hammer piling operations, were likely to be rapidly attenuated and that it was unlikely that noise levels exceeding 60dB would be experienced more than 2 kilometres from the noise source.

During construction of the GGSF, the greatest impact to fish species and marine mammals will be from percussion piling should that installation method be used. However, as discussed above it is unlikely that concurrent piling operations will take place. In addition, if Gateway is required to employ percussive piling methods utilise a submersible hydraulic hammer method to install the monopods this generate significantly less noise than that associated with the piling of the larger offshore wind turbine foundations.. Given the above it is anticipated that there will be no significant cumulative noise impacts during

construction of the GGSF.

Pipeline/cable installation activities are likely to cause a minimal amount of disturbance to the background noise level of the area. This is not likely to cause significant cumulative impacts, however, if Gateway activities are carried out at the same time as cable lay activities for the Ormonde OWF increased noise levels may occur over an extended duration.
No cumulative noise impacts are anticipated from the operation of the Gateway GSF in relation to other offshore activities.

Accidental Hydrocarbon Releases

Accidental hydrocarbon releases arising from spills, collisions etc, will be statistically more likely to occur if all the proposed offshore developments are constructed. Each individual development will have their own emergency response procedures, which will detail the contingency measures put in place to deal with any incidents. There are, therefore, not expected to be any specific cumulative impacts due to accidental releases.

Environmental Management

Gateway operates under an integrated Business Management System that includes a comprehensive Environmental Health and Safety (EH&S) management system. This system will help to ensure

that the project is undertaken on a sound environmental basis.

Environmental mitigation and monitoring programmes together with any conditions attached to the Project Consents will be compiled into an Environmental Management Plan and incorporated into the Project planning process. A system of internal and third party audits will provide the necessary feedback to ensure that the process operates correctly.

Overall Conclusions of the Gateway Project EIA

In conclusion, it is considered that, providing the proposed mitigation and monitoring requirements are put in place, the offshore GGSP will not have a significant adverse impact on the local and far-field physical, biological or social-economic environment, and from a cumulative perspective, is unlikely to comprise a significant component. Overall, any adverse impacts should be balanced against the beneficial effects of the project to the East Irish Sea area including the potential effects of the local economy, strengthening the region's reputation as an energy hub.

Gateway will continue to consult with all interested parties throughout the development and operational phases of the Project, keeping local residents and business informed of progress and addressing any comments and concerns that may be forthcoming.

APPENDIX 5: DUNQUIN PROSPECT OFF THE KERRY COAST HAS 18 TIMES MORE GAS THAN CORRIB

Exxon woo new partners to allay Dunquin drilling costs

By Pat Boyle
Irish Independent Friday February 22 2008

http://www.independent.ie/business/irish/exxon-woo-new-partners-to-allay-dunquin-drilling-costs-1295318.html

US oil giant ExxonMobil said yesterday that it is looking for farm-in partners to allay the cost of drilling on its giant Dunquin prospect in Porcupine basin off the west coast.

The news is a major boost for its Irish exploration partner Providence Resources, the company responsible for bringing Dunquin to the attention of the US oil giant in the first place.

Providence secured the Dunquin licence in November 2004. The Irish explorer held an 80pc stake in the license with its partner Sosina holding the balance.

Then in 2006 it announced a farm-out to ExxonMobil who in return for an 80pc share undertook to cover the cost of an extensive exploration programme. Apart from a detailed seismic survey, the US giant was committed to drill up to two wells on the acreage -- provided the results of the seismic warranted further exploration.

In turn Providence saw its share fall to 16pc and Sosina to 4pc.

The decision on whether or not to drill has to be taken by August this year but the decision to look for a partner indicates that Exxon has already decided to press ahead with the drilling commitment.

In a statement issued yesterday ExxonMobil said it is offering half of its 80pc share and will accept bids for stakes of 15pc or more. It also expressed interest in accepting an asset swap in return for the 40pc share -- stating it would accept an equity position in a similar exploration play or an undeveloped discovery.

By taking in a partner ExxonMobil is following a long standing industry tradition of spreading the risk on what is essentially a new exploration province.

ExxonMobil said two prospects have been identified, Dunquin North and Dunquin South. Both are anticipated to hold gas or gas/condensate with the estimated potential to hold over 18 trillion cubic feet of gas -- Corrib holds one trillion cubic feet.

This estimate is referred in the industry as a 'P10' figure, meaning that there is roughly a 10pc chance that it will be proven up by drilling.

It also said that both are ready for drilling, meaning all the preparation work barring the choice of a location for the rig has been completed.

The decision to offer part of its stake will not affect the share held by Providence or Sosina.

Providence is the operator of the acreage but under the first farm-out deal in 2006, ExxonMobil is to assume this role once it gets to the drilling stage.

- *Pat Boyle*

Ireland's upstream boom will produce significant opportunities

Energy Business Review
25th May 2007
By EBR Staff Writer

http://www.energy-business-review.com/article_feature.asp?guid=531E2EB9-5F93-4030-96C5-DE9184E5659B

Recently revised estimates of Ireland's oil and gas resource endowments paint an upbeat picture of future production levels. If these latest estimates translate into the production levels forecasted, Ireland has the potential to not only meet its indigenous oil and gas needs but also to become a net exporter.
'Content Recent estimates published by the Irish Petroleum Affairs Division of the Department of Marine and Natural Resources indicate significant potential for future oil and gas production levels offshore Ireland.

The majority of these reserves are understood to be located in the Atlantic Ridge, a geological structure running parallel with the west coast of Ireland and part of the same geological formation as the North Sea reserves.

The fact that the Irish reserves are on this geological formation bodes well for their future development. The success of the Norwegian, Danish, Dutch and British fields at the other end of the structure is well documented. Closer to home, fields on the same structure such as Dunquin, which is estimated to contain 25 trillion cubic meters of gas and over 4,100 million barrels of oil, all increase the likelihood that the undeveloped reserves will be both technically and economically recoverable.

A recently published government report shows potential reserves of 130 billion barrels of oil and 50 trillion cubic feet of gas. Given Ireland's geographic location, there is significant scope for these reserves to be exported. Subject to the construction of suitable loading facilities, the oil can be relatively easily exported by tanker to anywhere in the world. The existing gas interconnection capacity with the UK could easily be reversed through the construction of new compression facilities, creating scope to export gas to the UK or even Continental Europe. Construction of LNG export facilities is also a possibility.

If developed, the Atlantic Ridge reserves would give a significant fillip to current indigenous production levels in Ireland. Currently, Ireland produces only a fraction of the gas and oil it needs, creating a significant level of import dependence.

Ireland's first indigenous gas reserves were discovered off the southwest coast in 1971 as a by-product of a search for oil. Currently, the majority of Ireland's indigenous gas production activity takes place off of the Kinsale Head area. Smaller levels of production are sourced from the Seven Heads area, although this development has been significantly impacted by technical problems leading to a rapid decline in output.

Industry players developing the Atlantic Ridge reserves will no doubt be hoping to avoid the problems encountered by the developers of the Corrib field, located 70km offshore the northwest coast. Corrib was first discovered in 1996 by Enterprise Oil and was the first significant new gas discovery in Irish wasters since Kinsale Head. In 2002, Enterprise Oil was acquired by Shell and the operating license of Corrib transferred to Shell, with the project owned by Shell E&P Ireland Limited (45%), Statoil (36.5%) and Marathon (18.5%). A long series of legal and planning related delays relating both to the project itself and associated infrastructure development have resulted in the project remaining years behind schedule.

If the new Atlantic Ridge reserves can be developed in a timely, cost-effective and streamlined manner, significant scope exists to transform the Irish energy sector and create a massive injection to the Irish economy

APPENDIX 6: HESS TAKE 42% SHARE OF SLYNE-ERRIS PROSPECT OFF THE DONEGAL COAST

Statoil agrees deal on north west licences

Thursday 14 June 2007, RTE news

http://www.rte.ie/business/2007/0614/statoil.html?rss

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The Norweigan group Statoil, in partnership with Shell Ireland, has signed a farm-out agreement on its two licences off Donegal.

The agreement will see Hess Exploration Ireland take a 42% share in the two licences in the Slyne-Erris Basin.

Statoil Exploration (Ireland), will remain as operator of both licences and retain a stake of 39.3%, and Shell will keep its 18.5% stake. The firms said drilling will start in 2008.

John Conroy, General Manager of Statoil Exploration Ireland said: 'We now face into an active work programme which includes acquiring state-of-the-art seismic data later this year and the drilling of an exploration well in early 2008'.

In 2003 Statoil Exploration Ireland capped and abandoned the well on the Cong Prospect, 32 miles northwest of Co Mayo, after no oil or gas was found.

It is understood that the company has spent around £20m on the project.

APPENDIX 7: BORD GAIS TO CONSIDER BUYING MARATHON FIELDS FOR STRATEGIC UNDERSEA STORAGE

Bord Gáis to consider Marathon fields

By Conor Keane, Business Editor
Irish Examiner 21 February 2008

http://www.examiner.ie/story/?jp=OJOJIDAUEY&cat=Business

THE Marathon Oil Corporation has put the "for sale" sign up on its Irish operations, which include gas fields off the Cork coast that supply 8% of Ireland's natural gas needs.

Within hours of the Marathon announcement, Bord Gáis Éireann chief executive, John Mullins, said the State-owned gas company would be taking a serious look at acquiring some, or all of Marathon's Irish assets.

The proposed sell-off includes an 18.5% interest in the controversial Corrib gas development and it is expected to attract a lot of interest as energy prices reach all-time highs worldwide.

Marathon yesterday confirmed it is planning to evaluate its Irish assets as part of its previously announced global asset portfolio review.

"Marathon's Irish assets to be evaluated include the wholly owned Kinsale Head and Ballycotton fields, as well as Marathon's 86.5% interest in the Seven Heads field and the company's 18.5% interest in the Corrib development," the company said.

Marathon also owns the pipeline which connects the Kinsale gas field to Bord Gáis Éireann's national gas distribution grid. In 2007, 44 million cubic feet of gas was brought on shore through the pipeline which is also connected to a large certified undersea gas storage facility in the Kinsale complex.

Bord Gáis's Mr Mullins said being the State gas company it "behoves" them to look at the assets that have come on the market.

It is understood Bord Gáis would be interested in Marathon's stake in the Corrib gas field and the strategic undersea storage facilities owned and operated by Marathon. Bord Gáis has the resources and access to funds to comfortably buy some or all of the assets on offer.

Marathon would not say how much extractable gas is left in the south coast assets, explaining this was difficult to access, as it depends gas price, the rate on extraction and the associated production costs.

Marathon, which employs 61 people in Ireland, said the proposed sale was consistent with their philosophy of maintaining financial discipline and flexibility.

"We have commenced a review of our global portfolio of assets with the intent of divesting those assets which are either mature or otherwise non-strategic, thus allowing us to redeploy our capital into the projects included in our capital, investment and exploration budget. We are in the early stage of this review process, so we expect the majority of proceeds from any such asset sales would be received in the second half of 2008," the company said.

It said the review of its Irish assets could lead to a sale in the event of an acceptable offer.

"If an acceptable offer is not received, we will continue to operate our interests in Ireland in the same professional manner in which we have done for the past 40 years," Marathon said.

Marathon said it plans to conclude the review of its assets in Ireland during the first half of this year.

The Irish Times – Thursday, February 21, 2008 - Barry O'Halloran - Marathon to sell Irish Operations

Natural gas supplier Marathon signalled yesterday that it could sell its Irish operations. Texas-based Marathon has been supplying natural gas to the Irish network from wells off the south coast since 1978. Last year it produced 8 per cent of the country's needs.

The multinational issued a statement yesterday saying that it intended evaluating its Irish assets as part of a global review of its operations. Marathon stated that the review could ultimately lead to a sale of the Irish business if it receives an acceptable offer.

"If an acceptable offer is not received, we will continue to operate our interests in Ireland in the same professional manner in which we have done so for the past 40 years," the company said.

Marathon added that the global review was aimed at identifying businesses that are mature or "non-strategic" with a view to selling them and reinvesting the proceeds in developing its operations. Before issuing the statement at lunchtime yesterday, the company informed workers at its Irish base in Cork. Marathon employs 61 people in Ireland.

The company owns and operates the Kinsale Head and Ballycotton gas fields off the Cork coast. It holds 86.5 per cent of the Seven Head field, which it bought from Scottish explorer, Ramco, in 2006. It also has an 18.5 per cent interest in the Corrib field off the west coast, whose other owners are Shell and Norwegian state company Statoil. Marathon's involvement in Corrib is financial only. It will not be operating the field. A high-profile local campaign has delayed the development of the gas field.

Marathon was the first company to begin producing natural gas from wells in Irish territorial waters. It has had a presence here for 40 years and, at one stage, was the main supplier to Bord Gáis, which owns the Irish network and supplies the fuel to more than 500,000 households in the Republic.

In 2007, it produced 44 million cubic feet - the unit in which the fuel is measured - of natural gas, which amounted to 8 per cent of the State's requirements.

Gas is the dominant fuel in electricity generation and is used in modern power plants such as Tynagh Energy and Viridian's two facilities in the Republic. The ESB is planning to build a modern gas-fired plant next to an existing power station that uses the same fuel at Aghada in Cork harbour.

The announcement comes at a time when oil and gas prices have been rising. Over the last month, natural gas rose from $7.60 to $9.12 for a million thermal units in New York. However, prices dipped one US cent yesterday as government data showed that stocks in the US are holding up ahead of the end of winter.

APPENDIX 8: Minister Martin announces new Mandate for Shannon Development

Department of
Enterprise, Trade and Employment

Minister Martin announces new Mandate for Shannon Development

http://www.entemp.ie/press/2005/20050728.htm

Mr Michéal Martin, T.D., Minister for Enterprise Trade and Employment today (Thursday 28 th July 2005) announced details of a new mandate for Shannon Development

Under the new arrangements Shannon Development will be given an enhanced regional economic development role with a specific emphasis on addressing the needs of the less developed parts of the Shannon region. It will also retain responsibility for all industrial property in the Shannon region and for developing and managing the Shannon Free Zone industrial estate. The existing enterprise support functions carried out by the Company in relation to both indigenous and overseas enterprises will be assumed by the national agencies, Enterprise Ireland and IDA Ireland.

Outlining the background to his decision, the Minister said:

"Since its inception in 1959, with a specific mandate to support the development of Shannon Airport, Shannon Development's role has evolved and adapted to meet changing circumstances and the needs of the region. There can be no doubt that the Company has served the region well and has made a valuable and lasting contribution to its economic development. It developed the world's first industrial duty free zone at Shannon; Ireland's first Science and Technology Park in Limerick; and has taken imaginative initiatives in relation to tourism product development that have served as a model for other regions."

Referring in particular to the decision to decentralise the Headquarters of Enterprise Ireland to Shannon and the establishment of the new independent Shannon Airport, the Minister said:

"A number of recent developments have dictated that the Company's role going forward should be reviewed. Discussions have been ongoing with the Company since early last year on this issue and in March the Chairman submitted proposals for a revised strategy for the Company. These proposals provided that the Company would exit certain tourism and enterprise support activities that could be carried out by other development agencies and that they would focus on strategic value added activities that would contribute to the economic development of the region."

The Minister said that he accepted the logic of this approach but he has directed that the Company's efforts in this regard should focus on the geographical areas within its existing remit most in need of development. "In this context, I have asked the Company to submit specific proposals to me as to how they propose to address the needs of these areas", he added.

In considering a future role for Shannon Development, the Minister said that he had also taken on board the Enterprise Strategy Group recommendation that

Shannon Development should disengage from industrial development activities, which should be carried out by the national agencies, Enterprise Ireland and IDA Ireland. Enterprise Ireland will be responsible for the development of indigenous industry which will involve the transfer of Shannon Development staff to that body.

The Minister added "Shannon Development supports this recommendation and it will be implemented as soon as practicable. I have also agreed that Shannon Development will retain its existing property function in all of the Shannon region, including the Shannon Free Zone."

The Minister said the Company will be required to work closely with the national industrial development agencies in providing property solutions. "In this regard its work will complement, rather than overlap with the agencies", he added. "Promotion of the Shannon Free Zone, will also be assumed by IDA Ireland, who, with its extensive network of overseas offices, is, in my view, clearly better positioned to carry out this function," he said. The IDA already has responsibility for promoting inward investment to the rest of the Shannon region.

The Minister explained that the decision in regard to the new mandate was taken following widespread consultation. " I have met with the Board of Shannon Development, and over the last few months I have also had the opportunity to hear the views of a range of interested stakeholders in the region, including the Mid-West Regional Authority, SIPTU and IBEC, as to how Shannon Development might best serve the interests of the Mid-West region going forward."

The Minister noted that "All of the interested parties in the region that I have spoken to agree that Shannon Airport is vital to the economic well being of the region. Shannon Development is ideally placed to support the new Airport Authority, and to complement its activities, particularly in its formative years and the Company and I are in agreement that they should do so.

The Minister said "The revised arrangements will, I believe, provide for a more logical delineation of responsibilities between the enterprise development agencies in the Mid-West region and for greater clarity in relation to the economic development aspects of Shannon Development's remit."

The Minister has asked the Company to prepare a new Corporate Plan that will reflect the specific actions that will be undertaken under the terms of the new mandate. The Minister said "I want to see included in this Plan, challenging and measurable targets for each area of activity that the Company will be engaged in. The Plan will be reviewed annually and I have also asked for regular reports on the progress being made in meeting these targets."

The Minister concluded "The Chairman, Board and Executive of Shannon Development have demonstrated a tremendous commitment in working to develop a new mandate for the Company and I look forward to working with them in discharging the new mandate."

Note for Editors

Future of Shannon Development

A number of developments over the last eighteen months have necessitated a review of the future role of Shannon Development. These include:

- the proposed relocation of the headquarters of Enterprise Ireland to Shannon as part of the decentralisation programme announced in December 2003;
- the Enterprise Strategy Group recommendation in July 2004 that Shannon Development should disengage from industrial development functions;
- the transfer in September 2004 of responsibility for Shannon town to Clare County Council;
- the repeal of the statutory requirement for companies in the Shannon Free Zone to hold operating licences; and

- the establishment of an independent Shannon Airport Authority as provided for in the Airports Act, 2004.

Discussions in relation to a future role for the Company, initiated in 2004, led to the submission in March 2005, by the Chairman of Shannon Development Company of proposals to the Minister for a new strategy for the Company. These proposals essentially provided that the Company will exit core enterprise support and tourism functions and assume a more enhanced regional economic development role in a broader geographical area that would include Galway. Following an examination of these proposals and after consultation with the Company and other stakeholders, the Minister decided on the revised mandate for the Company, announced today. The main features of the new mandate are:

- The Company will place an increased focus on the regional development aspects of its mandate within its existing geographical area of operation. In this regard special emphasis will be placed on addressing the needs of the less-developed parts of the region.
- The Company will retain ownership of industrial property in the Shannon region and responsibility for managing the Shannon Free Zone Industrial estate and will have responsibility for providing appropriate property solutions for both indigeneous and overseas enterprises.
- The support functions in relation to indigeneous enterprises in the Shannon region that are carried out by Shannon Development on behalf of EI will revert to EI. This will involve the transfer of staff to EI. EI will be recouped by Shannon Development with the costs associated with the transferred functions and staff.
- The IDA will assume responsibility for promoting investment in and supporting FDI companies in the Shannon Free Zone.
- The roles and relationships between EI, IDA and Shannon Development in carrying out their respective functions in the Shannon region will be specified in a Memorandum of Understanding to which each of the three agencies and the Department will be party. ENDS

Last modified: 28/07/2005

IRISH EXAMINER

Tuesday, January 10, 2006 :
http://archives.tcm.ie/irishexaminer/2006/01/10/story265852048.asp

Development firm defends role

By Jimmy Woulfe

SHANNON Development yesterday put a brave face on the loss of it's main role as a job creation agency when posting figures showing the company helped bring 1,795 new jobs to local industry last year. Of these 450 were created in the Shannon Free Zone and 1,345 in indigenous enterprises elsewhere in the mid-west. However, that figure was offset by a loss of 1,745 jobs giving a net gain of 50.

Speaking at the publication of the company's annual report, Kevin Thompstone said several hundred additional jobs are already in the pipeline for 2006.

There are now almost 20,000 Shannon Development-assisted jobs in the mid-west with a wages take of almost 700 million.

Shannon Development is in the process of handing over its job creation role to Enterprise Ireland and the IDA and this process will be finalised in coming months.

The company will retain its role as the regional tourism body in the mid-west.

The stripping of its jobs remit has caused deep anger among Shannon Development employees who have accused the board of failing the company.

Shannon Development will take on responsibility for developing marginalised areas in the region and is currently working out a strategy to tackle this brief.

Some of the 150 Shannon Development staff will transfer to other state agencies and others are expected to opt for redundancy under the new set up.

The company has been allowed hold on to its property portfolio in Shannon Free Zone and industrial parks in the region. These buildings yield annual rental of €18m, about 50% coming from the Shannnon Free Zone.

When the new Shannon Airport Authority takes over the full and independent running of Shannon Airport, Shannon Development will give marketing and financial support to generate more Irish passengers.`

Shannon Development chairman Liam McElligott said the company now had a written mandate from the Government to plan the way ahead.

"We have to get on with it. The company has gone through a traumatic situation where the future of the company was in doubt, the shape of the company was in doubt, the asset base was in doubt," he commented.

But he said they now had been given a Government mandate to construct a sea change in regional development and this was a fabulous challenge. Mr Thompstone said the board of the company, management and staff were up for the challenge ahead.

He said there would be a reduction in staff, but as this was at a sensitive stage with negotiations ongoing, he would not speculate on numbers.

Staff numbers, he said had fallen from around 200 three years ago to the current figure of 150.

Shannon Heritage, the company's tourism subsidiary attracted 620,000 people to its range of day visitor attractions and castle banquets last year.

"The Shannon Heritage operation is vitally important to tourism in the region as it continues to annually contribute more than €20m to the local economy in spin-off revenue," Mr Thompstone said.

He said a growing range of initiatives have been drawn up to tap into the domestic market.

Shannon agency to seek property portfolio advice

Irish Independent February 15th 2008
http://www.independent.ie/business/irish/shannon-agency-to-seek-property-portfolio-advice-1290081.html

By John Mulligan
Friday February 15 2008

Shannon Development wants to enter into a "technical dialogue" with consultants to advise it on how to manage its extensive property portfolio.

The body, responsible for promoting economic investment and development in Limerick, Clare, north Tipperary, north Kerry and south Offaly, has an extensive undeveloped landbank of almost 2,000 acres.

It also manages commercial and industrial space in 50 estates that generates €16m in annual rental income.

That money is used to fund Shannon Development's promotional activities.

The agency wants to explore plans for outsourcing its property management function and investigate "the various options which may be available". The initial consultation is expected to take up to two months.

A spokesman for Shannon Development could not comment on the proposed consultation process yesterday.

In 2005, the Department for Enterprise, Trade and Employment reviewed Shannon Development's remit, and said that the agency would no longer be involved in industrial development activities, but would retain its existing property function in the Shannon region, including the Shannon Free Zone.

In 2007, Shannon Development invested €8m providing property solutions, while it completed 17 land transactions and seven building sales, generating over €13m. The agency is also responsible for promoting tourism in the region.

- *John Mulligan*

APPENDIX 9: Planning (Location of Hazardous Sites) Bill [55] setting precedent for mandatory exclusion zones around Seveso II sites

http://www.publications.parliament.uk/pa/cm200708/cmhansrd/cm080115/debtext/80115-0004.htm

Planning (Location of Hazardous Sites)

3.32 pm

Bob Spink (Castle Point) (Con): I beg to move,

> That leave be given to bring in a Bill to require the introduction of binding guidance regarding minimum distances between developments classified as Control of Major Accident Hazard sites and other specified types of building; and for connected purposes.

This Bill seeks to improve protection for communities across Britain from the new development of potentially dangerous industrial sites. It will ensure increased safety by giving the Health and Safety Executive a framework for COMAH plant siting decisions, thereby improving the consistency of such decisions and affording a predetermined level of protection for communities.

As if we in Castle Point had not had enough, Oikos registered on 21 December a new application for biodiesel and glycerine plants. The plants, which are expected to produce 163,500 tonnes a year, are sited very close to houses. Feed stocks would be imported from ships in the Thames and there would be massive on-site storage of oils, fats, reacting agents and end products. The local council and the HSE will be working closely with me and with the organisation People Against Methane to protect our community, and residents will be fully consulted about the Oikos proposals.

I have fought to defend my constituents from the massive risk posed by Calor's proposals for a liquefied natural gas facility next door to the Oikos site. Calor wants to

import around 5 per cent. of the UK's total LNG needs and to store about 100,000 tonnes on site. The LNG would be offloaded from ships by means of a boom arm on a jetty on a waterway where activity is increasing massively, thanks to the new Thames Gateway port development just downstream and the Oikos proposal.

Calor's plans were withdrawn as a result of a strong campaign in this House, inputs from the HSE and the Environment Agency, and local efforts by People Against Methane. The Canvey Island Independent party's huge petition, which I presented in this House, was also most helpful. We have put politics aside in Castle Point and worked together to defeat the Calor proposals, and we shall do so again, but Calor says that it will reapply this year. I shall continue my fight to protect my constituents.

We were told that the Buncefield depot was totally safe, but it turned into the biggest fire in western Europe since world war two, as my right hon. Friend the Member for Hitchin and Harpenden (Mr. Lilley) explained to the House last week. A similar fire, but involving LNG rather than petrol, would make Buncefield look like a village bonfire night party. I congratulate my hon. Friend the Member for Hemel Hempstead (Mike Penning) on his excellent debate last week—he is doing a superb job of fighting for his constituents. He described one of his constituents' homes after the explosion as:

> "blown to smithereens. It looked like someone had dropped a 1,000 lb bomb next to his house. I have visited the site. The house is gone—it does not exist".

He went on to say:

15 Jan 2008 : Column 794

> "May I also praise him"—

that is, me—

> "for his quick response before Christmas when the hydrocracker at the Coryton refinery exploded?...I know the fears that exist, and I am conscious that my hon. Friend did not go in the opposite direction; he went straight down to see the firefighters to ensure that they, too, were looked after.
>
> To answer my hon. Friend's question, when the first explosion took place at Buncefield, the damage occurred several kilometres away...he will find that because there was nothing structurally to prevent the explosion spreading outwards, or the subsequent suction inwards after the oxygen had been used up, properties...several kilometres away, were subject to serious structural damage. One school in St. Albans had its central heating boiler sucked up through the flue, which blew up boilers throughout the school...That is the sort of damage that occurs in such explosions."—[*Official Report, Westminster Hall*, 9 January 2008; Vol. 470, c. 75WH.]

Thus, we see graphically the destruction caused even several kilometres away from such an incident.

George Whatley of PAM, who originally suggested my Bill, used a satellite navigation system to measure the distance separating the Calor site and homes on Canvey. It is precisely 200 yd. That is totally unacceptable, but there are no official separation limits for COMAH plants; hence the Bill that I am introducing today. An escape of LNG would vaporise and form an unstable, unconfined, highly combustible cloud which, on ignition, would explode and burn at extremely high temperatures, destroying everything in its path. According to the fire service, whereas the Buncefield petrol fire was easily contained, there is no way to contain or control an LNG fire; the fire service would just clear up the carnage afterwards.

International evidence on LNG explosions is legion. Tim Riley's documentary film, "The Risks and Dangers of LNG", and the 2003 Californian study predicting up to 70,000 casualties from an LNG accident or terrorist attack, graphically set out the implications. The Buncefield inquiry led to an HSE investigation, which concludes:

> "Clearly we have a poor scientific understanding of the mechanisms which led to the vapour cloud explosion at Buncefield, and we accept that installations storing other substances could present this type of hazard, for example bulk LPG storage, and other flammable liquid storage."

The investigation also reveals a fifteenfold increase in unconfined vapour cloud explosions over the past decade, and it challenges the current orthodoxy on the scale of risk to local communities that are adjacent to large petrol, liquid petroleum gas and LNG sites. The HSE is therefore reviewing its safety and planning advice on the siting of such plants.

United States federal regulations for LNG facilities—CFR 193—federal safety standards and the US National Fire Protection Association lay down that vapour gas dispersion distances must be calculated to determine how far downwind natural gas vapours could travel from an onshore LNG facility and still remain flammable. They show that a fire would burn with intense heat, so LNG plants must have thermal exclusion zones.

The Canvey island site involves additional risk, with LNG transfer from tankers on the Thames—on the water. Distinguished professor Jerry Havens and others have serious concerns about the vulnerability of massive LNG tankers, which could be engulfed in a fire

and would be unable to fight that fire. The risks of spills on to water are spelled out in the US publication, "Business Briefing: LNG review 2005":

> "there would be little or no control over the extent of liquid spreading and the consequent rapid burning or vaporisation of the gas."

A 2004 report by Sandia National Laboratories in the United States concluded that

> "cascading failure of LNG vessel containments by this mechanism cannot be ruled out",

which would result in "total loss" of the tankers.

A US fact sheet “Liquified Natural Gas (LNG) Energy Justice.net/natural gas” states that an accident or terrorist attack on an LNG tanker could cause

> “major injuries and significant damage to structures a third of a mile away and could cause second-degree burns on people a mile away.”

A congressional panel expressed similar concerns in 2004; Rear-Admiral Gilmour was reported in Factiva as saying that the minimum distance for an offshore LNG terminal ought to be about 10 miles. Castle Point does not have the luxury of 10 miles, several kilometres or even one mile. The distance separating our homes, schools and workplaces from the Calor site is precisely 200 yd. Canvey faces significant additional risks from terrorism—it suffered a terrorist bomb attack in the 1980s. The site is also well below sea level, creating major flood risks and increasing existing ones.

My Bill would increase and formalise the protection afforded to communities and give clarity and certainty to applicants, the HSE and planning authorities, saving time, expense and much community anguish. If the Government listen, they will amend the Planning Bill to accommodate the sensible and necessary provisions in my Bill. As it stands, the Planning Bill will cause more difficulties; under it, the location of a dangerous plant will be decided by an unelected quango, the infrastructure planning commission. The IPC will operate behind closed doors, removing democratic legitimacy as well as involvement by local councils or even the Secretary of State.

The Planning Bill fails conspicuously to give the necessary procedural rigour for the IPC to deal with the location of hazardous sites. That causes great concern to the Campaign to Protect Rural England and other excellent environmental organisations seeking, like me, to defend the public interest. I commend my Bill to the House.

Question put and agreed to.

Bill ordered to be brought in by Bob Spink, Mr. Peter Lilley, Dan Rogerson, Patrick Mercer, Mr. Christopher Chope, Mr. Dai Davies, Dr. Evan Harris, Mr. Andrew Love, Mr. David Gauke, James Duddridge and Mr. James Clappison.

Planning (Location of Hazardous Sites)

Bob Spink accordingly presented a Bill to require the introduction of binding guidance regarding minimum distances between developments classified as Control of Major Accident Hazard sites and other specified types of building; and for connected purposes: And the same was read the First time; and ordered to be read a Second time on Friday 6 June, and to be printed [Bill 55].

Planning (Location of Hazardous Sites) Bill
http://www.epolitix.com/EN/Legislation/200801/4e63f2df-4a95-48c0-9962-dd5545ad463b.htm

Bob Spink (Con, Castle Point) introduced the Planning (Location of Hazardous Sites) Bill on January 15.

He stated that "the Bill seeks to improve protection for communities across Britain from the new development of potentially dangerous industrial sites. It will ensure increased safety by giving the Health and Safety Executive a framework for COMAH plant siting decisions, thereby improving the consistency of such decisions and affording a predetermined level of protection for communities."

When introducing the Bill he argued that his constituents have suffered from the application for "biodiesel and glycerine plants" to be built very close to houses. He detailed the safety issues of having these plants so close by referring to the effect the Buncefield explosion had even though that was further away. He argued that the new plants could cause health and safety issues to the residents.

He argued that his Bill "would increase and formalise the protection afforded to communities" and that it would "give clarity and certainty to applicants, the HSE and planning authorities, saving time, expense and much community anguish."

He urged the government to listen and amend the Planning Bill to accommodate the sensible and necessary provisions in his Bill. He stated that the "Planning Bill fails conspicuously to give the necessary procedural rigour for the infrastructure planning commission (IPC) to deal with the location of hazardous sites." He argued that the Planning Bill "will cause more difficulties" as "the location of a dangerous plant will be decided by an unelected quango"

Progress

House of Commons

First reading: January 15 2008 [HC Bill 55]

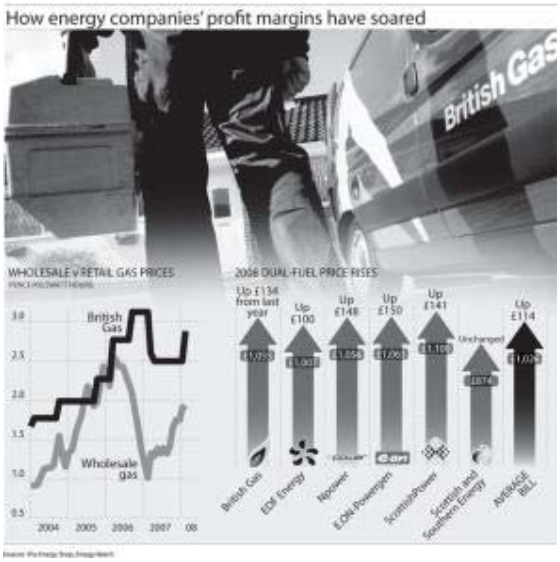
Second reading: June 6 2008

APPENDIX 10: Calls for Inquiry into profiteering by Energy Giants following 500% increase in profits at British Gas.

Boiling Point: Calls for inquiry into alleged 'profiteering' of energy giants

By Martin Hickman, Consumer Affairs Correspondent
"The Independent" Thursday, 21 February 2008

http://www.independent.co.uk/news/uk/home-news/calls-for-inquiry-into-alleged-profiteering-of-energy-giants-784918.html



British Gas, the country's biggest energy supplier, announced a 500 per cent rise in profits today, outraging campaigners who claim householders are being ripped off.

The company made £571m in 2007 compared with £95m the previous year.

Most of the money was made between January and March, when the wholesale price of gas went into freefall as a result of unusually mild weather and a new gas pipeline from Norway.

During those three months, BG's bosses kept prices high, earning what one analyst has described as "absolutely extraordinary" profits.

Consumer groups demanded an official inquiry into whether the "Big Six" energy companies have been profiteering and plunging low earners into choosing whether they eat or heat their homes.

"It's quite sickening when companies make these huge profits while, at the same time, we are expecting 25,000 excess winter deaths as a result of people not being able to keep warm," said Lesley Davies, the chairman of the National Right to Fuel Campaign. "The Government must do more for these consumers.

"They prattle on about the winter fuel payments for pensioners but there are just as many single-parent families and others who cannot get the payment."

Energywatch, the independent gas and electricity watchdog, called for the Competition Commission to investigate whether the £24bn-a-year domestic power business was working properly.

Its campaigns manager Adam Scorer said: "Consumers will fee justified in claiming that they are being taken for a very rough ride by the energy companies."

Five of the Big Six – British Gas, E.on, npower, EDF, and Scottish Power – have put up their prices by about 15 per cent to within £100 of each other in the first two months of this year.

Only Scottish & Southern is cheaper but it is expected to announce an increase after its price promise ends on 30 March.

Political pressure on the companies is mounting, with an investigation into the competitive structure of the market by the Select Committee for Business, Enterprise and Regulatory Reform, and 12 separate Commons' Early Day Motions.

Questions are being asked because costs have increased at a much lower rate than customer bills, leading to claims that the companies are profiteering. According to a report by the independent analyst Cornwall Energy Associates for the Right to Fuel Campaign, about £2.3bn of the £8bn increase in prices cannot be accounted for and is likely to be profit.

The companies say they have to invest heavily to improve their environmental performance and develop renewable power.

British Gas, which last month increased prices by 15 per cent, said it had to wait to find out whether wholesale prices fell before lowering prices in March and April. But its annual report will indicate it has been able to make bumper profits despite claiming the industry is extremely competitive. Since the energy market was liberalised, the former state monopoly gas supplier, which has 46 per cent of gas customers and 21 per cent of electricity customers, has been rated worst for customer service.

It receives 45 complaints per 100,000 customers, compared with 10 for Scottish and Southern and about 20 for EDF and E.on.

In its interim results for the first six months of 2007, British Gas made £533m. Profitability then slipped during the second half but the scale of the profits made while wholesale prices dropped means the annual result will be about 500 per cent higher than the £95m made in 2006.

Joe Malinowski, a former energy trader who now runs the price comparison site theenergyshop.com, said: "The first half-year profit was absolutely extraordinary. You don't normally expect a company to make that type of money. The margin was 15 per cent on what is essentially a trading business, buying and selling energy.

"The energy price kept falling. The difference between retail and wholesale got bigger and bigger. Before they cut prices the margin was massive – the money was just flowing through the door."

About four million people are officially in fuel poverty, meaning they have to spend at least 10 per cent of their income on fuel bills. For many others, the reality of rising fuel bills is deeply unwelcome amid strong rises in mortgage payments, council tax and water bills and a background of a weakening economy.

Peter Lehmann, of the group Fuel Poverty Advisory Group, urged the regulator Ofgem to investigate the market and to close the gap between the price paid by predominantly poorer pre-payment customers and those paying by direct debit.

The GMB union complained that as well as "fleecing its customers and making record profits" British Gas was scrapping its final-salary pension scheme. "It is about time that a full inquiry was conducted into the operation of the energy market," said Gary Smith, GMB's national secretary.

British Gas argued that it could not have predicted the steep falls in wholesale prices at the beginning of 2007. "Sharp falls in the price of gas in winter 2006 led to unexpected profits in British Gas early in 2007, but rising costs later in the year also mean that analysts expect margins in the second half to be very thin," a spokesman for the company said.

APPENDIX 11: New Safety Concerns raised on LNG Marine Incident Consequences.

http://www.sciencedirect.com/science?_ob=ArticleListURL&_method=list&_ArticleListID=700699788&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=352f79060b0cb41cfefab5cdeedab92a

Fire Performance of LNG Carriers Insulated with Polystyrene Foam

Jerry Havens
University of Arkansas, USA
James Venart
University of New Brunswick, CANADA

Abstract

Analysis of the response of a liquid-full Moss Sphere LNG tank insulated with polystyrene foam to an engulfing LNG fire indicates that current regulatory requirements for pressure relief capacity sufficient to prevent tank rupture are inadequate. The inadequacy of the current requirements stems primarily from two factors. Firstly, the area of a Moss Sphere protruding above what would be the nominal deck on a conventional carrier, which is protected only by a steel weather cover from exposure to heat from a tank-engulfing fire, is being underestimated. Secondly, aluminum foil-covered polystyrene foam insulation applied to the exterior of the LNG tank is protected above deck only by the steel weather cover under which the insulation could begin to melt in as little as one to three minutes, and could completely liquefy in as few as ten minutes. U.S. and International Regulations require that the insulation on the above deck portion of tanks have approved fire proofing and stability under fire exposure. Polystyrene foam, as currently installed on LNG carriers, does not appear to meet these criteria. As a result of these findings, but giving no consideration to the significant potential for further damage if the polystyrene should burn, the boil-off rate is predicted to be an order-of-magnitude higher than provided for by current PRV sizing requirements.

Introduction

A recent report by the Government Accounting Office[13] states that both the cold temperature of spilled LNG and the hot temperature of an LNG fire have the potential to significantly damage LNG ship tanks, possibly causing multiple tanks on the ship to fail in sequence. A recent report by Sandia[14] proclaims the credibility of a spill and fire on the sea following a terrorist attack that would have the potential to engulf one or more adjacent tanks on an LNG ship, potentially leading to cascading (successive) failures. As such failures could increase the severity of a catastrophic incident, the report cites as the leading unaddressed research need determination of the potential for cascading failures of cargo tanks on LNG carriers. This paper first considers the adequacy of present regulatory requirements for pressure relieving systems to prevent overpressure failure of a current-design, polystyrene foam insulated, liquid-full Moss Sphere exposed to an enveloping LNG fire. Then, as the philosophy of fire protection for such hazardous cargo containment systems is based on provision of protection from fire adequate to prevent failure for a prescribed period of time, the paper describes a one-dimensional transient analysis of the expected response to heat absorption from an enveloping LNG fire contacting a single liquid-full, ~36 m diameter (25,000 m^3 volume) Moss Sphere on an LNG carrier.

Adequacy of Regulatory Requirements for Pressure Relief Systems on LNG Ships

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[13] Public Safety Consequences of a Terrorist Attack on a Tanker Carrying Liquefied Natural Gas Need Clarification. GAO-07-316. February 2007.
[14] Sandia National Laboratories. *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*, 2004.

The International Maritime Organization[15] and the U.S. Coast Guard[16] specify similar requirements for pressure relief valve sizing on liquefied gas carriers. The following, quoted from the Coast Guard Regulation, is in all practical respects identical to the requirements of the IGC Code.

"The relief valve discharge for heat input of fire must meet the following formula:

$$Q = F\ G\ A^{0.82} \qquad (1)$$

where

Q = minimum required rate of discharge in cubic meters per minute of air at standard conditions 0 ^{o}C and 1.03 kP/cm^2,

F = fire exposure factor for the following tank types -

- F = 1.0 for tanks without insulation located on the open deck,
- F = 0.5 for tanks on the open deck having insulation that has approved fire proofing, thermal conductance, and stability under fire exposure,
- F = 0.5 for uninsulated independent tanks installed in holds,
- F = 0.2 for insulated independent tanks installed in holds,
- F = 0.1 for insulated independent tanks in inerted holds or for uninsulated independent tanks in inerted, insulated holds,
- F = 0.1 for membrane and semi-membrane tanks,

and G = Gas Factor = $177/(LC)*(ZT/M)^{1/2}$

where

L = latent heat of the material being vaporized at relieving conditions, Kcal/kg,

C = constant based on relation of specific heats (k), Table 54.15-25(c),

Z = compressibility factor of the gas at relieving conditions (if not known Z = 1)

T = temperature in ^{o}K at the relieving conditions, (120% of the pressure at which the pressure relief valve is set),

M = molecular weight of the product,

and A = external surface area in m^2(for a tank with a body of revolution shape)."

According to the IMO-IGC, for a Moss Sphere (insulated independent) tank installed in a hold, the fire exposure factor is designated to be 0.2. In contrast, Paragraph c-1 of 46 CFR 54.15-25 further states that "For an independent tank that has a portion of the tank protruding above the open deck, the fire exposure factor must be calculated for the surface area above the deck and the surface area below the deck, and this calculation must be specially approved by the Commandant (GMSE)". This added provision of the USCG regulation is important because it indicates the need for careful consideration of the surface area of the tank that could be most severely exposed to heat from a fire, as will be shown below. However, as this provision only affects the value of the fire exposure factor F, and noting that the Gas factor G in Equation (1) can be represented by the product of a heat flux to the cargo multiplied by an appropriate constant K representing the thermodynamic properties of the cargo, Equation (1) becomes:

$$Q = F\ K\ q\ A^{0.82} \qquad (2)$$

The development of Equation (2) is described in considerable detail by Heller[17]. This empirical equation is based on fire tests conducted more than fifty years ago; long before the practice of carrying LNG in shipping containers of the size and type considered here. Importantly, the equation precedes current widespread concerns for terrorist attacks on ships that could result in very large LNG fires engulfing the tank. The largest tests for which data were available for the development of Equation (2) involved tank surface areas of 568 ft^2 (53 m^2), nearly 80 times smaller in area and over 600 times smaller in volume than the single LNG Moss Sphere under consideration. Furthermore, Equation (2) is based on tests in which the liquid wetted area, the total surface area, and the area exposed to fire were all varied, the latter in particular resulting in the $A^{0.82}$ term. It appears that Heller considered, as we do,

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[15] International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, International Maritime Organization, London, Second Edition 1993

[16] United States Federal Regulation 46 CFR 54.15-25(c)

[17] Heller, Frank J., "Safety Relief Valve Sizing: API Versus CGA Requirements Plus a New Concept for Tank Cars", Proceedings of the American Petroleum Institute, Vol 6, pp. 123-135, 1983.

that the use of the area ($A^{0.82}$) term in Equation (2) is inappropriate for application to a catastrophic engulfing pool fire.

In consideration of the much larger fire sizes as well as containment (tank) sizes in use today, it is appropriate to briefly review the current state of knowledge of LNG fire-on-water sizes and durations that might result from an intentional attack on an LNG carrier. The Sandia Report cited earlier[2] analyzed the fire scenario that could follow spillage onto the water of the contents of a single ½ tank (12,500 m^3) of LNG, providing analyses for hole size (areas) ranging from 1 m^2 to 10 m^2. The pool size diameter for the nominal hole size of 5 m^2 was 330 meters with a burn time of 8.1 minutes. Since the fire diameter would be similar to the pool size, the Sandia report suggests that with the nominal hole
size, the size of the fire (diameter) could be larger than the length of the ship. And while the predicted burn time for the 5 m^2 hole is only 8.1 minutes, the 2 m^2 hole size spill is predicted to result in a pool size of 209 m diameter with a burn time of 20 minutes, and the 1 m^2 hole size spill is predicted to give a fire with 148 m diameter lasting for 40 minutes. Thus the smallest hole size spill could have a diameter of almost 500 feet, or more than half the length of the ship, and might burn for 40 minutes. Finally, assuming the smallest hole size spill and a conservative flame height to flame diameter ratio of ½, the flame height could, even for the smallest hole size, considerably exceed the maximum height of the ship above the water line. Given the uncertainties that would attend the actual spreading that would occur as the LNG reaches the water, including wind effects, momentum of the ship, and the presence of objects (including the ship) that could channel the LNG flow, the possibility of complete engulfment of the entire above-deck portion of at least one tank adjacent to the tank ruptured in the attack must be anticipated.

With this background, and to consider the propriety of the current regulatory requirement (based on Equation (2)) for determination of PRV sizing on LNG carriers in service currently, we reviewed an analysis of PRV system design methods performed for the U.S. Coast Guard by the National Academy of Sciences in 1973[18].

The National Academy of Sciences Report

The analysis provided in this paper was presented almost four decades ago to the U.S. Coast Guard, at its request, by the U.S. National Academy of Sciences. However, as far as we can tell, there has been no follow-up to the conclusions of the NAS report, despite its suggestion of an urgent need to update the regulatory requirements for pressure relief systems design to accommodate changing practices in the LNG industry. Such a recommendation was particularly apt for the LNG industry in the Seventies, as today, as the report was prepared when the LNG industry was just beginning the expansion which has been so much increased recently.

We support the NAS report's statement (applied here to LNG carriers) that the determination of the heat absorbed by an LNG-full Moss Sphere exposed to an engulfing fire can be expressed properly as:

$$Q_H = F_I \, q \, E \, A \qquad (3)$$

where

Q_H = total heat absorbed by the cargo,
F_I = environmental factor, including insulation and radiation shielding,
q = heat flux to the outside of the container,
E = exposure factor, the fraction of the total tank area (A) exposed to fire,
and A = tank surface area (for full tanks, equal to the wetted area).

The heat absorbed by the cargo, Q_H, multiplied by the part of the gas constant G that accounts for the thermodynamic properties of the cargo (K in Equation (2)), gives the relieving capacity:

$$Q = K \, q \, F_I \, E \, A \qquad (4)$$

where the product (EA) represents the area of the outside of the container exposed to fire.

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[18]" Pressure Relieving Systems for Marine Cargo Bulk Liquid Containers", Committee on Hazardous Materials, Division of Chemistry and Chemical Technology, National Research Council, NAS, 1973

Comparison of Equations (2) and (4)

We assumed that 40 % of a Moss Sphere protrudes above what would be the nominal deck on a conventional carrier. This area is unprotected from heat from an engulfing fire except by the steel weather shield (see illustrations following). With E = 0.4, and a tank-engulfing fire, Table 1 shows the ratio of Equation (4) to Equation (2) determined for values of the tank surface area ranging from 1 m^2 to 4072 m^2 (the area of a 36 m diameter Moss Sphere), along with the largest value (53 m^2) from the data base from which the $A^{0.82}$ term in Equation (2) was developed, using the requirements for designating the insulation factor F from the IGC Code and 46 CFR 54 respectively.

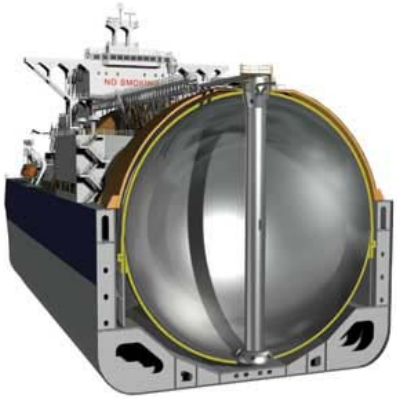

Table 1. Comparison of PRV Requirements Using Equation (2) and Equation (4)

Area (m^2)	1	10	53	100	1000	4072
Ratio (Equation 4 / Equation 2) – IGC Code	2 F_I	3 F_I	4.1 F_I	4.6 F_I	6.9 F_I	8.9 F_I
Ratio (Equation 4 / Equation 2) – 45 CFR 54	1.3 F_I	1.9 F_I	2.6 F_I	2.9 F_I	4.3 F_I	5.6 F_I

Following paragraph (c-1) of the Coast Guard Regulation, the value of F was determined for the surface area above the deck and the surface area below the deck, assuming the fraction of the tank area above deck as 0.4, as (0.4)(0.5) + (0.6)(0.2) = 0.32. We note that this method of determination of the value of the fire exposure factor F increases the required PRV size by 60%, illustrating the importance of careful handling of the determination of the area of the tank effectively exposed to a fire.

In either case, the extrapolation over tank surface area of the correlation assumed in Equation (2) (the $A^{0.82}$ term) by two orders of magnitude is clearly not applicable to the Moss Sphere tank configurations in use today, particularly in view of the severity of fire exposure that could result from terrorist attack. The highest value of this ratio (using the IGC Code) for a typical Moss Sphere (8.9 F_I) means that the value of the factor F_I accounting for insulation (or other shielding from heat transfer) in Equation (4) must not be greater than 0.11 in order that the required relief capacity be as small as indicated by Equation (1). Conversely, total loss of insulation and weather cover (radiation) shielding on the part of the tank exposed to fire, i.e., above deck, would result in under-prediction of the required relieving capacity by a factor of 9.

Furthermore, we believe that the heat flux implicit in the current regulation may not be appropriate for describing engulfing LNG fire exposure. We note that increasing the heat flux from the currently used value of 71 kW/m^2 to 108 kW/m^2, which we believe would be the more appropriate value for a tank engulfing fire based upon test data for gasoline or kerosene fires (see Heller[4]), increases the required vapor relieving capacity by an additional factor of 1.52. And, perhaps importantly, the data upon which Equation (1) is based includes none for LNG fires. Whereas local surface emissive heat fluxes have been measured in test LNG fires as high as ~300 kW/m^2, there is considerable debate regarding the appropriate value for the heat flux applicable to a large impinging LNG fire. This question is currently being investigated, with large scale LNG fire tests planned in the United States for completion in 2008. While it appears clear that with the presently prescribed heat fluxes the relief systems on LNG carriers could be undersized by more than an order of magnitude; it follows that exposure to an engulfing LNG fire with greater heat fluxes could worsen the under-estimation of the relieving capacity.

As it appears clear then that a Moss Sphere with a pressure relief system designed according to Equation (1), and for which the PRV system fitted to a specific tank exposed to the fire is required to provide the only pressure relief[19], could be subject to bursting overpressure if the insulation should fail, it is necessary to determine whether the insulation could withstand such a fire for its duration or until remedial action could be taken.

One-Dimensional Transient Heat Transfer Analysis of a Moss-Sphere Tank Section

We utilized COMSOL Multiphysics® (formerly MATLAB) to perform a one-dimensional analysis of the thermal response of a unit area section of a Moss Sphere (assumed flat) in which fire (R1) is contacting the steel weather cover (R2), followed by serial resistances representing the air gap (R3) between the cover and the aluminum foil covering the insulation, the aluminum foil (R4) covering the insulation, the insulation (R5), and the inner aluminum tank wall (R6) - which is in contact with LNG (R7).
Table 1 specifies the properties of the resistances R2-R6 assumed for the analysis.

Table 1. Specifications and Thermodynamic Properties of System Components

Zone	Thickness (m)	Density (kg/m^3)	Heat Capacity (J/kg ^{o}K)	Thermal Conductivity (W/m^{o}K)	Emissivity	Failure Temperature (^{o}K)
R2	0.015	7850	475	44.5	0.85	810*
R3	1.0	COMSOL	COMSOL	COMSOL	NA	NA
R4	0.0003	2700	900	70	0.1,0.5	873**
R5	0.30	26.5	1045	0.038	NA	510***
R6	0.02	2700	904	70	NA	873**

*Limit temperature for fire exposure, mild carbon steel[20], **Solidus temperature[21], *** Melting temperature[22]

[19] We are informed that all current LNG carriers utilize piping interconnecting all of the LNG tanks on the vessel in order to collect LNG boil off gas for propulsion and that all valves in said interconnected piping connecting the cargo tanks to additional relief valves are required to be locked open when the ship is in service . As a result, actual relieving capacity may exceed that prescribed by Equation (1). While this may be true, we believe that the current regulatory practice deserves careful review, since it is not clear whether relief valve capacity placed on external piping (as opposed to the tank itself) is authorized, or whether any such additional piping is designed to allow the boil-off gas flow rates that could occur if the vessel were exposed to severe, even multiple-tank, fire engulfment.
[20] At 538 ºC the maximum permissible design strength (60% of yield) would equal its strength at temperature, SFPE Handbook of Fire Protection Engineering, 1988.
[21] The range of solidus temperatures, or commencement of melting, for Aluminum alloys is ~510 to 640 ºC.
[22] Polystyrene foam melts over a temperature range: we assumed for the purposes of this analysis 510 ^{o}K as a representative value.

The following sections describe the initial conditions assumed for the analysis and the boundary conditions interconnecting the resistances specified in Table 1 as well as the boundary conditions connecting the fire (R1) to the steel cover (R2) and the aluminum tank wall (R6) to the LNG (R7).

Initial Conditions

The initial-condition temperature profile for the one-dimensional system was calculated with a steady-state COMSOL analysis assuming an ambient air temperature of 305 ^{o}K. Figure 1 shows the temperature profile through the system with aluminum emissivity specified as a parameter, illustrating the sensitivity of the heat transfer calculations to the emissivity of the aluminum foil covering the insulation. Figure 2 shows the heat flux into the cargo with the foil emissivity as a parameter. For an emissivity of 0.1 (assumed appropriate for a new, clean system) the heat flux into the cargo is approximately 20 W/m^2. For a 36 m diameter Moss Sphere, this heat flux to the cargo at ambient conditions (305 ^{o}K) would result in a boil-off rate of ~ 0.12 % of the cargo per day. This result, which is in good agreement with typical specifications for operating Moss-design carriers, provides a useful check on the propriety of the heat transfer calculation methods utilized in the analysis.

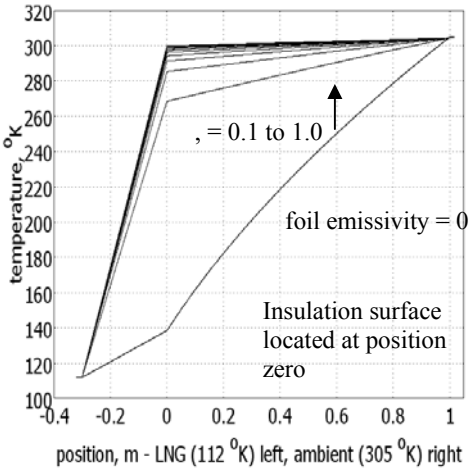

Figure 1. Initial Temperature Profile

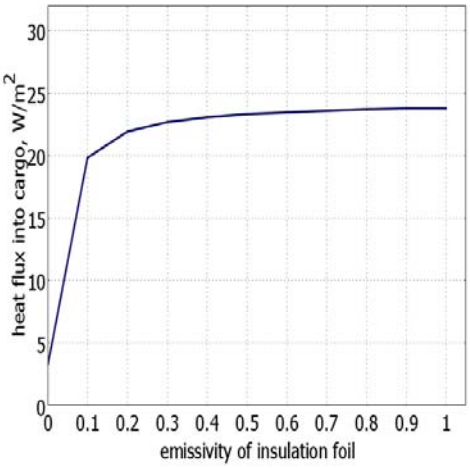

Figure 2. Operating Heat Flux into Cargo

Boundary Conditions

We accounted for radiative heat transfer (assuming grey body properties) and convective heat transfer (h = 28 W/m^2 ^{o}K[23]) from the flame to the weather cover. Radiative heat transfer and conductive heat transfer were accounted for in the air space under the weather cover; convective heat transfer in that space was neglected. The temperature profiles at the interfaces R4/R5, R5/R6, and R6/R7 assumed continuity (infinite heat transfer coefficient assumed from the tank wall to the LNG). Calculations were made for flame temperatures of 1300, 1400, and 1500 ^{o}K -- corresponding to calculated initial (maximum) total (black-body radiative and convection) heat fluxes from flame to the steel weather cover (with emissivity = 1.0) of 188, 245, and 315 kW/m^2 respectively.

Results and Conclusions

We calculated the time-varying temperatures and heat fluxes throughout the system with properties as specified in Table 1, with flame temperatures of 1300, 1400, and 1500 ^{o}K, and aluminum foil emissivities of 0.1 and 0.5, the latter representing the range of emissivities that might be expected for new, clean, aluminum foil and dirty, aged aluminum foil respectively. All of our calculations assume that all of the materials (including the insulation) remained in place and functioning with the properties specified above. The purpose of these calculations was to estimate the times at which the components of the tank system would reach temperatures sufficient to cause failure, and further therefrom (using

[23] Welker, J.R., and C.M. Sliepcevich, Heat Transfer by Direct Flame Contact Fire Tests – Phase I. Prepared for the National Academy of Sciences by University Engineers, Inc., Norman, Oklahoma, 1971.

the heat flux at the time of incipient failure) to estimate the time period expected for complete failure of the insulation – the calculation results are not considered applicable for greater times.

We assumed for purposes of this analysis that failure of the steel and aluminum components of the system would begin upon reaching the designated failure temperature, and we assumed that the minimum rate at which the polystyrene insulation would fail would be determined by its melting rate, which would in turn be determined by the heat flux into the foam at the time at which the foam reached its melting temperature.

Figures 3-5 show, as a function of time for 600 seconds of fire exposure, temperatures of the steel weather cover (wc) surface (contacting flame with , = 0.85) and the (hot-side) insulation (ins) surface, as well as the heat flux into the insulation surface, for aluminum foil emissivities of 0.1 and 0.5, for flame temperatures of 1300, 1400, and 1500 ^{o}K.

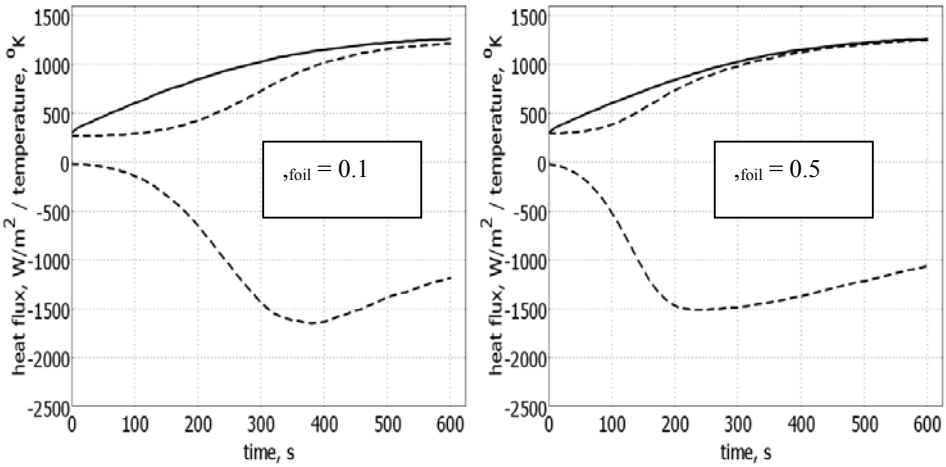

Figure 3. Temperature and Heat Flux – wc solid, ins dashed – T_{fire} = 1300 ^{o}K

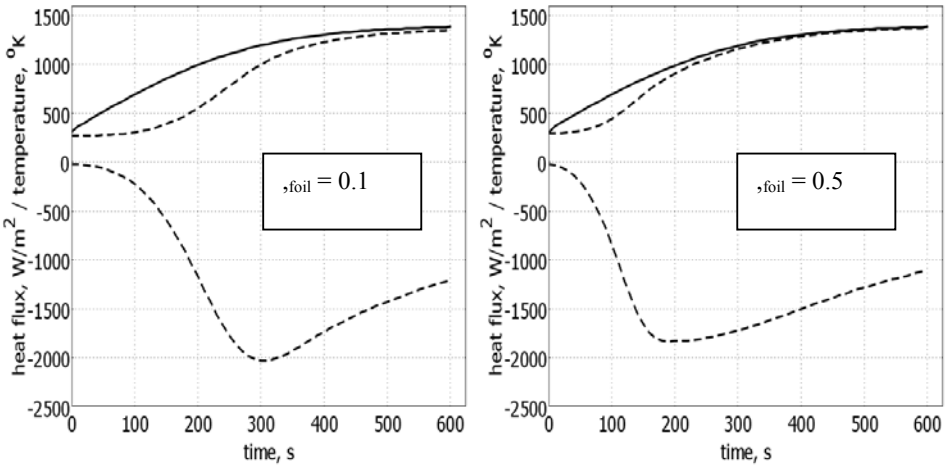

Figure 4. Temperature and Heat Flux – wc solid, ins dashed – T_{fire} = 1400 ^{o}K

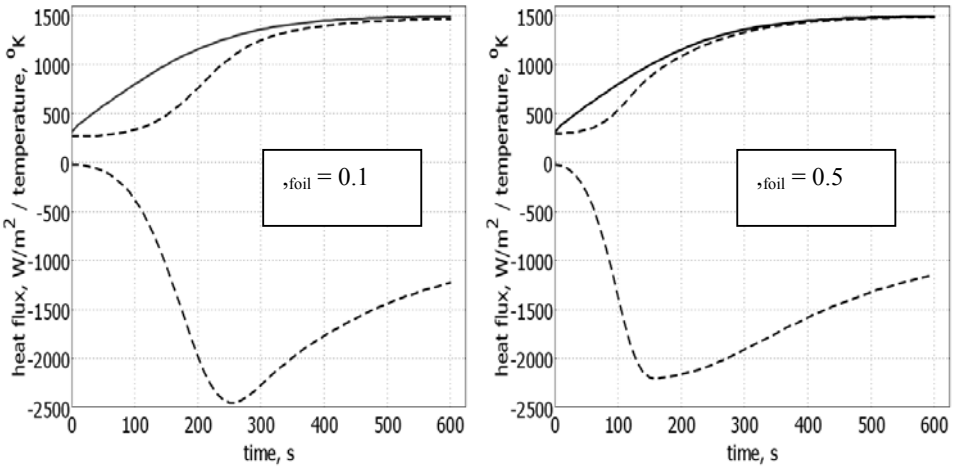

Figure 5. Temperature and Heat Flux – wc solid, ins dashed – T_{fire} = 1500 °K

Predicted Component Failure Commencement Times

Table 2 shows the estimated times from the plots in Figures 3-5 for the (outer) steel weather cover surface, the aluminum foil, and the polystyrene foam insulation (hot-side) surface to reach the failure temperatures designated in Table 1. Because of the small thickness of the aluminum foil (0.3 mm), the temperatures of the foil and the insulation (hot-side) surface were assumed identical for this analysis.

Table 2. Predicted Component Failure Times (seconds)

Component	T_{fire} = 1300 °K		T_{fire} = 1400 °K		T_{fire} = 1500 °K	
	, = 0.1	, = 0.5	, = 0.1	, = 0.5	, = 0.1	, = 0.5
Weather Cover	170	180	125	125	100	100
Aluminum Foil	330	260	265	180	215	150
Foam Insulation	225	140	190	120	160	95

Metal Failure: The temperature of the steel outer surface reaches 810 °K, indicating approach to failure, in the range 100 seconds to 180 seconds. The time when the aluminum foil reaches its melting temperature (873 °K) ranges from 150 seconds to 330 seconds. To calculate more accurately the actual response of the system is difficult, requiring assumptions as to the specific behavior of the system components as they fail (and beyond). Nevertheless, inclusion of such information for specific failure modes can do nothing, it appears, but increase the rapidity with which the system components would fail.

Insulation Failure: The polystyrene surface temperature reaches its melting point of 510 °K in the range 95 seconds to 225 seconds. Following the time at which the polystyrene foam reaches its melting temperature, the heat flux into the foam insulation maintains an average value ranging from about 1 to about 1.5 kW/m^2 for the balance of the 10 minute period shown. With a continuous heat flux of 1.5 kW/m^2 into the foam surface, the foam would melt at a rate (approximately) given by 1.5 kW/m^2 divided by the product of the foam density and its latent heat of fusion. The latent heat of fusion for styrene monomer is 105 kJ/kg and the density of polystyrene foam is 26.5 kg/m^3, indicating a melting rate of about 3 centimeters per minute. However, this appears to be a lower limit on the melting rate because the latent heat of polystyrene (mass basis) could be (much) smaller, depending on the molecular weight of the polymerized styrene. Nonetheless, this analysis indicates that total melting of a polystyrene insulation layer
0.3 m thick could occur in less than 10 minutes after it reaches its melting temperature if the foam were subjected to the heat exposure considered here.

Insulation Combustion: This analysis has not considered the potential for combustion of (poly)styrene vapors mixed with air in the space between the weather cover and the insulation surface. Both the IGC and 46 CFR 54 require, in order to take credit for the insulation in PRV sizing, that the insulation on the above deck portion of tanks have approved fire proofing and stability under fire exposure.

Polystyrene foam, as currently installed on LNG carriers, does not appear to meet these criteria. Even if the exterior fire were isolated from the foam (by an intact weather cover), ignition of these flammable vapors appears highly likely, given the relatively low autoignition temperature of styrene (~760 ^{o}K), and the fact that only about 1 mm thickness of the insulation would have to vaporize to raise the average vapor concentration in the air space under the weather shield above the lower flammable limit. Given the flue-like configuration formed by the space between the cover and the insulation, the volume of air in that space, and the potential for failure of the steel weather cover that would admit additional air, there is a potential for rapid burning of the insulation material[24], even if the ignition of the vapors prior to the steel weather cover failing did not result in an overpressure that failed the cover instantly.

We estimated, assuming that all of the foam melts and either burns or runs off, thereby exposing the tank wall to radiation heat transfer from an intact weather cover, that the steady-state heat flux into the cargo (all surface emissivities assigned a value of 1.0 except the steel weather cover, assigned , = 0.85) would range from 80 kW/m^2 to 135 kW/m^2 for a flame temperature range of 1300 ^{o}K to 1500 ^{o}K. An accurate determination of the potential for failure, and the probable mode, whether overheating of the tank wall in the vapor space or general failure due to overpressure, is beyond the scope of this paper. Nevertheless, even if potential for failure of the metal components of the system is neglected and no consideration is given to the potential for combustion of the insulation, it appears that a Moss Sphere insulated with non-fire resistant polystyrene foam, protected only from the heat of an engulfing fire by the steel weather shield, could rupture as a result of overpressure if the weather cover were subjected to an engulfing LNG flame for a time period of order 10 minutes.

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[24] Zicherman, J., Fire Performance of Foam-Plastic Building Insulation, Journal of Architectural Engineering, September 2003