ORAL HEARING

PROPOSED LIQUEFIED NATURAL GAS (LNG) REGASIFICATION TERMINAL LOCATED ON THE SOUTHERN SHORE OF THE SHANNON ESTUARY IN THE TOWNLANDS OF RALAPPANE AND KILCOLGAN LOWER, CO. KERRY

HEARD BEFORE THE INSPECTOR,

MR. ANDREW BOYLE

ON WEDNESDAY, 23RD JANUARY, 2008

AT THE BRANDON HOTEL, TRALEE, CO. KERRY - DAY 3

I hereby certify the following to be a true and accurate transcript of recordings of the evidence in the above-named action.

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APPEARANCES

KERRY COUNTY COUNCIL:	MR. T. SHEEHY
FOR THE APPLICANT (SHANNON LNG):	MR. HUGH O'NEILL SC MR. JARLATH FITZSIMONS BL
INSTRUCTED BY:	NICOLA DUNLEAVY SOLICITOR MATHESON ORMSBY PRENTICE
OBJECTORS:	MR. J. McELLIGOTT MS. GRIFFIN MR. NOEL LYNCH MS. JOAN MURPHY MR. DONNCHA FINUCANE MS. EILEEN O'CONNOR MR. E. McELLIGOTT MRS. LILY O'MAHONY MR. RAYMOND O'MAHONY MR. TIM MAHONY MR. THOMAS O'DONOVAN MR. MICHAEL FINUCANE MR. RICHARD O'SULLIVAN MR. DES BRANIGAN

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THE HEARING RESUMED AS FOLLOWS ON WEDNESDAY, 23RD JANUARY, 2008

INSPECTOR: Good morning everybody. This is Day 3 of the oral hearing on the Shannon LNG project and today I was hoping to at least start on the health and safety module. Before I do that though, I have been reminded by EirGrid that I promised them that they could have a few minutes and Mr. Mark Norton is here. They put in a very brief submission to us just a few days before this hearing and I think the best thing is if they read it over and then if anybody has any brief questions we will allow time for that. So, Mr. Norton please.

MR. NORTON PRESENTED HIS SUBMISSION AS FOLLOWS:

MR. NORTON: Hello. This is a letter dated 15th January, 2008. It is regarding the proposed Liquefied Natural Gas Regasification Terminal located at the southern side of the Shannon Estuary in the townlands of Ralappane and Kilcolgan Lower, Co. Kerry and it as follows:

"Dear sirs,

In response to your letter dated 21st December, 2007, EirGrid wishes to make the following observations in relation to the development of the Liquefied Natural Gas Regasification Terminal in the previous mentioned townlands.

All connections to the transmission system are subject to the terms and conditions as specified by various directions by the Commission for Energy Regulation to EirGrid from time to time pursuant to Section 34 of the Electricity Regulation Acts, 1999, as amended.

EirGrid is a licensed transmission systems operator under SI 445/2000 and has a public transparent connection offer process which it is required to comply with as part of its licence conditions.

In compliance with our duty not to discriminate unfairly between various system users, pursuant to Regulation 11 under SI 445/2000, EirGrid does not rank or discriminate between demand projects.

This project is currently within the connection offer process. Until the offer to be issued is signed the scope of EirGrid's transmission development works cannot be finally determined. It is important to ensure that there is no unintended conflict between this public planning process and EirGrid's connection offer process in respect of this development.

Notwithstanding this, EirGrid would like to make the following observations. The closest existing transmission station to the project is Tarbert 220kv station. As part of the connection offer process initial network studies have identified Tarbert 220kv station as adequate capacity ti accommodate the new facility and limits the needs identified for new additional infrastructure to the 110 station at the terminal site and 110 circuits to connect the station into the transmission network. The limited scale of network development to provide access to this terminal indicates the enhanced viability, for a transmission infrastructural perspective, of this connection point for a servicing of this size.

Regards Andrew Cook.
Director, GDC EirGrid."

INSPECTOR: Thank you Mr. Norton. Does anybody have any brief questions?

MR. O'NEILL: Sorry, perhaps I should go last. 10:07

INSPECTOR: Mr. Fox?

MR. FOX: Yes, my Lord. Thank you. Mr. Inspector, my question is mainly concerning the run of any line from the ESB supply out to the site. As I mentioned yesterday. We 10:08 would prefer underground, we don't want to spoil that area any further. We have concerns about how the ESB, or EirGrid as they are properly known now, how they intend to run that line. I think it is only fair to say that whenever the application comes up we will have 10:08 a lot to say about it at that stage. We would like you, Mr. Inspector, to make it a condition that the cable be run from the existing pylon system underground, out to the site. Thank you.

INSPECTOR: Mr. Norton? 10:08

MR. NORTON: We would see that the decision at this stage whether to go overhead or underground is undetermined. We will be going into a detailed planning process upon receipt of an offer and we would look at that point in 10:08 time to see what is most appropriate. The only thing I would say to that is the fact that it is normal practice, nationally and internationally, to use overhead lines, not withstanding the conditions, outside of urban areas. I would suggest that this decision would be better placed in the application for the lines, at that time.

MR. FOX: Mr. Inspector, I raised the point in view of the fact that I understand the Inspector can, at his discretion, make a recommendation or apply a condition. We would respectfully suggest this would become a condition, that the cabling be placed underground.

INSPECTOR: Okay. Mr. McElligott?

MR. J. McELLIGOTT: Yes, I think that we would like to object that that planning application for a transmission line should have been included with this current application, because of the risks it can cause to safety in being an ignition source for further accidents. That should have been included in the QRA. So, we are both objecting to the project splitting, contrary to the EIA Directive, and we are objecting to the fact that the risks of this high powered electric transmission system is not being included ini this current application.

INSPECTOR: Okay. Mr. O'Neill?

MR. O'NEILL: In fact, Mr. Fox asked the question I was going to ask myself. One point I would like to make, in case it escapes my attention later, Mr. Fox has suggested that you would impose a condition, or the Board would impose a condition, if it is of the view that planning permission should be granted, requiring that the cable

be underground. I am not sure that you have jurisdiction to impose such a condition and, in any event, it would probably be inappropriate before a proper assessment of the ground conditions and other conditions is undertaken and completed by EirGrid. 10:10
Thank you, sir.

INSPECTOR: Okay.

MR. J. McELLIGOTT: We would like a right a reply to the last statement by Paddy Power yesterday evening on the statement by 10:11
the Minister for Energy in the Dáil. It is very brief.

INSPECTOR: Well, just bear in mind that, I think, you are one of the prime people who wishes to talk about health and safety. 10:11

MR. J. McELLIGOTT: Okay, yes. The statement by Minister Ryan is interpreted by us as the Minister giving more importance to the announcement of the in Kinsale storage facility being the first such storage facility 10:11
in Ireland --

INSPECTOR: Mr. McElligott, I think we are having a little bit of difficulty here.

MR. J. McELLIGOTT: The statement by Minister 10:11
Ryan in the Dáil is interpreted by us as the Minister giving more importance to the announcement of the Kinsale storage facility being the first such storage facility in

Ireland and is only speaking of Shannon LNG's planned development as a supporting aside. His statement read:

> "The CER has granted a gas storage licence to Marathon Oil Limited to make the full capability of its depleted Kinsale facility, which has a capacity 10:12 of 7 billion cubic feet, available to third parties. This is the first such storage facility in Ireland and Bord Gáis Éireann has contracted to use over 5 billion cubic feet of it.
>
> Work is also nearing completion on an All Island Study overseen by my Department and the Department of Enterprise, Trade and Investment in 10:12 Northern Ireland on a joint approach to gas storage and liquefied natural gas. The planned development of a merchant LNG storage facility at Shannon will also have a positive impact tonne security of our gas supply and improve our connectivity to the global gas market.
>
> The connection of the Corrib Gas Field, 10:13 with its estimated capability to supply some 60% of our annual natural gas requirements over a span of 15 to 20 years, will significantly reduce our dependence on imports during that period."

So, we ask the Inspector to take that statement in its 10:13 context, because I think it was taken out of context yesterday evening. It also highlighted that the Minister and the Government now predict that there will be 60% of our annual natural gas coming from Corrib. That should be taken into account also. Thank you. 10:13

INSPECTOR: Thank you Mr. McElligott.

MR. O'NEILL: If I may very briefly reply to that. We do not accept that the statement from the Minister was taken out of context at all. But I do want to put it in a proper context. It is a statement by a Minister, it is not a matter to which you have to have regard. You have to have regard to the Government policy, the White Paper on identifying the Government policy on energy is much 10:14 more significant. It was included in Mr. Power's submission but it does, of course, have the caveat that it is simply the expression of one member of the Government, the appropriate Minister, obviously. We did not intend, and I do not want to give it a status 10:14 that it doesn't enjoy.

MR. J. McELLIGOTT: That's why we would like to say that I agree with you and that the Government has put more emphasis on its policy on renewable energy. Yesterday evening, before 10:14 he mentioned this Dáil speech, we had said that there was more emphasis at the moment being put tonne policy for renewable energy than our fossil fuels and our carbon emissions commitments under Kyoto Protocol.

INSPECTOR: Thank you, McElligott. 10:14

MR. O'NEILL: Just very briefly on that, Sir. The White Paper speaks for itself. I do not accept what Mr. McElligott is saying, but you will look at the White Paper, no doubt, and form your own view. 10:15

INSPECTOR: Now, do we have somebody here from the Department of Agriculture. Could I have the Department's full title, please.

DEPT. OF AGRICULTURE: Department of Agriculture, Fisheries and Food.

INSPECTOR: Your role in relation to this project is in relation to the Foreshore Act and the granting of a licence or a 10:15 lease; is that correct?

DEPT. OF AGRICULTURE: That is correct.

INSPECTOR: What factors do you take into account in granting such a lease? 10:16

DEPT. OF AGRICULTURE: We will take a wide number of factors. They would include environmental factors, I suppose primarily environmental factors. Our decision would be informed by advice from our Marine Licence Vetting Committee and 10:16 our own engineering division. So, marine engineering aspects would be looked at. The final thing would be a question of, I suppose, of valuation, that would be on the basis of advice from the valuation office before any lease would be granted. 10:16

INSPECTOR: Right. And does health and safety form any part of your considerations? Do you liaise with any other body to see that there would be no risk?

DEPT. OF AGRICULTURE: In the context of our 10:16 granting of our lease, yes, we would. We would have the MSO, as part of the Department of Transport, as a consultee with regard to the navigational issues -- that would be standard

procedure -- in our assessment of any application for a
lease on the foreshore.

I just want to draw the distinction between our
function of granting a lease and any observations we 10:17
might have to offer to An Bord Pleanála, because my
understand in relation to the Strategic Infrastructure
Act is that issues relating to navigation, insofar as
advice from An Bord Pleanála are concerned, would come
from the Minister of Transport. But I just want to 10:17
emphasise, in the context of the grant of any lease
that we might grant, we would consultant our normal
consultees and in that context they would include the
Department of Transport and the MSO, insofar as
navigation safety is concerned. 10:17

INSPECTOR: What is the MSO?

DEPT. OF AGRICULTURE: It is the Marine Survey Office.

INSPECTOR: I am not going to take questions on that, it is 10:18
just I wanted to have that information on board. So
thank you. Okay.

MR. COUGHLAN: I wish to make a statement.

INSPECTOR: We have got somebody from the Shannon Foynes Harbour 10:18
Authority.

MR. COUGHLAN: Alan Coughlan, Harbour Master, Shannon Estuary.
In relation to the navigational safety issues, it is in

the first place for us to decide what we will put in,
in terms of navigation safety procedures and resources.
And that has to satisfy the MSO, they come and look at
what we put in and they lift from us, from our
template, and they advise the Marine Licence Vetting 10:18
Committee. It has to be said that they can put any
conditions that they wish on the licence, from a
navigational safety point of view.

INSPECTOR: Okay.

MR. J. McELLIGOTT: Can may I ask a question? 10:19
Who has primary
responsibility for safety tonne estuary.

MR. COUGHLAN: The Harbour Master.

MR. J. McELLIGOTT: Does the Department of
Agriculture have any role 10:19
in undertaking a risk assessment on water.

MR. COUGHLAN: That's a question for the
Department of Agriculture.

MR. J. McELLIGOTT: Then a question for the
Department of Agriculture. 10:19

INSPECTOR: Hang on now.

DEPT. OF AGRICULTURE: As I said, we would take
our advice from the MSO.
So, as I have said, we have a number of consultees, in
the same way as we would take advice from particular 10:19
scientific people in relation to scientific matters we
would take advice in relation to navigation and safety
aspects from the appropriate people. I suppose, I
should have added, in the context of our consultees,

one of our normal consultees would be the Department of
Environment and we would consult them directly on
matters of environmental issues as well. That would
include nature conservation and underwater archaeology.
INSPECTOR: Thank you. Look, I want 10:20
to press on with the health
and safety module, and this is one of your major
concerns. So, I am going to now start into that and I
am going to call on you, Mr. McElligott, to open
proceedings. 10:20
MR. O'NEILL: Just very briefly, Sir.
You did raise at an early
stage issues that you had or issues that you wanted to
address in relation to health and safety, maybe if I
can briefly deal with one matter now it may clarify, 10:20
certainly, the Developers' approach. That relates to
the questions as to extent of the application of the
Seveso Directive and the Major Accidents Regulations
here, and particularly whether it extends to the
jetties. The application of both the Seveo II 10:21
Directive and the regulations are the same, they both
apply to the establishment, which would include the
jetties, the construction and unloading jetties. It
does not apply, both the Directive and the Regulations
are very clear in explicitly saying that they do not 10:21
apply to the transport of dangerous substances to and
from an establishment. And, therefore, the extent of
the establishment and the extent, therefore, of the
assessment by the HSA under the Directive is confined

to the land based facilities, including the jetty. In other words, the assessment of risk commences as soon as the gas hits the connection between the ship and the jetty. That's the fixed arm pipe.

INSPECTOR: Very good. Thank you for 10:22 that.

MR. J. McELLIGOTT: We would like to say that the establishment includes 25 acres offshore and that is included as part of the proposed application. So, we would, at least, say that 10:22 anything that happens in those 25 acres should be taken into account. Secondly, in the interest of safety to people, those safety issues coming up the estuary will have to be taken into account as well.

INSPECTOR: Okay, Mr. McElligott, do 10:22 you want to get on with your presentation at this stage.

<u>MR. MCELLIGOTT PRESENTED HIS SUBMISSION ON HEALTH AND SAFETY AS FOLLOWS:</u> 10:22

MR. J. McELLIGOTT: We requested the HSA defines the "specified area" subject to major accident planning regulations under the Seveso II Directive, because this is not 10:22 being given before the planning application is going through we think that this should be done afterwards. I am just going to give you a synopsis of the things I have submitted otherwise it will go on forever. Is that okay?

INSPECTOR: Do you have a copy here for our stenographer?

MR. J. McELLIGOTT: Yes.

MR. O'NEILL: If he has additional copies. We were simply given one copy. If Mr. McElligott has additional copies it would be very helpful. We have sent down to provide copies but it would be helpful if there were more copies available. 10:23

MR. McELLIGOTT: I have just two copies here left. I have just two more copies.

MR. O'NEILL: I don't know if the stenographer needs one right now. We can certainly make one available to her later this morning.

MR. J. McELLIGOTT: If you would be so kind. Thank you.

(SAME HANDED TO MR. O'NEILL) 10:24

Okay. Our submission is pretty detailed so that is why I just want to synopsise the different areas and issues that we are raising. I have given a complete copy to the Inspector and to the applicants, as well as the local authority. 10:24

Our main problem that we have is on the safety issue and we feel that we are not getting all the safety information before this planning application and oral

hearing has commenced. The first problem was that we
do not know the "specified area" that will be subject
to major accident planning regulations under the Seveso
II Directive. Secondly, the Department of Agriculture
have requested more environmental information from the 10:25
applicant and we do not have access to that information
either. Thirdly, we do not have a Marine Risk
Assessment undertaken yet by the Shannon and Foynes
Port Company.

10:25

We have been refused information tonne SemEuro
petroleum storage facility and we worry about the
cascading affects that would have and issues on
cascading affects, in the case of an accident, that
that would raise. 10:25

The safety issue is our main priority. We note that
there is no one statutory body to give overall safety
advice to An Bord Pleanála on overall of the project.
The HSA are giving land use planning advice without 10:26
taking any Marine Risk Assessments into account. The
Marine Risk Assessments will not be carried out until
planning permission is given.

The HSA ignored the detailed Kilcolgan Residents 10:26
Association submission to it on January 10th, one day
before the deadline given by it for public submissions
because it actually ruled on January 9th that it was
not advising against the granting of planning

permission. The HSA has since agreed, on January 15th, 2008 -- and I include the e-mail communication in the appendix -- that it will now review the material that we submit with the help of three world renowned LNG experts, which could alter the view of the authority.

We object that if an exclusion zone is implemented which prevents other port use and other land use of the remainder of the landbank then Shannon Development will have broken the aims of the land, as expressed in the County Development Plan, when they had expressed the aim that the lands were going to be kept for "a premier deep water port and for major industrial development and employment creation". This land was sold under pressure, with the understanding in the media over many years that it was being done for the common good. Less than fifty jobs is not a relatively major employment creation. We raised that issue yesterday but we just want to enforce it.

Dr. Jerry Havens, the world authority on LNG, has flown in especially from America to attend this oral hearing. We already asked the HSA and Shannon and Foynes Port Company to be present so that Dr. Havens may question and be questioned by them in order to ensure that as many of the safety issues as possible be covered in this short timeframe. From the Kilcolgan Residents perspective, advice on land use planning issues do not represent an independent analysis of all the safety

issues by any statutory body, so we would urgently request that this opportunity to get a better understanding of all the safety issues involved from Dr. Havens in person is seized upon. Because of extremely limited resources the KRA is of the opinion 10:28
that our role is in only raising issues of concern to us. It is the job of the statutory bodies to deal with the safety issues completely and cohesively and not in the piecemeal manner that seems to be taking place to the date. 10:28

Article 5.1 of the Seveso II Directive states that: "Member States shall ensure that the operator is obliged to take all measures necessary to prevent major accidents and to limit their consequences for man and 10:29
the environment".

This means that as we have found safer alternatives, for example offshore, then that safer alternative should be used instead of the current one. Article 12 10:29
of the Seveso II Directive is more specific on this when it states: "Member States shall ensure that the objectives of preventing major accidents and limiting the consequences of such accidents are taken into account in their land use policies and/or other 10:29
relevant policies. They shall pursue those objectives through controls on, among other things, the siting of new establishments."

Now, as we have said many times, we have had no time to prepare for this oral hearing in any meaningful way because of the very short timeframe involved.

10:29

Yesterday we talked about some of the alternatives: The offshore floating storage. The gravity based structure that is being implemented in Italy. The dock side terminal in Teesside, run by Accelerate Energy, which is currently in place. Submerged buoy 10:30 technology, also run Accelerate Energy. It is in the Gulf Gateway Terminal 116 miles off the coast Louisiana. Shannon LNG questioned the acceptance of this type of technology by LNG suppliers as there is no storage. However, Accelerate Energy also has received 10:30 its Record of Decision from the US Maritime Administration for approval for the companies Northeast Gateway Deepwater Port LNG Facility in Massachusetts in December. That's the scheduled to be operational soon.

10:30

We also mentioned yesterday the new technology, which is catching up all the time, and that it is now possible to pump directly from an LNG carrier into salt caverns, which exist in the north of Ireland. That costs roughly 480 to 650 million dollars. The other 10:31 alternatives we had raised yesterday, also, were the discussion about Corrib and the storage need being filled by the Kinsale reservoir. So, these were alternatives that are safe. Our claim is that if it can be shown here clearly today that the proposed Shannon LNG site is dangerous for the people of North Kerry then it is your duty to say that if other alternatives exist then they should use those alternatives. But it is not our job to assess those in more detail. It is up to the Board to get the expertise to do that. 10:31

We have also noted that underground tanks are used in Japan and were identifying as a way of reducing risks. 10:32 We question that this is not considered here purely on economic grounds.

As I said yesterday, also we had petitioned the European Union Parliament. This is point 10. And I 10:32 have included the details of this petition. It was a petition for condemnation of breaches of EU Directives by An Bord Pleanála and the Irish Planning and Development Act, 2006, in the planning application for this terminal because it is a top-tier Seveso II 10:32 development. We have also petitioned for condemnation of breaches of the SEA directive by Kerry County Council for refusing to conduct a Strategic Environmental Assessment when they rezoned the lands.

10:32

We request that any decision tonne proposed LNG terminal be postponed awaiting the outcome of the European Union petition.

We have also complained about the breach of procedure at An Bord Pleanála, which we believe compromises the independence An Bord Pleanála in dealing with this application. An Bord Pleanála is also withholding vital environmental information and, therefore, also safety information -- as that is how environmental information is defined in the Seveso II Directive -- tonne intentions of SemEuro for a petroleum storage facility tonne site adjacent to the proposed LNG terminal. 10:33 10:33

We have also made a formal complaint to the Office of the Ombudsman concerning a serious breach of procedure by Kerry County Council. That is currently under investigation by the Ombudsman's officer, reference L18/07/2518. We request that any decision tonne proposed LNG terminal be postponed awaiting the outcome of this complaint. That was to do with the rezoning of the lands. 10:33

10:33

We have also forwarded the complaint to the Minister For the Environment requesting that he overturn the rezoning, as it breached the Department's own guidelines. The reference number here is REP4126/JG/07. We request that any decision tonne proposed LNG terminal be postponed awaiting the outcome of this complaint. 10:34

Shannon Explosives Limited has applied for an

explosives storage facility at Charercon further west of the Shannon LNG site tonne other side of the Shannon, on the coast of Clare. And we are also worried about -- that's currently under planning application in Clare County Council. We also asked 10:34
that An Bord Pleanála considers this application in examining the risk of accidents that are caused -- you know, the risk of cascading accidents that would be caused by an accident either of the LNG tanker or of the explosive devices at the Shannon Explosives Limited 10:35
proposed site at Charercon.

The last thing I would like to show is the "Prime Time" video of November 15th. This concluded that vapour clouds do not evaporate harmlessly into the air, as was 10:35
claimed by Shannon LNG. Furthermore, the company sponsored trips by selected individuals to foreign plants and they, as we have mentioned before, they have sponsored local GAA clubs. We have questioned their behaviour because what we are trying to get the point 10:35
across is that when you are putting in a very serious application like this, and it is a chemical hazard company, you must tell every bit of the truth and be completely transparent in your dealings with the public. So, I think I would like to show the "Prime 10:36
Time" video because it raises the issues of what they had said consistently for the last one and a half years about this proposal being so safe and so clean that nobody else looked at the issues until it was almost

too late. So I would like to just show that now, please.

MR. O'NEILL: Sir, I am not sure of the relevance of any media presentation or publication. The purpose of this 10:36
hearing is for you, as an Inspector of An Bord Pleanála, to, obviously, consider the application and listen to the objections and observations that are made on behalf of parties. There is no probative value whatsoever in a report compiled by RTÉ, or anyone else 10:36
for that matter, on an application that is being made and ultimately heard by you. If I could just finish please, Mr. McElligott. We have present, I understand, Dr. Havens, who professes expertise and, undoubtedly, he will deal with all of these issues. That may be 10:37
value to you. What RTÉ says can be of absolutely no value.

INSPECTOR: What RTÉ says included an expert opinion, but I think you have had the opportunity to see this video already, 10:37
it is not introducing any new evidence. Is that correct? Your team?

MR. O'NEILL: My team. I personally haven't seen it. My team may well have seen it. 10:37

INSPECTOR: Can we just confirm that? It would have been made available anyway.

MR. O'NEILL: Yes. But if it is

introducing -- insofar as I personally don't know what is in it, it is difficult for me to comment. But all I can say is if it is introducing expert's reports, who are then not subject to examination -- and experts other than Shannon LNG experts -- that is hardly an appropriate procedure. If a view is to be expressed at this hearing the person who is expressing that view should come here and express that view. There is no provision for you to take, as part of the evidence, probative evidence, information that is provided in a different forum.

MR. J. McELLIGOTT: Mr. Inspector, you have great leeway and this is in an informal hearing. It does have an expert opinion in it, but it also gives -- it shows the context of what is taking place. We do no not have the resources, as I said before. Our limited resources are based on the few limited resources we have. We can't afford to do anything else.

MR. O'NEILL: The comment that is made in paragraph 14 is this "the "Prime Time" video concluded that vapour clouds do not evaporate harmlessly". That is not a conclusion that "Prime Time" is entitled to come to or has the expertise to come to and cannot make that conclusion without being subjected to some examination. That facility is not available here and, in those circumstances, it would be a breach of the principles of natural and constitutional justice to allow that video be admitted without the facility to cross-examine.

MR. J. McELLIGOTT: Mr. Inspector, they did a lot of public advertisements and they put out a lot of brochures in 10:39
the public domain and they did a lot of publicity and they had their chance to give a public display. We feel that they were wrong and now we want to show contrary information, also in the public domain. So, I think it is only fair that we should have a fair shot 10:39
at it as well.

INSPECTOR: It is what, a five minute video?

MR. J. McELLIGOTT: Five minutes. Well, seven I think. 10:39

INSPECTOR: I think we will allow it.

MR. O'NEILL: You will note my reservations.

INSPECTOR: Yes.

10:39

(VIDEO SHOWN)

MR. J. McELLIGOTT: Mr. Inspector, we submitted a fairly detailed submission to the Health and Safety 10:50
Authority...(INTERJECTION)

MR. O'NEILL: Sorry to interrupt, Mr. McElligott. Perhaps Mr. McElligott could confirm that that's an unedited version of the "Prime Time" presentation.

MR. J. McELLIGOTT: No, no, I shortened it.

MR. O'NEILL: It is edited?

MR. J. McELLIGOTT: Yes.

MR. O'NEILL: On what basis? 10:50

MR. J. McELLIGOTT: On the basis that I thought I had limited time to show four videos.

MR. O'NEILL: Or did you edit information in that, that didn't suit 10:50 the case that you are trying to make?

MR. J. McELLIGOTT: I put in all of Dr. Coxs' and the expert opinions.

MR. O'NEILL: Why did you not tell the Inspector that you were 10:50 presenting an edited version, rather than lead everyone to believe that we were seeing the full "Prime Time" version?

MR. J. McELLIGOTT: I said "Prime Time" investigated, and the 10:50 Inspector already has -- the full version has been submitted to An Bord Pleanála anyway.

MR. O'NEILL: So you didn't think it was necessary to inform everyone here that what we were seeing, in fact, was 10:51 not the "Prime Time" production, it was your version of that.

MR. J. McELLIGOTT: Yes. But that was extremely clear from the very beginning, when you saw the first five seconds, it was obvious it was an edited version.

MR. O'NEILL: Not of that issue. Not in relation to that issue, the LNG issue, it certainly was not. But that is something we will deal with later.

MR. J. McELLIGOTT: If you like, I can show the full version of it.

MR. O'NEILL: It is something that I am surprised and disappointed that you didn't, in the sense of being open, something that you have accused Shannon LNG of not being open, that you yourself do not tell the members of the public here, many of which support this proposal, tell the members of Shannon LNG, tell the members of Meath County Council (sic) and, of course, and most importantly, tell the Inspector that what you are showing is my selective version, edited version of the "Prime Time" presentation.

MR. J. McELLIGOTT: Yes, I informed An Bord Pleanála, Nicola Meehan, and I asked her how long could I show a video for. She said 'you will have to shorten it so that it will not take too much time. Five or seven minutes would be okay', she said. I told her it was 12 minutes and 44 seconds and I had to shorten it, according to Nicola Meehan. So, I assumed that was understood. And I do not have any legal advice on the intricacies of the legal statements you are making and I cannot compete with you, I am sorry. So I put my hands up.

MR. O'NEILL: No doubt though, Mr. McElligott, you understand the impression that can be given when statements are taken out of context and when productions are edited. That doesn't take any legal experience or training.

MR. J. McELLIGOTT: I apologise profusely. I would like, also, to say that we submitted a pretty detailed submission to the Health and Safety Authority and we had input from two other LNG experts, James Venart, Ron Koopman, as well as Dr. Havens. But I have included it as an appendix and I think it would be better that Dr. Havens deals with those issues, because it is pretty lengthy and I am not an expert on LNG.

MR. COUGHLAN: May I make a correction to something that Johnny McElligott said, please. Alan Coughlan, Harbour Master, Shannon Estuary. He made reference to an explosives factory in Charercon. In actual fact, that factory is at least 12 miles away from the proposed site of the Shannon LNG project. Also, my understanding of that facility, if it ever gets going, because it is tonne planning books for quite a long time, is that two inert substances will be brought in and mixed locally on site to make explosives. There would be nothing of a dangerous nature passing the proposed site. Thank you.

INSPECTOR: Thank you for that clarification.

MR. J. McELLIGOTT: I am just wondering about ships passing close to site. How close would the ships pass near that site? 10:54

INSPECTOR: But Mr. Coughlan has just told you that those ships will contain inert substances.

MR. J. McELLIGOTT: Okay. I was thinking more of when ships pass near the 10:54 sites. Those explosives might be inert when they arrive, but if it is an explosives storage facility will they be explosive devices when they are completed? I think it should be just looked into.

MR. COUGHLAN: May I reply? Nothing will 10:54 be explosive until it reaches Charercon, which is at least ten to twelve miles from the proposed LNG site. Everything will be inert until that time.

MR. J. McELLIGOTT: How far is this site from 10:55 the shipping lanes?

MR. COUGHLAN: I have just told you. Which site do you refer to? The LNG site?

MR. J. McELLIGOTT: No. How far is the 10:55 Charercon site from the shipping lanes?

MR. COUGHLAN: That's totally irrelevant to this procedure.

MR. J. McELLIGOTT: Thank you, I am finished.

INSPECTOR: Do you wish to continue?

MR. J. McELLIGOTT: I have put in the detailed submission. Dr. Venart noted that we should take into account the Buncefield site and the accidents that happened there. He says: 10:55

> "In preparation for your studies you might want to take a look at the UK HSE Buncefield site and review the reports available on that accident in 2005. The review, especially the one dealing with the Explosion Mechanism Advisory Group, while methane is not butane, in terms of its explosive sensitivity, it can be detonated. For example, with the vapour cloud explosion studied by Dr. Michael Hanarooski (sic)..." 10:55

He says:

> "There is some controversy regarding the explosive sensitivity of C1 and, as Buncefield clearly shows, a vapour cloud explosion was ruled out. That is it was given a probability of zero..." 10:56

And it exploded anyway.

> "...in its QRA like evaluation. So, despite what the Shannon QRA states, I think this possibility must be carefully considered." 10:56

That's what Dr. Venart submitted. Dr. Koopman, he pointed out that he was happy to see that a QRA was undertaken. This is in appendix 3 by the way. 10:56

> "He said he was happy to see that a QRA was undertaken which was basically sound (good news for the proposal). He also agrees with the consequence calculations of the accident scenarios

reviewed, find them inconsistent with his work and the work of others he has reviewed (also good news for the proposal). He agrees that the probability or risk of an accident is very low, even if the consequences of the worst incidents are quite severe and can extend for miles downwind. But he does say that "unfortunately there is no equivalent QRA for LNG shipping in the Shannon Estuary...and that ship collisions are fairly common in and around port areas."

"Dr. Koopman also pointed to me in a further e-mail that there is an error in the QRA in the frequency estimate for a large hole to a storage tank.

"Indeed, the flash fire hazard distance far large hole (d) in the storage tank is 11.3km downwind but the frequency estimate for such a whole is 0 in table A1 of annex A, therefore the risk is 0. In table 3.3, page 20, in the body of the report a frequency of 5E-8 is used for catastrophic failure, not 0. This should have been used in the calculation rather than 0, but would probably not change anything. The tanks proposed for this project are very robust and have never failed. The only real possibilities for tank failure that I can think of are attacked with a truck bomb or shaped explosive, an earthquake or a large aeroplane. In all of these cases the frequency is extremely low and close to 0."

Our contention, as residents, is that you must get everything right in a Quantitative Risk Assessment.

Dr. Koopman also pointed out and he raised the following issue in the same e-mail.

"Ship collision probabilities are higher than LNG plant accidents, especially in approaches to harbours, such as the estuary. They depended directly on the traffic and controls put in place. Without knowing the ship traffic information, numbers, speeds and sizes, it is impossible to judge the probability."

Dr. Havens then highlighted the issue that there is no requirements for exclusion zones in the United States of America to project the public from LNG spills onto Water. So, our claim is that this is incontrovertible information that the HSA must take on board and insist on awaiting the outcome of the Marine Risk Assessment. 10:59

Our position is that the fact that we have experts of the calibre of Dr. Havens, Dr. Koopman and Dr. Venart interested in a QRA at the other side of the world, at Tarbert, in itself is proof enough that the Risk 11:00 Assessment of this application should not leave any stone unturned and it has, indeed, raised very serious issues. We should not leave any stone unturned in ensuring that all safety precautions are taken and that the latest scientific knowledge is not ignored. They 11:00 are highlighting the need to ensure that we are taking accurate measurements of the true risks involved. Now, there is one other point that I note. Just give me a minute.

MR. COUGHLAN: As he looks for that 11:01 information may I make another correction, please?

INSPECTOR: Okay.

MR. COUGHLAN: Alan Coughlan, Shannon

Foynes Port Company again. The statement by the expert who claims to Mr. Koopman to say that collisions are very frequent in and around port areas, and that without knowing the traffic frequency you couldn't possibly judge what the probability was. 11:01

MR. J. McELLIGOTT: That was Dr. Koopman.

MR. COUGHLAN: Thank you. The number of traffic movements in at the Shannon Estuary - 905 ships last year. That is a total of 1810 traffic movements. When they go in they have 11:02 to come out. That's less than five ship movements per day. They all meet each other end on. There is no crossing. By any standards, that is a very, very low incident of traffic in any port. We have never had a collision in the entrance to the river and it is highly 11:02 improbable. Thank you.

INSPECTOR: Thank you Mr. Coughlan.

MR. J. McELLIGOTT: Yes. We had also requested more time from An Bord Pleanála for these LNG experts to do a site specific 11:03 study, but we were not accorded that time from An Bord Pleanála so we had, once again, to make do with very limited resources and very limited time. That concludes my submission.

11:03

We have invited David Robinson to come from Wales to explain and give a perspective, the Milford Haven perspective, as residents there, on some of the risk issues that they faced. Because we know that the HSA in Ireland is the baby brother of the HSE in the UK and in the absence of rules specifically dealing with LNG in Ireland, under the HSA rules, they would automatically look at the HSE, The Health and Safety Executive, in the UK. So, we just want to point out with David Robinson's submission that there are other issues that are also raised in the UK. So we should not take them at face value either. Thank you. 11:03

INSPECTOR: Mr. Fox, do you have something brief to say, because really Mr. McElligott has the floor. 11:04

MR. FOX: Yes, Mr. Inspector. That video that was shown was highly selective. The full video, when it was shown, when aired on RTÉ, we regarded as being very fair and balanced and we had no objection. That is the Tarbert and Ballylongford Development Associations. Because we know that we have over 95% of the registered electors in Tarbert and Ballylongford supporting us. 11:04 11:04

INSPECTOR: No, the point really of the video, or the part that I was interested in, was on the expert and what he had to say, and the opinions of residents, one way or the other, is not a particular interest at this point, as far as I am concerned. Ms. Griffin? 11:04

MS. GRIFFIN: Catriona Griffin. I just want to pick up on something that Mr. Fox just said. He said 95% of the electoral in Tarbert are in favour of this project. Well, I wasn't aware that any survey had been done in Tarbert and I, my friends, my neighbours, all live in Tarbert and no one from Tarbert Development Association or Tarbert Chamber of Commerce have ever come to us and 11:05 asked for our opinion. When i am dropping my daughter to school every morning I get people coming up to me saying "good luck, well done", and I think it is important, Mr. Inspector, that you realise that Mr. Fox is not speaking for the people in Tarbert. Thank you. 11:05

MR. MURPHY: Mr. Inspector, may I reply to that? Joan Murphy, chairperson of Tarbert Development Association.

INSPECTOR: I want to close this aspect. I am concerned now 11:05 about health and safety.

MR. MURPHY: Fair enough. But Mr. Fox is our spokesperson for Tarbert Development Association.

MS. GRIFFIN: Yeah, but not for 95% of 11:06 the people in Tarbert.

INSPECTOR: Closed.

MS. GRIFFIN: Okay.

INSPECTOR: Mr. Robinson, before you commence. The copy you 11:07 have given me is marked "mine" and it has certain notes.

MR. ROBINSON: Sorry.

INSPECTOR: So this is a clean copy, is it?

MR. DAVID ROBINSON PRESENTED HIS SUBMISSION AS FOLLOWS:

MR. ROBINSON: Good morning, ladies and gentlemen. Can I congratulate you on your having this seminar, or whatever. 11:07

INSPECTOR: It is a hearing, oral hearing. 11:08

MR. ROBINSON: Yes. We didn't have one in Milford Haven.

At the top, where it says "Safe Haven", "to whom it may concern". My name is David Robinson. I am 61 years old. I have lived and worked all my life on both sides 11:08 of Milford Haven waterway for Oil & Utilities Companies. In the 1970's, 80's and 90's I spent twelve years working in Saudi Arabia and Oman for the Oil Utilities and Mod companies. I am now retired and my last job was being a shift charge engineer at a power 11:08 station in the Sultans Armed forces in Oman.

I am here today to represent Safe Haven, which is a group of concerned residents from around Milford Haven, asking about the reasonably insurmountable safety 11:08 concerns we have regarding LNG receiving terminals in the world. Sorry, regarding the largest LNG terminal in the world, which Milford Haven is, namely the Exxon "South Hook" terminal and the British Gas "Dragon" terminal.

Can I straight away state that we are not a group who are against LNG, as we all use gas, either for cooking or heating or if it is used in power stations to produce our electricity. Although it is a fossil fuel, which has cause for concern for climate change, it is the reasonable insurmountable safety concerns and the way regasified LNG will be used in large power stations -- I stress large power stations -- that concern us. Although, I must add at this point that in the LNG producing countries around the world, the liquefaction process of LNG produces one tonne of CO_2 for every 5 tonnes of LNG produced. That is the best. The worst is somewhere about 3.5 tonnes of LNG for one tonne. So I have given the best example.

I am not saying one tonne of CO_2 is not counted in the CO_2 footprint in the west under the Kyoto Agreement. Our preferred way of burning regasified energy would be in the combined heat and power stations. This is going on in Woking in this country and in Malmo in Sweden. So, it is possible to do it. You can see film of this on www.youtube.com. I will let you look at that in your leisure. This would allow us here in the west to burn half as much gas through the greater efficiency that CHP allows. It allows you to burn the LNG to produce electricity and the waste heat is then used to heat or cool communities, as they wish. But it would mean that small power stations, community based would be used, would be used, as in Malmo and Woking.

There is an added bonus to this, this being that it would allow more LNG to be burned by China and India, 11:11 who are both intent on burning high polluting low grade coal, and as we all live in the same atmosphere it would seem sensible.

Could I just add that I believe we are probably at 11:12 tipping point of the fossil fuel and renewable industries. This industry, the fossil fuel industry, will be on the way in the next 20 years probably.

Now, then, with regard to your deliberations in the 11:12 planning application for the LNG terminal at Tarbert, Co. Kerry, can I be so bold as to ask the LNG companies to answer a few questions. The first one:

1. Will Shannon LNG (Hess) indemnify the local 11:12 planning authority, the Irish Government and the EU for any claim or lawsuit brought by third parties as a result of damages due to an accident in an LNG regasification plant or pipeline? Maybe they can't answer the pipeline? 11:13

Given that this exact question was asked by the major of Long Beach of the LNG Companies (Special Energy Solutions (Conoco/Philips)) planning an LNG terminal in

Long Beach Harbour, to which the companies answered they would not indemnify. Needless to say that the LNG project is not going ahead. Although it is still being talked about.

11:13

Is it appropriate for me to ask at this point? Would you like me to ask? Could I ask this question?

INSPECTOR: I don't think it is appropriate at this point. I think just continue with the presentation and, 11:13 possibly, the applicants will talk about this at some stage during the hearing.

MR. ROBINSON: Item 2. What is the worst case scenario -- and this is a questions to Hess again -- what is the worst case 11:14 scenario for a spill of LNG on water at the jetty, that QRA has been done by either the port authority, the LNG companies or an independent risk assessor? Note that if a proper full independent risk assessment were to be done for a spill of LNG on water it would be for a 5th 11:14 of the cargo, which equates to 50,000 cubic metres. One tank in the five in the LNG carrier.

No. 3: What would the domino effects be if an LNG pool fire were to occur, that resulted in a 1, 5 or 12 metre 11:15 hole in one tank of the LNG carrier? Where would the burning carrier be carried by wind and tide? I will qualify that. Give that the pool fire burns at well over 1000 degrees centigrade -- that's a low figure so

I have stayed within bounds -- and the LNG carrier is moored with ropes made of to polypropylene, which have a low melting point.

No. 4. Is the deliberate ignition of any gas cloud on water being considered by the LNG companies or the port authority? Who will be responsible for igniting the cloud? What domino effects are expected from this gas cloud ignition? 11:15

Note that the Sandia Report 2004 makes this statement on page 46: 11:16

> "This suggests that LNG vapour dispersion analysis should be conducted using site specific atmospheric conditions, local topography and ship operations to assess adequately the potential area and levels of has hazard to public safety and property. Risk mitigation measures, such as development of procedures that quickly ignite a dispersion cloud and stem the leak, should be considered if conditions exist that the cloud would impact critical areas." 11:16

11:16

No. 5: I think we went through this one yesterday. Do you agree with the Society of International Gas Tanker and Terminal Operators, SIGTTO, their statement in their PowerPoint presentation, that the risk differences between crude oil and LNG, if either were spilled, are as follows: Crude oil affects the environment. LNG does not affect the environment, to a great extent anyway, but it does affect people and property. 11:17

No. 6: Do you agree with the HSE's confirmations -- that the British HSE -- that LNG has two properties that are not fully understood? The first being rapid phase transition. There is a paper here by the Society of Petroleum Engineers that might be of interest. I have put asterisks either side where it says that it shouldn't be used in risk assessment deliberations because it is an unknown phenomenon.

Rapid phase transition, RPT, this is a phenomenon when LNG spills and mixes with water, causing flameless explosions that have been observed to damage surrounding structures. Now, that means when it is coming out of the ship it is breaking in the ship, it is exploding in the water next to the ship.

Computer modelling predicts larger explosions than are predicted using physical spill tests of smaller quantities of LNG in water. See attachment, which is this one.

B. The percentage of contaminate gases in LNG that make it as explosive as LPG -- I would like that question answered -- at what point does the methane content -- if it drops between 90%, 86%, at what point does it become as explosive as LPG? This is of extreme importance as when LNG is spilled on water and regasified the LNG companies will lead you to believe

that the regasified LNG will not explode. Please note,
on the 19th January, 2004, in Skikda, Algeria, which I
believe you saw on the film, an LNG vapour cloud did
explode, resulted in the death of 27 souls and the
injury of 120 people. I have seen figures of 57, 80, 11:19
120, so maybe that last figure could be wrong. I don't
think anybody really knows, maybe because they didn't
know how many people were on the plant at time. I am
not sure.

11:20

This is known as a "Seeded" explosion. In this case a
steam boiler -- I think what happened was it was a
breakage in a pipe, a gas cloud formed and then the
boiler, the FD Fan, the four strap fan on the boiler,
sucked in some of the gas into it. Of course, it is a 11:20
confined space, a boiler, so it will explode there. In
this case a steam oil blew up under the vaporised cloud
of LNG. This phenomenon is not fully understood, but
is believed to alter the explosive range of the gas
cloud, which is normally 5 to 15%. It is thought that 11:20
that the explosive range could be altered to 5% - 45%
by this explosion under the cloud, a "seeded"
explosion. If the LNG has contaminate gases that are
higher than 14%. That means 86% methane, 14% a mixture
of butanes, ethanes and propanes. The latter three are 11:21
detonator gases, hence the reason for this questioning.

No. 7: Are you aware of the GAO report? You should
have that, this one here (indicating). Are you aware

of the GAO report for the United States Congress GAO -- I needn't read it -- "Public Safety Consequences of a terrorist attack on a tanker carrying Liquified Natural Gas" needs clarification?

11:22

In your risk assessment deliberations have you taken into account the relationship between "Hole size and cascading tank failure"? Hole size is an important parameter for modelling LNG spills because of their relationship to the duration of the event. Larger 11:22
holes allow the LNG to spill from the tanker more quickly, resulting in larger LNG pools and a shorter duration of fires. Conversely, small holes could create longer duration fires. Cascading failure is important because it increases the overall spill volume 11:23
and duration of the spill. See page 11 of the report.

I have not included the whole report because it is 46 pages long. It can be downloaded from the internet if you put in the number at the top and go to the GAO web 11:23
site in Washington.

In your risk assessment deliberations did you take into account "Waves and Wind", which will tend to tilt the LNG pool fire downwind, increasing the heat hazard in 11:23
that direction. Page 12 of the report.

Finally. In your risk assessment deliberations did you take into account that the Surface Emissive Power of a large LNG pool fire is unknown? Page 12 in the report.

No. 8. What level of terminal radiation (flux) do you expect the public to endure offsite in the event of an LNG fire on land or water, given that a hot summers day gives a value of 1.2 kilowatts per metre squared? Note the Gordon Milne report that is also available on the Milford Haven Port Authority web site. This had to be fought for through the information commissioner. On page 3, under "pool fires" you will see, in the third paragraph, near the bottom, it says "1.5 kilowatts metre squared is considered safe".

Mr. Gordon Milne, Senior Risk Analyst for Lloyds Register of Shipping comments in the document, released under the Freedom of Information to Safe Haven, entitled "explosions and gas releases from LNG carriers at 1.5 kilowatts per metre is safe". Yes, at page 3 of the document.

Also, Dr. Jerry Havens, who is to talk today, is of the opinion that 1.5 kilowatts metres squared is safe from the public. Please ask him today. In our case, in Milford Haven, the HSE have used 5kw per metres squared as safe for the public. The HSE quote an OFFSHORE report (Human Vulnerability to Thermal Radiation Offshore HSL/2004/04) as evidence that this level of thermal radiation is safe for the public. It seems perverse that when offshore workers are paid, trained and clothed and have shelters to withstand such radiant heat that the general public are expected to endure 5kw per metres squared without being paid, trained, clothed or having any shelters provided. Please note that 5kw per metres squared will burn bare skin to blisters in 11:26 30 seconds.

No. 9: An emergency plan in our case -- I am not sure about here -- has to be in place before an LNG plant can start up for onsite personnel and offsite 11:27 personnel. I am not sure who is responsible for writing this emergency plan in Shannon, but has confounded us in Milford Haven how this can be done without a quantitative risk assessment for a spill of LNG on water. 11:27

That means if you don't know the consequences of a spill on water how else can you advise the public of what to do.

11:27

Finally, I have heard it said that the probability of an LNG accident is so remote that it is not worth worrying about. I would ask you to review the 14th International Conference and Exhibition on Liquefied Natural Gas, LNG 14, which took place in Doha, Qatar, 11:28 on 21/4/2004, where Mr. Tony Acton of British Gas, in conjunction with Tractebel LNG, Gaz de France, Osaka Gas and Tokyo Gas presented a paper, "LNG Incident Identification - a Compilation and Analysis By the

International LNG Importers Group (GIIGNL). This is a good example of a thorough cooperative safety report by the LNG industry. 246 incidents of releases of hazardous material, near misses and other instances of concern over a period 1965 to 2000 have been reported and analysed by GIIGNL members, LNG reception terminals and peak shaving facilities. Only 11% of the results reported resulted in an explosion, fire or rapid phase transition and the frequency of reported incidents is low. They 0.33, 1/3 of an incident per year, per site. So, that would mean that in three years I imagine you would have one incident.

There is a trend towards a decrease in the relative number of events where significant quantities of hydrocarbons have been released. GIIGNL is committed both to improving further and reporting incidents and to maintaining its database up to date for the general good of the industry. See attached highlighted document. I have only printed off one page of it. It says "LNG journal" at the top. About a third of the way down, a bottom, it is the fourth paragraph up from the bottom "Tony Acton BG Group". Have you got that? It is worth reading the whole of the safety part, after the top third. But I have highlighted on mine and the Inspector's copy from "Tony Acton" down. You will see I have quoted that in my text.

Finally, a statement by the Society of International

Gas Tankers and Terminal Operators (SIGTTO). Zoo.

> "Playing By the Rules:
>
> Disasters are not the result of lack of regulations, but the lack of compliance. First and foremost, it is important the enforce the rules that already exist". 11:31

Remember, and this is important, remember, too, that even if LNG accident happens elsewhere in the world Tarbert Co. Kerry will immediately be looked on in a different light. And that concludes my submission. If 11:31 anybody has any questions I would be pleased to answer.

INSPECTOR: Thank you Mr. Robinson.

END OF SUBMISSION BY MR. ROBINSON

11:32

Do you wish to present your next witness?

MR. J. McELLIGOTT: Dr. Jerry Havens please.

INSPECTOR: We will take a five minute break before we have Dr. Havens. 11:32

SHORT ADJOURNMENT

THE HEARING RESUMED AFTER A SHORT ADJOURNMENT AS

FOLLOWS.

INSPECTOR: Okay, we have had a very long five minutes, maybe 11:50 it's an Irish five minutes, so if people could resume their seats please. Now, Mr. McElligott, I think you were about to introduce Dr. Jerry Havens; is that correct?

MR. McELLIGOTT: Yes. We just invited 11:51 Dr. Jerry Havens. Last week we were raising such serious issues about the shortcuts we feel were being taken in the planning process and we contacted Jerry Havens and he said he would come over for just two days so he is flying back 11:51 to America in the morning and this is a great opportunity for a world renowned LNG expert to give his learned and expert opinion on the risks and safety issues involved in an LNG importation terminal. I will now hand out his submission. 11:52

MR. JERRY HAVENS ADDRESSED THE ORAL HEARING AS FOLLOWS.

INSPECTOR: Dr. Havens.

DR. HAVENS: Good morning. My name is 11:53 Jerry Havens, I am a Professor of Chemical Engineering at the university of Arkansas in the United States. I am speaking here as a concerned scientist. My comments are not to be attributed in any way to the University of Arkansas.

I want to thank you for allowing me to appear here on behalf of the Kilcolgan Residents Association. As I understand why you might question the propriety of my "butting" in on this LNG siting hearing I hope you will give me a few minutes to explain my purpose.

I have spent my adult life researching the potential consequences of catastrophic releases of hazardous materials, with an emphasis on fire and explosion hazards. I believe you have, or at least I have submitted to Mr. McElligott, my resumé which will give more detail than I am time for here. I do think it pertinent and hopefully of interest to you to state that I have had a close association with European authorities on such questions as the one before this authority since the 1970s, having first served in England as a consultant to the Major Hazards Committee and the Health and Safety Executive in the conduct of the heavy gas trials at Thorney Island in Hampshire in the early 1980s. The Thorney Island trials were gas dispersion experiments which were recommended by the British Government as a result of the Flixborough disaster in which there occurred a very serious explosion of a cyclohexane vapour cloud that resulted in worldwide changes in regulatory practices for handling of hazardous materials. Similarly, I have investigated and continue to study the Bhopal gas cloud

disaster which occurred in India in 1984 and was
arguably the worst industrial chemical accident in
history. I was invited to participate in research
resulting from these catastrophic events as well as
other similarly directed programmes in Europe largely 11:55
because I was contracted by the US Coast Guard in the
late 1970s to develop a general purpose gas dispersion
model that would be particularly applicable to LNG
vapour dispersion, a subject that was of great interest
in the 1970s as it is now. 11:56

I played a seminal role in the development of the two
LNG vapour dispersion mathematical models that are
currently required in the United States to be used by
applicants for approval of LNG terminal sites. 11:56
I have also been heavily involved in the development of
the mathematical models that must be used to determine
the fire radiation safety distances that must be
observed for approval of LNG terminal sites. Both of
these modelling procedures are used in the US to 11:56
determine the extent of exclusion zones for safety
around LNG terminals.

In the US presently approval of land-based (as opposed
to offshore) import terminal sites is the purview of 11:57
the Federal Energy Regulatory Commission, whereas the
US Coast Guard currently plays the more formative role
regarding the safety aspects of the shipping side of
the project. I have most recently been involved in

continuing studies to better determine the potential consequences of marine incidents involving LNG with an emphasis on the studies of the consequences of very large vapour clouds or pool fires that could result from massive spillage of LNG on to water.

I believe that there is sufficient similarity in the LNG terminal proposals under consideration that similar requirements for the protection of public safety are appropriate worldwide. These ventures, which involve the potential for very high consequence accident or intentional events, are truly international and should be treated with a high degree of care and cooperation - it is in everyone's best interest to be as certain as practicable that we treat these issues with the respect that they deserve.

I want to state before proceeding that I am neither for or against any particular LNG terminal on any grounds other than provision of public safety, that is the only expertise I am professing here, which brings me to why I agreed to appear at this hearing to speak on several issues that I believe are important for you to consider in the process of siting LNG import terminals.

I have three subjects that I want to talk about. You will have to forgive me, I am a little bit under the weather and I can't stop coughing. The first: Potential consequences of LNG releases from the terminal.

I will speak later about potential releases from the
shipping side, but I will start with potential
consequences of LNG releases from the terminal. 11:59

For the land based part of an LNG terminal, I believe
that our current understanding of the consequences of
releases on land, where they can be most effectively
contained, is sufficient in large measure - needing for 11:59
the most part only "maintenance" efforts to ensure the
propriety of that information to changing industrial
practices. I am not here to suggest that we
drastically need more study in this area. I am
suggesting that the information that has been made 12:00
available in the research programmes already completed
is not being brought uniformly on board in the siting
process. I point to perhaps, to me at least, one of
the most glaring examples that I have observed in
discussions relative to the Shannon LNG terminal 12:00
proposal. In discussions relative thereto I have read
and heard expressed at large the opinion that LNG
vapour, being principle methane, is lighter than are
and therefore will rise harmlessly into the air,
presumably out of danger. It is true that methane 12:00
vapour at ambient temperature is lighter than air
providing an important and widely recognised safety
feature of natural gas in contrast to heavier than air
fuel gases such as propane or butane or cyclohexane, as

at Flixborough. But LNG is a liquid at very low temperature, about minus 165 degrees centigrade and the vapour that is initially formed from LNG when it boils is at the same temperature and because of its low temperature it is considerably heavier than air, about half again as heavy as air. The result is that an LNG vapour cloud will spread laterally and remain close to the ground prolonging both in distance and time the potential hazards to the facility and/or to the public. That hazard is primarily a fire hazard rather than an explosion hazard. Now, there are reasons why I say that and I will be happy to explain and quantify that, the question of explosions has been touched on here before, but I would like to not go on about that question here until I finish because I think there are other potentially more important subjects.

So one of the principal concerns that I want to highlight here is that in the haste to site LNG terminals, and I must say that in my opinion there is some haste, we should be careful not to cut corners on issues of public safety such as this glaring example that is the vapour cloud rising harmlessly implies.

Let me turn my attention to the potential consequences of LNG releases from ships. The shipping side of the LNG importation business is more complicated in my opinion if only because, and here I am speaking primarily of the United States, the major emphasis on regulatory requirements for public safety have historically been associated with the land-based part of the venture. In the United States there are mandatory "exclusion zones" required for the land based terminals. These exclusion zones demarcate zones in which the public is not allowed; however, there are no such mandatory exclusion zones to exclude the public from the vicinity of LNG ships. There are safety and security zones imposed by the Coast Guard, but those are not mandatory and legal requirements as are the exclusion zones that I talked about earlier.

I believe that more serious consideration should be given to this gap in the provision of public safety measures relating to potential ship incidents. The containment vessels, cargo tanks on LNG carriers are, in my opinion, because of weight requirements primarily, likely to be more vulnerable to failure due to puncture damage, for example, especially if that were intentional, than the more massive land-based full containment storage tanks that are currently available. Whereas spills from a land-based tank are required to have secondary containment features to limit spreading of this spill LNG, no such measures appears to be practical for spills on water. The result is that if a land spills occurs from a ship onto the water it will spread until it completely evaporates whether or not it is burning. If ignition does not occur early a vapour cloud forms and that vapour cloud can drift significant

distances with the wind before it becomes diluted to a
concentration where it cannot be ignited. During that
travel if the cloud is ignited the result is a vapour
or flash fire which will severely endanger people or
property in the confines of the fire. LNG is not 12:06
odorised. Unlike natural gas that leaks in your house
or from a pipeline which is odorised you cannot smell
it. If ignition does occur the result -- I should say
also that you cannot see it except for the presence as
indicated by typically the condensation of water vapour 12:06
in the air, I will show you some examples of that if we
have time today -- if ignition does occur the result is
what we call a pool fire, basically it is just like
pouring gasoline or any other liquid on the water and
setting it on fire. Large LNG fires on water have not 12:06
occurred throughout the 50 to 60 years that LNG has
been shipped on water, none, no large LNG fire. While
that record is justifiably encouraging, we must not
encourage or allow any corner cutting here either in
taking adequate and appropriate measures to ensure 12:07
public safety. Now, all of this comes down I think to
the discussion which has been hinted at heretofore.
I want to say a few words about rationally assessing
the risks.

12:07

The KRA asked me to respond to the "Prime Time" video
by Dr. Tony Cox regarding the Shannon LNG terminal
proposal and I agreed to do so. Dr. Cox and I worked
together in the 70s and 80s in the various research

efforts designed to get a better understanding of the potential for dense gas behaviour of LNG vapour involved from spills. The video presentation by Dr. Cox appears to me to be in essential agreement with me as described above regarding the interpretation of dense gas behaviour by LNG vapour cloud.

However, at the close of the video Dr. Cox stated and I quote:

> "The risk is in fact extremely low and any rational person or any person who is fully informed ought to be able to accept then and I would."

As I stated earlier I have had a long association with Dr. Cox which I hope to continue, but I am puzzled by his statement. I intend to talk with him about this issue to get clarification on his view as I am fully aware of the difficulty of expressing one's full thoughts under the pressure of media scrutiny, but I have been unable to do so in the very short time since agreeing to be here today. I will try to tell you why I am concerned about his statement and I hope that he will be willing to set me straight if I have misinterpreted anything he said. Perhaps it is simply in the end an disagreement between us, but I think it is important that experts be prepared to defend their statements and I expect that Dr. Cox would agree.

I agree with Dr. Cox that the risk is low, but

I believe to say that it is extremely low, which well
might be interpreted by the public as justifying
dismissal from further careful consideration, is not
justified. I also agree with Dr. Cox' assertion that
there is no such thing as a risk free activity. That 12:10
is why I believe that in our increasingly
technologically based society, which I think is likely
to continue as long as we can maintain it, we have to
balance the risk, that is the probability, and the
consequences in order to determine the acceptability of 12:10
a venture such as an LNG import terminal. However,
adequate and quantitative balancing of risks and
consequences is not easily accomplished -- certainly
not by just making subjective statements such as
"extremely unlikely". 12:10

Furthermore, even if the feared events are determined
to be extremely unlikely, if the consequences of the
event could be so severe as to raise serious questions
as to the acceptability of the venture anyway there may 12:11
justifiably remain serious concerns.

That is the quandary I believe we have today with such
ventures as LNG importation. As with the difficulty in
arriving at a measure of acceptability of risks that 12:11
plagues the nuclear industry, I believe that the
chemical energy industry has developed a major
consequence hazard identification.

As an example of the confusion that is rampant in this
area, I have heard repeatedly expressed that the energy
content of an LNG ship is equivalent to that of 50 or
more Hiroshima-yield nuclear weapons. In my opinion
that is an unjustified stretch. However, the statement 12:12
that the energy content of an LNG ship is that large is
entirely true; the comparison, however, is meaningless
unless the time in which the energy can be released is
considered. In a nuclear weapon all of that energy is
released in a fraction of a second. In an LNG incident 12:12
it is of course much longer. However, I am concerned
about the potential for releases from an LNG ship in
particular that might result in burning of all of the
contents of the ship in a time frame, much larger than
seconds, but in order minutes, less than an hour say. 12:13
If that were possible then the energy could be released
in a time frame where it would never be equivalent to
50 Hiroshima bombs, but it could be a very serious
event associated with a heat exposure to the
surroundings. 12:13

The LNG shipping industry, as is clearly the case with
the entire LNG industry, has an enviable record of
which I think they should be very proud. However, this
is not the time for complacency or cutting corners or 12:14
patting ourselves on the shoulders. I believe that
serious consideration should be to recommendations to
the United States Congress by the Government Accounting
Office, this was alluded to this morning earlier. The

title of that document is "Public Safety Consequences of a Terrorist Attack on a Tanker Carrying Liquefied Natural Gas Need Clarification". Now, I am fully aware that there is more concern probably about the terrorist issue in the United States than there may be here. This report does not deal only with terrorist attacks, it also talks about the need for these measures associated with accidents as well.

If an LNGC, that is an LNG carrier, were to be attacked or suffer a severe accident, such as a collision, in the proximity of the shoreline or while docked at the terminal and cascading failures, that means domino failures, of the ship's containments were to occur it could result in a pool fire on water with a magnitude beyond anything that has been experienced, at least to my knowledge, and in my opinion could have the potential to put people in harm's way to a distance perhaps of approximately three miles from the ship. I have testified repeatedly that I believe that the parties that live in areas where such a threat could affect them deserve to have a rational science-based determination made of the potential for such occurrences, no matter how unlikely they might be considered.

In closing I want to say that the residents association assured me in requesting my presence here today several things -- in fact, they had to assure me to do that before I would come. They assured me that their main concern has been and remains the safety aspects of the LNG terminal proposed and the idea of having to live with the thought of an accident, however remote, for the next number of decades. They have assured me that 12:16 they are not against LNG. They have endeavoured only to highlight any shortcomings for completeness that may exist in the quest to ensure public safety to the maximum extent practicable.

12:17

Finally, they have assured me that they have attempted to be pragmatic in the consideration of what will ultimately be required, tradeoffs, of the environment with the economy. It is because I agree completely with these sentiments and because I want only to ensure 12:17 to the maximum extent practicable that we site LNG terminals, as should be the case for any other major hazard industry venture, in full view and observation of the best scientific knowledge and guidance available. It is for that reason that I happily agreed 12:17 to appear here today.

Now, I have some other things that I could discuss here, but I anticipate that I will get some questions and if it becomes appropriate to answer those questions 12:18 with some of the pages that I have brought I will do so, but at this point that concludes this part of my presentation.

END OF SUBMISSION OF DR. HAVENS TO THE ORAL HEARING

INSPECTOR: Thank you, Dr. Havens. Mr. McElligott, do you have a further witness to call. 12:18

MR. McELLIGOTT: No, sir.

INSPECTOR: Okay. I think because Dr. Havens is flying out tomorrow morning; is that correct?

DR. HAVENS: That's correct. 12:18

INSPECTOR: It would be appropriate that he at least would be questioned now and I would ask the Applicants maybe to ask questions, if they have questions.

MR. O'NEILL: Yes, I don't know if anyone 12:18 else has questions of Dr. Havens. Just looking at the sequence of events or sequence of procedures that you have identified in your letter, Sir, the Board's letter, perhaps other people who wish to question Dr. Havens should do so first, 12:19 there may be nobody else.

INSPECTOR: Okay. Mr. McElligott?

MR. McELLIGOTT: Yes, I have a question.

DR. HAVENS: May I make one quick statement. I told you 12:19 I was a little bit under the weather. The thing that is bothering me worst is I have an inner ear problem and I am not hearing well. Some other folks in the room have the same trouble I observed yesterday so

I may have to ask you to repeat the question, I will certainly do my best to answer it.

<u>DR. HAVENS WAS QUESTIONS AS FOLLOWS BY THE OBJECTORS</u>

12:19

1 Q. **MR. McELLIGOTT:** What I am really concerned about are the exclusion zones and how are the exclusion zones calculated in your experience, would you expand on that please?
A. **DR. HAVENS:** Your question is how are they what? 12:19
2 Q. How are they determined.
A. I am speaking here of course at the moment about the United States, I know less about your situation. In the United States the term 'exclusion zone' is a legal 12:20 requirement that has to be made for the determination of the distances, ultimately to protect the public and property, from an LNG plant that would ensure that the public is not in harm's way. So there are prescriptions for determining those exclusion zones 12:20 that are set out in considerable detail. There are two types of exclusion zone: One is for vapour cloud travel, that's the one I have alluded to, how far would a vapour cloud go before it became non-flammable. The other is fire radiation exclusion zone. That is 12:21 required in the event that there is a fire at the facility which will radiate heat to some distance and the safe distance to that level of heat has to be determined. All of these things are determined by

mathematical models. I am the author of the models that are used to determine the vapour cloud exclusion zones. I also know about the others, but I have more direct contact with the vapour cloud exclusion zone.

12:21

At the end of the day in the US design spills are specified. That simply says you must plan for an event of this kind. For example, it might be that you have to prepare an impoundment to catch the liquid spill from the ship unloading line, you must build an 12:22 impoundment to help with that volume. Then there are specification of the spills that you must model to determine the exclusion zones. So you go through this procedure, you make a calculation of these distances, then you in the siting process provide those to the 12:22 authorities and they either approve or don't approve. Now, in the end there is a bit of opinion associated here, but the way I read the regulations in practice the effect of these exclusion zones is that they cannot go off the Applicant's property, they cannot extend off 12:22 the Applicant's property. If they do extend off the Applicant's property then somebody has to grant an exception or something so that's the way they are determined.

12:23

Now, the point that I was trying to make is that those legal requirements in the US extend only to the land part of the facility. The Federal Energy Regulatory Commission is much more complicated than I could explain here, but essentially the jurisdiction of the Federal Energy Regulatory Commission stops at the water line, it is someone else's responsibility beyond the shoreline.

3 Q. Are there specific calculations used for LNG as opposed 12:23 to other chemicals such as fertilisers as we have here?

A. To my knowledge the requirement for exclusion zones that I have described in the US regulatory picture are only applied to my knowledge for liquid fuels to LNG. That's not to suggest anything other than to answer 12:24 your question. I am not aware of exclusion zones being required to site any other kind of facility except for LNG facilities.

4 Q. What is in these exclusion zones, is it for businesses or are there different types, is it so that nobody can 12:24 go into certain areas at all?

A. No. Again I would have to get into more detail than I think I probably should here. The regulations are free for everyone to read, the specifications are all open, at the end of the day, though, in practice 12:24 I think it has to be the goal of the Applicant that they ensure through the determination of these exclusion zones that they don't extend off their property. The reason being that if that is the case, if the hazard cannot extend off the property then the 12:25 risk is restricted to the facility. That's the idea that is behind the exclusion zone.

MR. McELLIGOTT: Thank you. Mr. Inspector.

INSPECTOR: Could I have your name

please?

MR. O'DONOVAN: Thomas O'Donovan.

INSPECTOR: Hold on a moment, we need to get a microphone down to
you. 12:26

5 Q. **MR. O'DONOVAN:** Thank you, Mr. Inspector.
Thank you, Mr. Havens, for
a very comprehensive analysis on the safety issue.
I just had a couple of questions, you might not be able
to answer them, but we will try you anyway. It's to do 12:26
with insurance and the immunity. Now, as we all know a
facility of this size would require a tremendous amount
of insurance and I would like to know were there any
agreements between any of the governments of the
facility where the LNG was placed with partial or full 12:26
immunity from a potential accident or an real accident,
could you just maybe cover that a little bit, immunity
from prosecution afterwards?

A. I am very sorry, but I am very trouble with
understanding completely the question. I don't know 12:27
whether it's my hearing. I can hear the tone, if
I came over there and you spoke and I will listen to
you without the microphone.

6 Q. My mouth is kind of dry too, I dry up when I speak in
public. I wanted to cover the area of immunity. To 12:27
your knowledge has any government where the LNG is
placed did they grant partial or full immunity from any
potential or real accident?

A. I am not aware of any such thing.

7 Q. So in other words a government that would bring in LNG,
they seem to be hell bent on bringing one in here,
might be tempted to grant immunity to any potential
disaster, but you are not aware of that, you are not
aware of any? 12:28
A. The only answer I know to give you is that I am not
aware of any such thing.
MR. O'DONOVAN: Okay, thank you,
Dr. Havens, thank you.
INSPECTOR: Mr. Robinson. 12:29
8 Q. **MR. ROBINSON:** Yes, could I ask Jerry
Havens, the 1.5 kW/m^2 is
considered safe for the public by yourself and
Mr. Gordon Mill of Lloyd's Register of Shipping, yet in
other instances in Milford Haven 5 kW/m^2 is considered 12:29
safe for the public, do you have a view on the
difference or what do you think should be safe for the
public?
A. A little bit of explanation about what some of terms
mean before I answer your question. There is a 12:29
considerable unfortunately large database on burn
injuries and that data can be used to determine how
much heat over a given amount of time will cause
different degrees of burn injury. I am sure you
probably have heard of the terms first, second and 12:30
third degree burns. A second degree burn is considered
the kind of burn that would give you a severe
blistering and some potential damage. Now, 5 kW/m^2 of
thermal radiation, we are talking now about if you sit

in front of your fire and you are not in the fire, the fire itself is not burning, but the fire is radiating heat to you and 5 kW/m^2 is a measure of how much heat is there, it's the amount of heat per unit area in your body. If a person with exposed skin, if my skin is exposed to 5 kW/m^2 of thermal radiation I will get second degree burns in about 30 seconds. If I were exposed to 10 kW/m^2 then I would get second degree burns in a much shorter time. In 30 seconds I might get a first degree burn or something, the point is that the level of heat and the time of exposure is what is important. Now, I think you may have said this morning, I don't know the figure, but I think that on a hottest summer day, clear day the thermal radiation from the sun might be somewhere around a little above 1 kW/m^2. Now, there have been determinations that have been made, recommendations that have been made that you would have to reduce this flux level from 5 down to, say, one and a half or something in order to ensure the safety of those people, if there were those people, who could not get out of the way and who had to be exposed. So I have a concern that rather than say 5 kW/m^2 is a safe distance, I believe that it's not in fact a safe distance because you can get hurt at that distance unless you can get out of the way. There may be some people that we have to be concerned about that could not get out of the way. Have I answered your question?

MR. ROBINSON: Yes, thank you very much.

INSPECTOR: Gentlemen in the second

row.

9 Q. **MR. LYNCH:** Noel Lynch, Ballylongford. In submission L011 by Kathy Sinnott MEP she states that LNG plants are normally located in port sites? 12:33

A. Port sites?

10 Q. Port sites. There would normally be a lot of other industry within close proximity of each other in port sites, how do they fit in with your prognosis of dangerous explosions and things like that? 12:34

A. Are you talking about the proximity of other activities?

11 Q. Yes, quite close to LNG plants.

A. I can't say that I profess an expertise in that area, I am sure that there are a thousand different answers 12:34 to that question depending on who that industry is and who that party is. I can tell you that, and again I will have to refer to the United States, one of the ways that the exclusion zones has an effect in the United States is that in addition to ensuring public 12:34 safety it I think is intended, surely it is considered to be an expression of the fact that the accidents that might occur at an LNG facility would be contained on that facility. So I can tell you from experience that if in the United States an LNG terminal is proposed in 12:35 an area where it is close to some other activities, perhaps residential, perhaps industrial, and if they cannot meet the exclusion zone requirement then it is highly likely that the people next door would be very

upset and I can tell you that I don't know of anybody
that have gone to completion, but there surely is the
potential, in the United States at least, for lawsuits
because the adjacent property might be either
endangered or economically disadvantaged because of the 12:36
presence. That's the best I can do. I am not an
expert in that area.

INSPECTOR: Sorry, the lady in the back row.

12 Q. **FEMALE SPEAKER:** I want to ask you to your 12:36
knowledge the residential
exclusion zones in the United States, I have read
someplace that it's 1.2 miles, is that the case?

A. Unfortunately I can't give you a specific answer to the
question, I need to clarify. In the US there is a lot 12:37
of talk about exclusion zones, which I have just
described, but there is also a lot of talk about safety
and security zones, that's generally associated with
the tankers. For example, the Coast Guard specifies on
a site by site basis the safety zones that must be 12:37
maintained around a moving LNG tanker, but those are
not exclusion zones in the sense that they are legal
requirements, okay. Now, moving to exclusion zones on
land, which we are talking about, the exclusion zones
on land are of two types, vapour cloud travel and heat 12:38
radiation. The exclusion zones that are submitted and
approved for individual terminals are likely to be
different from one another. The reason -- well,
I don't know whether I can say that or not, but I have

made this observation -- the land area that is available to the different terminals that are being proposed in the United States varies considerably. The smallest one that I know anything about is a terminal that I have worked on repeatedly for some time was a proposal in Long Beach, California. If I remember correctly the total terminal area was 25 acres. Now, there were exclusion zones early on that were submitted that said that we can contain whatever happens inside the 25 acres so it might have been a distance of 100 metres, okay. On the other hand, there are examples of terminals that have much greater areas. In those cases they are more likely to submit an exclusion zone for a larger spill which might go some other greater distance and not go outside the property so I can't tell you that there is a uniform value. I can tell you that I am not aware of any land based exclusion zones that are as long as 1.2 miles, but I can't tell you also that there are none, I am not aware of any. I want to be sure you understand all of my comments are to land based exclusion zones.

MR. O'DONOVAN: Thank you, Dr. Havens. I have just one brief question for you -- well, actually it's a statement, if you like. It's from USA Today recorded in the paper on Thursday, 25 October 2007:

> "In Mexico many people still remember the November 19, 1984 explosion of a liquefied petroleum gas depot that killed 334 people in Mexico City."

Are you aware of that?

A. Yes, I am.

13 Q. You are. We are just wondering is that a potential to happen? Thank you. 12:41

A. The Mexico City disaster, which was a major event, was at an LPG storage facility which handled propanes, butanes, other LPGs. I assume you know what I mean by Liquid Petroleum Gas as distinguished from Liquefied Natural Gas. That's the first answer to the question. 12:41 Now, there are some very important differences between LNG hazards and the hazards of LPG. I don't think it's to our benefit to start comparing today, I would suggest to you that that event should not be considered to be comparable to what might be possible at the LNG 12:42 terminal and that we should restrict our consideration primarily to LNG with one proviso, one exception. It was alluded to this morning, and I am coming back to something that I mentioned in my talk, if you have a large release of LNG, it is dangerous of course because 12:42 it catches on fire, and we wouldn't be interested if it didn't catch on fire easily and burn very nicely and burn hot, it wouldn't be the valuable fuel that it is. However, the same thing is true of LPG. LPG is normally, not always, pressurised. LPG can be stored 12:43 either refrigerated, unpressurised or pressurised unrefrigerated or actually a combination of the two. LNG cannot be stored under pressure. Now, I don't think we want to get into that, but you cannot compress

LNG enough to make it turn into a liquid. The only way you can make it a liquid is cool it down to these very low temperatures. [Mobile phone]

INSPECTOR: Somebody is using a cell phone. 12:44

MR. O'NEILL: Sorry, that was my phone. Sorry, Sir.

DR. HAVENS: My point is that the explosion hazard is generally judged to be more severe for LPG than LNG. 12:44 If either one of them is in a confined space, such as a cloud that gets in your house, then an explosion can occur, but we are talking here about an explosion of a gas cloud that is outside. Now, everything that is known suggests that the possibility of an LNG vapour 12:44 cloud explosion is very low. We also know that the possibility of an LPG cloud explosion has to be considered. Cyclohexane formed the vapour cloud explosion at the Flixborough plant that was destroyed and it was a really landmark explosion, very severe. 12:45 LNG is primarily methane gas, LPG is primarily propane gas, butane, ethane, heavier things. When you get LNG out of the ground it typically contains LPG components. In different cases, depending on the market etc., you typically take those additional compounds out and sell 12:46 them for a separate market and then the methane rich LNG would come here, for example. However, the LNG comes from a number of locations in the country so the composition of the LNG that leaves different places in the world headed for Shannon Ireland will differ depending on its source and some other technical factors. It was alluded to this morning that there is data that suggests that if you do have as much as 15 or more percent of LPG, like propane say, in the LNG then 12:46 if that forms a vapour cloud we are not confident that it could not explode. However, most LNG is restricted to have less than that, and I don't know what the plan is here so, therefore, under normal conditions the LNG that you would expect to come in here I think would be 12:47 quite likely to be lower than those concentrations. If so, the primary hazard is fire rather than explosion. I think all of that answers your question, I hope.

MR. O'DONOVAN: Thank you.

INSPECTOR: Mr. Fox. 12:47

14 Q. **MR. FOX:** Dr. Havens, you mentioned in your submission "as certain as is practicable", can you tell me what that means?

A. Containment is not practicable? 12:48

15 Q. You said in your documentation:

> "It is in everybody's best interest to be as certain as is practicable."

A. Which page are you on?

16 Q. The first paragraph of the second page, bottom of the first paragraph. 12:48

A. I am still having trouble, I am sorry.

17 Q. Page 2, paragraph 1.

A. Page 2 paragraph 1.

18 Q. Bottom line.
A. It is in everyone's best interest?
19 Q. Yes.
A. Well, I believe that's in all our interests,
industry's, ours, yours, to be as certain as is 12:49
practicable that we treat these issues with the respect
they deserve. I am simply saying that we could spend
ourselves all out of money so that we wouldn't have
enough left to eat if we studied this problem to death.
That's the sense in which I am saying 'practicable'. 12:49
I do think it is practicable, surely it is practicable
to pay attention to all of the information that we
already know and make good use of it and it may even be
necessary to find some answers to some other questions
which we don't know enough about, but in the end 12:49
I guess what I am trying to say is we have to be
practical about it. There is no way that we can assure
absolute safety.
INSPECTOR: Any further questions?
Okay. Foynes harbour -- 12:50
sorry, Shannon Foynes harbour authority.
20 Q. **MR. COUGHLAN:** Whatever. Dr. Havens, can
you hear me?
A. Yes.
21 Q. Okay. Your bibliography at the back gives an awful lot 12:50
of information about vapour dispersion models that you
have worked on?
A. Yes.
22 Q. Is there in your opinion any reliable vapour dispersion

model available?

A. Yes.

23 Q. Where can we get it?

A. Well, I realise that was maybe not a good response.
Let me start here. I developed under contract to the 12:51
US Coast Guard starting in the 80s a model called
Degadis. It's an acronym for dense gas dispersion. It
is applicable to LNG spills. It is the model that is
required to be utilised -- one of the models required
to be utilised in the US. There is another model that 12:51
is also approved called FEM 3 which is what we would
call a very complex computational fluid dynamic model.
It has received very little use yet in the US so the
primary use in the US for LNG vapour dispersion for
determining exclusion zones is the Degadis model. Now, 12:51
there are a number, I have had a brief look, a very
brief look at some of the documents that were provided
here and I think that in some of the documents there
were provided some information about gas dispersion
models that had been used to make predictions 12:52
associated with the Shannon venture. I frankly don't
remember what they were, I could probably know what
they were if I was refreshed, but let me answer the
question this way: The models that are accepted like
Degadis and similar models in the UK which would, for 12:52
all practical purposes in my opinion, be very similar,
give similar results, they are restricted in their
applicability somewhat and the way they are restricted
is they are what we call flat earth models, they are

designed so that you specify an amount of LNG vapour
that goes into the atmosphere from some area source,
you specify the conditions of the atmosphere, wind,
etc, and the programme calculates the distance that
that gas will go before it drops below a concentration 12:53
level that makes it not similar. These models cannot
account directly for complex effects such as flow
around a tank, flow in a ditch, flow over a mountain
etc so they are restricted in that use; nevertheless,
those are the ones that are used currently in the 12:53
United States and I believe -- you shouldn't be
surprised to hear me say this -- I believe that they
are adequate to the task as long as the restrictions on
their applicability are observed.
24 Q. Could I follow up on that please and ask you are they 12:54
of value in modelling cloud dispersion over water?
A. Are they applicable to that? My answer is yes.
I developed this model in fact for the US Coast Guard
and their requirement was obviously that it be
applicable over water. In fact some of the 12:54
simplicities that it requires like flat land are met
better over water than they are in a complex plant
environment.
MR. COUGHLAN: Thank you.
INSPECTOR: Do we have anybody from the 12:55
Health and Safety
Authority? Do you wish to ask any questions.
A. No.
INSPECTOR: Okay. What about the

planning authority?

A. No.

INSPECTOR: Do you have a fire officer present?

A. Yes, no questions. 12:55

END OF QUESTIONING OF DR. HAVENS BY THE OBJECTORS

INSPECTOR: I take it the Applicants have quite a lot of questions? 12:55

MR. O'NEILL: I have quite a lot of questions. I was going to suggest it is now five to one, perhaps we could leave it until 2 o'clock and in fact it may limit the questions that I will ask. 12:55

INSPECTOR: Okay. We will reconvene at 2 o'clock please. Thank you for your attention.

12:55

(LUNCHEON ADJOURNMENT)

12:55

THE HEARING RESUMED, AS FOLLOWS, AFTER A LUNCHEON ADJOURNMENT

INSPECTOR: Good afternoon everybody. It is just 2 o'clock, so if you could resume your seats please. 14:02

I am now going to call on the applicants to put questions to the third party. Because Dr. Havens is with us just for this afternoon I would ask that you would concentrate your question on him. 14:02

MR. O'NEILL: Good afternoon. Thank you sir. And in fact, having considered the matter over lunch, despite the barrister's normal anxiety to ask questions, in fact I am not going to ask any questions of either Dr. Havens or Mr. Robinson. I think Mr. Robinson's précis or address is more, in fact, in the line of questions which will be addressed by the applicant's witnesses in due course. I don't have any issues that I need to raise with Mr. Havens. 14:03 14:03

INSPECTOR: Fine. Does the planning authority want to ask any questions?

MR. SHEEHY: No, not at this stage. 14:03

INSPECTOR: Okay. Does the planning authority have a submission on the issue of health and safety?

MR. SHEEHY: Mr. Inspector, we don't

have the expertise of that detail. The HSA is what we were relying on to inform you on that issue.

INSPECTOR: Okay. Then I will call on the applicant to make their own submission. 14:04

MR. J. McELLIGOTT: Sorry?

INSPECTOR: Sorry, Mr. McElligott, I can't hear you.

MR. J. McELLIGOTT: Can we ask Dr. Havens another couple of 14:04 questions, please?

INSPECTOR: Yes.

MR. J. McELLIGOTT: Dr. Havens was talking to Alan Coughlan of the Shannon and Foynes Port Company and he was explaining 14:04 to him about the Degadis cloud dispersion, vapour cloud dispersion model. I am asking Dr. Havens how would you put in the Degadis model into a quantitative risk assessment in a marine environment?

A. **DR. HAVENS:** Firstly, the Degadis model 14:05 is a consequence model only. It would normally be used in conjunction with some other kind of probability assessment in order to arrive at some measure of risk. But my understanding of the assessment of risk, it is usually divided into 14:05 two parts. You identify what the potential consequences might be and then you seek to determine what the likelihood or probability of those occurrences might be. And in the end the accepted measure of risk is some multiple of those two.

So, for example, if you get an exclusion zone that is so many miles, or so many feet, then you must also say but the probability of that event is very low or very high or something and you must assign some numerical values to that. Now, I personally feel that's problematical, but it is the best thing we have and it is the thing that I think should be done.

But in direct answer to your question: The Degadis model could only be used to determine what the potential consequences would be and that, specifically, the distance to which a vapour cloud travel might occur that could still be flammable, that is coincident with the danger distance, if you will. So, to use the Degadis model to do that -- and I assume your question is associated with a marine incident.

MR. J. McELLIGOTT: Yes.

DR. HAVENS: So I need to clarify that the -- I think perhaps I did earlier -- that there is no reason why the Degadis model is inapplicable to vapour cloud travel over water. In fact it may be even more applicable because the water is flat.

Now, the requirements to put into the model are, basically, of two types. The most important one probably is that you must tell the model, you must input into the model how much LNG vapour goes into the atmosphere. You must specify the rate at which it goes in, the area that it is coming off of and the time schedule for it going into the air. Beyond that you need only to specify what atmospheric conditions you want to do the dispersion model for and then it will essentially calculate the distance for you.

Now, I probably should insert here, it is something, again, that's peculiar to the US regulations and may not apply here but we need to be clear about it. The lower flammable limit of methane gas is generally considered to be 5%. What that means is that one part of methane and 19 parts of air is flammable. That's the lower flammable limit. If the concentration of methane falls below 5% then it won't ignite. It is lean. The upper flammable limit is about 15%.

Now, by contrast, for example, propane has a lower flammability limit of, if I remember correctly, about 2%. So, propane gas stays flammable longer than does methane.

However, there is another complication. In a vapour cloud that would be formed the concentration in the cloud as it moved downwind is not uniform. There are pockets of gas that have higher concentrations and pockets of gas that have lower concentrations. In order to take that into account, in the US regulations, you are required to calculation the distance the cloud will follow go before the concentration drops to one-half of the LFL. So, to 2.5%. The reason is that the gas models can only calculation average concentrations. 14:10

So, as a safety factor, if you want to call it that, they argue that you calculate, use the model to determine the distance where the average concentration is 2.5%. Then they argue that there might be pockets 14:10 of gas that could be 5%. So, with that clarification, that's the way the exclusion zone is determined.

Now, in the case of a marine spill, the only thing that you would have to do differently is to determine how 14:11 much gas you want to be concerned about going into the atmosphere. That may have answered part of your question.

MR. J. McELLIGOTT: Yeah. So, if I understand correctly, the model 14:11 depends on what you put into the model?

DR. HAVENS: It depends entirely on the amount that you put in.

MR. J. McELLIGOTT: So it has to be credible; is that correct? 14:11

DR. HAVENS: Yes. Well, we would not want to put an amount into the model that was impossible, or incredible.

MR. J. McELLIGOTT: Can you give us an example

of credible events from the marine side that would be
used to calculate exclusions zones, on the marine side?
DR. HAVENS: The subject of credible
events is any man's
argument. However, I believe that there is good reason 14:12
to accept, and I have accepted in all of the testimony
that I have given, the assessment the Sandia Report --
which I think, perhaps, has been mentioned here
before -- of 2004, in which for marine spills from an
LNG tanker they deem credible a release of one-half of 14:12
one tank onto the water. Now, one-half of one tank
depends on the size of the tank, obviously.

I don't know what ships would serve this terminal,
there are different size ships. The typical LNG ship 14:13
is a 125,000 cubic metres ship. The typical ship.
MR. J. McELLIGOTT: They are planning for the
biggest ships in the world,
the 265,000 cubic metres.
DR. HAVENS: The biggest? 14:13
MR. J. McELLIGOTT: The Quflex (sic) or the --
DR. HAVENS: Well, let me tell you,
there are plans for,
perhaps some even under construction, I can't tell you
exactly, for ships, that are being considered, for up 14:13
to 265,000 cubic metres. But the typical ships that
are sailing are 125,000 cubic metres. Maybe a bit
bigger, but that is a typical size. Now, those typical
ships, if they are one particular kind of ship that I

am most familiar with, which is a Moss Tanker, and I
just use it for illustration, they might have five
tanks. Each tank would contain 25,000 cubic metres.

Now, you are probably more familiar with cubic metres 14:14
than gallons, I am not sure, but 25 cubic metres is
around about or a little more than 6 million gallons.
So, the ship contains close to 33 million gallons of
LNG.

14:14

What Sandia did was to say it is incredible that all of
that material could be spilled at once. It couldn't
happen. It is so unlikely to happen that it is
incredible. But they did say it is credible that you
could have a massive spill from one of the tanks. Then 14:15
they say, for technical reasons, part of that tank
would be below the water level, and so all of that tank
can't easily spill into the water. If there is a hole
in it at the top it can't all easily spill into the
water. So, they said we deem credible a one-half one 14:15
tank spill. That's 12,500 cubic metres. 30 million
gallons, a little more.

It is that spill that they analysed, using models like
the ones I have just discussed, to determine what the 14:15
vapour cloud distances might be and, also, what the
pool fire radiation distances might be if it were
ignited when it spilled.

Now, I can't speak authoritatively without a copy of what they predicted for the vapour cloud distances. But it was some few miles.

What most people, and I agree with this, if there were an event that caused a massive spillage like that I believe that the real likelihood is that the event would cause the material to ignite as it was released. So, that would mean that I consider the pool fire formation more probable than the vapour cloud formation. I cannot rule the vapour cloud formation out, but I consider the pool fire more probable.

Now, the pool fire from a 12,500 cubic metre spill has been calculated by Sandia to cause 5kw per square metre exposure, out to about 1 mile.

So, I think the original question was: How would you suggest you take models and calculate an exclusion zone around a ship? My first answer would be I have endorsed the calculations like that, that have already been made by Sandia, as being reasonable and they would be easily repeatable if anyone wanted to apply the Degadis model, for example, to that spill.

MR. J. McELLIGOTT: Okay. Can I just make sure I understood correctly so. A credible spill from a tanker could have an exclusion zone around it -- the effect would be have an exclusion zone of what, if there is a credible spill around a tanker, with a credible spill of half a tank? What would be the credible exclusion zone to have around that?

DR. HAVENS: I am confused with your question a bit. Here is what I have said. Sandia, not me, Sandia has said 'we believe it is credible that there might occur at 12,500 metre spill' -- that's one-half of one tank -- 'on to water'. So that's their starting point for the determination of the hazard distance. They would calculation the hazard distance for that spill with a vapour dispersion model, like Degadis. In fact, I think you will find if you go into the Sandia Report they did that. In fact, they calculated it for a number of different models, including Degadis. However, they also calculated a hazard distance -- call it exclusion zone if you will, but there is no requirement for such a thing now legally -- they calculated a hazard distance associated with a fire radiation from that same spill if it caught on fire instead of drifted downwind. That gave the mile distance for the fire radiation. The distance for the vapour cloud travel is more than a mile.

MR. J. McELLIGOTT: Okay. Would that have an affect then on siting decisions by other industries within that one mile distance? Would it have an affect on ships and creating other shipping facilities within that one mile distance, and other industries working on the landbank?

DR. HAVENS: The one mile distance is predicated on a heat level of 5kw per square metre. That particular distance and that particular heat level is not going to destroy a ship, or other activities. It will, however, result in burns to people, who are unprotected, at that distance. Now, at closer distances there will be higher heat flux levels. The Sandia Report specifies all that information as well. For example, they would tell you how close you could have to be to that fire before you might, perhaps, even endanger a ship or something. 14:20 14:21

So, I think it is fair to say that, that is an estimation for that spill size of what would be a reasonable danger zone that you should observe. 14:21

MR. J. McELLIGOTT: How much bigger do you think that hazard zone would be for ships that are twice the size as the ships you just mentioned? Because they are planning ships up to 265,000 cubic metres. 14:21

DR. HAVENS: It is not an easy question to answer, however, let me put it this way: It is my understanding that if you had a ship that were twice the size of the ones we are talking about it would be my expectation that the ships would be similar -- similar, generally similar -- to the ones that we have now, except just bigger. What that would probably mean is that we might have a similar number of tanks. So, that means each tank 14:22

would be bigger, and roughly by, say, a factor of 2. So, if you had one of those twice as big a tank, I think, based on the arguments that Sandia is making, which I agree with, that all of the stuff in the tank can't spill out easily, some of it is below the water line, it might be below the hole in the vessel, etc. but you might lose half of it. They consider that is possible or credible. So, that means that if the tank were twice as big then half of the tank would be twice as much as what I said before.

Now, how would that affect it? It would not double it. It would go up some fractional amount. I can't tell you, without doing the calculations, exactly how much it would be, and I would prefer not to guess.

The concern that I have, that I mentioned here, is not so much what would happen -- although that's a consideration, I think, that needs to be kept in mind, that bigger ships may come in, but that is not my primary concern. My primary concern is that we have some good indication, that I think is indicated clearly by the GAO report, and there is some expert agreement on the fact that if you have a one-half tank spill and it caught on fire there is a very real possibility that the ship would not be able to survive that event and there would be cascading failures.

Now, if cascading failures occurred that can do nothing

but make the situation worse. The question is how much
worse, and how fast? And that gets into very complex
considerations. I think I have already mentioned,
however, so I will say it again, in my judgment, to be
prudent, and this is my opinion only, if a conventional 14:24
ship were to be in a fire like this, from the spillage
of half a tank, I believe that the ship would very
likely be in jeopardy, to total loss.

If it were a total loss, and if the cascading failures 14:25
occurred rapidly, I won't qualify rapidly, but if they
occurred reasonably rapidly, then my calculations
indicate that the one mile distance from the half tank
spill might increase, and I believe, up to possibly
about 3 miles. All of that is still based on the 5kw 14:25
per square metre.

INSPECTOR: Mr. Robinson?

MR. ROBINSON: Mr. Inspector, could I ask Jerry Havens one question?

The gas cloud from the spill from one tank is 14:26
travelling across the water, the HSE reckons it could
travel, before the methane contents lifts, 4.25 miles.
I am not sure what the Sandia says. I believe it is a
figure roughly the same. But the LNG is made up of,
let's say, 90% methane and 10% contaminate gases, with 14:26
are butanes, propanes, and ethanes. Those gases are
heavier than air at ambient temperature.

As the gas cloud goes across the water it picks up heat and when the methane gets to about minus 100 it does start to lift off, I believe. That is leaving the detonator gases, the butanes and propanes, on the water. Are they still a danger?

DR. HAVENS: When the LNG mixture is spilled on the water it will boil at a rate that is determined by the heat input to it. The primary heat input to it is the water below it. The air above it puts a little bit of heat in but it is not very much. Most of the heat that causes the vapour [inaudible] is from the water under the LNG.

In the early days there was a great deal of speculation that the water under the LNG would freeze and that would decrease, with time, the boiling rate. The conventional suggestion in most modelling today is that because the water will circulate under the LNG it will not freeze sufficiently to cut down on that boiling rate.

Now, when it boils, if it is a mixture -- if it were pure methane, pure methane would come off. If it is a mixture of propane and butane and methane, then, as chemical engineers would say, the methane is more volatile, boils more easily than does the propane and butane. That does not mean that the methane will separate and leave the other behind. What it means is it will preferentially boil and the gas that comes off is higher concentration methane. So, as it boils off the boiling pool will enrich in the heavier compounds. All right?

Now, you made a statement, I believe, that if the 14:29 methane comes off first when it reaches 110 degrees it would be boiling. I can't verify that here, but that may be true. However, that is not what would happen. As the gas comes off of the boiling pool it mixes with air, in fact you can't keep it from mixing with air, it 14:29 is going to whether you wish it or not. Now, if we look at the thermodynamic properties -- and here I will talk about methane only -- if we mix methane at its boiling point, which is minus 165 degrees Fahrenheit, if we mix that with air, for the moment let's say dry 14:30 air -- you don't have dry air here, but let's say dry air -- if you keep adding air the mixture will get lighter. It makes sense. But, unless you add heat to it somehow it will never get lighter than air. All it will do is it will go from a density of about one and a 14:30 half times air, when it is pure LNG vapour, up to the density of air, when it becomes nearly all LNG vapour -- I mean all air. So, the notion that part of the gas would get to be 110 degrees and rise up is fallacious. 14:31

What all this means is, and I think Dr. Cox stated this before, it is well known that these clouds will stay heavier than air unless there are some unusual circumstances which, somehow or other, heats the cloud up tremendously. Which is not likely to happen in the marine environment around here. I think he stated, and I would agree with him, they will not lift off until after they have become non-flammable. 14:31

MR. J. McELLIGOTT: Could you explain, just to the general public, the importance of the Sandia Report? Secondly, were the tests in Sandia done with pure methane, or pure LNG, or with contaminants. 14:32

DR. HAVENS: Was it pure LNG or? In what? In the calculations?

MR. McELLIGOTT: In the calculations.

DR. HAVENS: In Sandia?

MR. J. McELLIGOTT: Yes. 14:32

DR. HAVENS: Sandia considered that LNG does contain other things. I suspect that I would have to verify this. I suspect that they calculated these distances that they showed, which was, somebody said, a few miles, and I don't 14:32 remember the numbers, but I suspect they calculated it for pure methane. They may have calculated for certain specific concentrations of the other components as well. I don't know the answer to that.

14:33

I do know this: In the US regulations you are allowed to assume that the LNG that is spilled is pure methane. For purposes of calculating the exclusion zone you are allowed to do that.

MR. J. McELLIGOTT: What is the importance of Sandia? I mean, Shannon LNG have based their calculations on Sandia. So, just for to the general public, what does Sandia mean? What is so special about that?

DR. HAVENS: Why is Sandia important; is that what you are saying?

MR. J. McELLIGOTT: Yes. What is so special about Sandia report as opposed to other reports?

DR. HAVENS: I think it is fair to say that the Sandia Report was a result of 9/11. I think that's a fair statement. After 9/11 there was a growing concern about the increased activity in the LNG area and there was increased concern about the fact that there were many proposals for putting terminals in urban areas. Now, we only have one terminal in the United States that would realistically, I think, now be considered to be an urban area. That's the one in Boston. It is the oldest one I guess, or if not, close to it.

Following 9/11 there was a big concern in the United States about what were the actual hazards of these ventures. One of the things that was done, in fact probably one of the first ones and ones of the major ones, was that the Sandia Report was published in 2004. There have been other reports that Sandia has prepared, but they have been on specialised subjects, like offshore terminals. There are some other Sandia Reports which are classified. But the Sandia Report that we have referred to here, 2004, is important, I think, to everyone, and I make no bones about hanging 14:35 my hat on it, because the Sandia Report in relation to the United States was prepared by the Sandia National Laboratory, which is a Government National Laboratory. It used to be a weapons laboratory, it still is a weapons laboratory, but they have a much greater 14:36 mission today. So, they are considered, at least by the US Government and everybody else, a credible agency.

So, I have made many calculations of how far a vapour 14:36 cloud would travel, but I realised, and still realise, that I can do nothing but get into arguments with other vapour dispersion modellers, and the public, on how far I think something should come. So, I decided I am not going to try to push my product, I am just going to say 14:36 that these calculations by Sandia are reasonable to me and that they are sufficient for planning purposes. There are other people, I am sure, that think they are too extreme.

MR. J. McELLIGOTT: Okay. Can we move on to 14:37 just another question.

INSPECTOR: Mr. McElligott, I would just like to clarify something with Dr. Havens. The Sandia Report arose out of concern about a terrorist attack, is that purely on LNG ships, or was it on the terminals as a whole and the ships?

DR. HAVENS: I don't want to get this wrong. I believe that the Sandia Report 2004 directed specifically to LNG ships.

INSPECTOR: Thank you.

MR. J. McELLIGOTT: Dr. Havens, in an article in the Journal of Hazardous Materials, February 20th, 2007, Volume 140, you stated:

> "It is clear that the offshore option can, under the right circumstances, obviate the onshore public safety concerns. The authors of this paper, believing that updating the Consequence Assessment Procedures to consider post 9/11 hazard separation distances, will result in a finding that people onshore will be out of harms way from offshore LNG terminals of the size presently being considered if sited ten or more miles offshore."

Now, my question to you is: Yesterday Shannon LNG rubbished the idea of offshore terminals as one alternative, possibly, to an onshore terminal. Now, this is not to say that there is anything wrong with onshore terminals. But could you give us an explanation or your view of the feasibility of building offshore terminals? Is this really the way it is going? What is the industry thinking on this matter?

DR. HAVENS: Let me answer this way. When I wrote that article for that journal I had just finished another

involvement in another LNG project in the United
States, that I can tell you just a little bit about and
it will provide an answer to your question.

This was the terminal application to build an LNG 14:39
terminal in the Port of Long Beach, California. I was
hired by the California Public Utilities Commission as
an expert and I testified and filed testimony very
widely, which is all available on the FERC web site.
At the time the proposal in Long Beach was being 14:40
considered there were also being considered three
offshore terminals, offshore California. One of them
was the Woodside Terminal that was discussed here
yesterday. There were three. One was a proposal to
build a storage facility on a disused platform, oil 14:40
platform. That situation is still alive, still under
consideration. The other two were floating storage
gasification units. I believe both of them were the
type that were anchored to the bottom, so they were
floating. 14:41

There is a classification of offshore that is,
basically, if the water is shallow enough you build a
big rig, concrete, and you just sink it into water and
it sits on the bottom. In any case, they had 14:41
simultaneously a proposal for one in Long Beach. Three
offshore. The California Government was wrestling with
all of the questions, I think, that you all are in. Do
we need all that gas? If we don't need it all, which

way is the best way to do it? Etc. Etc. Etc. It became very clear that the California Government wanted me to give them my opinion on the relative safety of these two kinds of ventures. And at the end of the day I testified that I believed that if there were 14:42 alternatives to putting the terminal in the port of Long Beach they should be considered.

They asked me the question: Do you think that if these terminals were ten miles or more offshore -- which 14:42 happens to be the minimum distance of the three that were under consideration -- do you think there is anyway that the public onshore could be endangered by that placement? I testified that I did not.

14:43

It was at that same testimony that I opined that in the port that, given the potential for incidents, like some of which I have discussed today, I believe people could be in harms way up to about 3 miles. So I am labouring to try to keep what I am saying here today entirely 14:43 consistent with what I have said at, at least three or four different places.

MR. COUGHLAN: May I ask a question? Dr. Havens, the GAO report is predicated on a terrorist attack? 14:44

DR. HAVENS: Is what?

MR. COUGHLAN: Predicated on a terrorist attack?

DR. HAVENS: Is what predicated?

MR. COUGHLAN: The GAO report. Sandia in other words.

DR. HAVENS: No. As I have said, my understanding is that we might not have it if it hadn't been for 9/11 but it does address both accidental events and terrorist events. 14:44

MR. COUGHLAN: Okay.

DR. HAVENS: For example. It has a considerable discussion about ship collisions, energy required on and off. 14:44

MR. COUGHLAN: Well, the issue of ship collision is something that's the subject of an assessment at the moment. So I can't comment on that. 14:44

DR. HAVENS: I understand. And I tried to say in the beginning that I am not making any judgments here about the relative risks of this particular site. All I am saying is that these are things that you need to consider when you make these judgments. I also testified, and I am sure that somebody will remind me, that I did not believe that we should completely exclude the possibility of further placement of LNG ships in the United States onshore. But I also said that I believe that if we can we should observe greater distances around them than we are tending to do, and furthermore, if we have an alternative that is acceptable to the onshore then I believe that, all 14:45 14:45

other questions aside, we can obviate the problem of public safety, by putting it offshore.

MR. J. McELLIGOTT: Do you believe the industry is capable of building offshore terminals?

DR. HAVENS: I am not an offshore expert, but I know this: I have been working with this area seriously since 1976. In 1976 there were proposal to build offshore terminals. They never went anywhere. Probably one of the main reasons is that before anybody got anywhere the gas bubble burst and there was no interest in LNG in the United States for a period in importation. We have about 100 peak shavers, like you all talked about, and that's big time business. But there was no interest until about the year 2000.

Now, at that time, at the beginning, there was literally no discussion of offshore terminals. And you could read articles that said it is too difficult, too expensive, for all the reasons that have been talked about here, it is more advantageous to put it on land. Now, the only thing I can tell you now is that, as I have observed, that as concern has grown about these issues there are a lot of people stepping up to the table and saying 'we will build an offshore terminal'.

Now, there are three under consideration off the coast of California. There is one operating, as has already been specified, way out in the Gulf of Mexico. It is only a gasification ship, no storage. There is another one like that planned up off of Massachusetts and another one second one like that planned off of Massachusetts. So, I think that's six right there. There is an offshore floating storage and gasification unit planned in the middle of Long Island Sound, mid way between Connecticut and New York, and that would be operated and built by Shell. It has just received approval from FERC for going ahead. I believe that's accurate. But in any case, it is definitely still in the works. So, anyway, we have six or more that I know of in the United States. I know also, because I am a consultant to the Regional Government of Tuscany, in Italy, that they are considering building an offshore terminal off of the port of Lavorno. I suspect there are others, but those are the only ones that come to my mind.

So, and I don't mean this facetiously, but either these people don't know what they are talking about, they are bluffing, or they intend and, in fact, are already starting to build it.

By the way, I do remember and acknowledge the report that Exxon is considering. I don't know the details on that. I think it is probably true that they have not made any application or anything that has been announced.

INSPECTOR: Does that conclude questions?

MR. J. McELLIGOTT: I have one final question. Have you done any specific -- You know the "Prime Time" video that shows 14:50 the vapour not being lighter than air, how can you prove that it goes laterally and not just straight up?

DR. HAVENS: Well, first of all, I can calculate it. It has been observed experimentally, in fact I have some 14:50 illustrations of that, that I could show you, if it would be productive.

INSPECTOR: Can you take another question while he is setting things up. 14:51

DR. HAVENS: Could I take it in just a minute, because I would like to make a remark or two about what he is going to do so it saves time.

14:51

I have a film, video, a short video clip, about two minutes long, that was the result of a test that was done in the 80's at the Liquefied Gaseous Fuels Test Facility, which is the big name for the LNG test centre that they built out in the Nevada desert after the 14:52 first LNG go round concern. There was some large scale field tests. These particular tests were called the "Falcon" tests. What they were intended to do was to see what the effect of building a vapour fence around a spill area. The vapour fence would not -- these facilities have concrete sumps or [inaudible] sumps, bunds, but that is to retain the liquid from spreading. It has been postulated that if you put a vapour fence, perhaps even on top of the bund, that it would lessen 14:53 the travel distance of the vapour that was evolved. So this was a set of experiments to study that. So, in essence, it is hold up of vapour, how much would a structure hold this vapour and prevent it going down wind. 14:53

There were five tests that were conducted. I will show you a still picture of one. It is the only picture I have with me. But the reason I will show you it is to show you the effects of the density of the gas. Okay? 14:53 So you will be looking at an LNG cloud, you will be looking at it staying close to the ground etc. etc. This first slide, I won't delay with the details, but I will provide it to you if you wish. I will read it quickly at the top so that we will all know what I am 14:54 talking about.

The "Falcon" test series involved five moderate scale, that is 20 to 66 cubic metres, releases of LNG into a fenced vapour containment area, with dimensions 44 14:54 metres, 88 metres by 10 metres tall. It, basically, is just a square fence. Table 1 shows the LNG volume spilled in each test. Along with the volume of the LNG vapour, at its boiling point, that would be evolved.

If you take LNG liquid you change it to vapour. At its boiling point it is about 270 times as large. You take it all the way to ambient temperature it is closer to 600 times. But at the boiling point it is about 270 times. 14:55

The last column shows what I have called the vapour fill ratio. Now, all the numbers are small from 0.14 up to 0.46. What that means is that all of the liquid that is spilled in there formed a certain amount of 14:55 vapour and that vapour, if it remained pure, didn't mix with air, would not fill up the fence, would not overflow. In the US currently I believe that there is still being used technology, in doing vapour cloud explosion models, that assumes that the gas from a 14:56 spill will fill up as a pure gas and overflow, rather than being is scooped out by the wind, for example. The point of this is that the flammable gas mixtures, in spite of these numbers, all overflowed the fence and flammable gases went downwind to some considerable 14:56 distance. I think that the 2.5% concentration extended to about 250 metres in the first test. We can get the numbers for all the others but that's the only one I have.

14:56

Now, this is a three quarter view looking down onto this enclosure. So, I will point at what you are looking at. That is the fence, it is 10 metres tall, it goes all the way around here. There is a pipe coming here from storage tanks, going through the fence, coming out to this thing they call a spider network. Basically, it is a distribution pipe system. They pump the LNG through the long pipe out into that. It had a bunch of holes in it. It was a way to rapidly 14:57 spill onto water. That's water underneath. So they built a pond -- this is in the middle of the desert but they built the pond. The LNG is virtually sprayed, if you like, down onto the water.

14:57

Now, this is one of the tests. Frankly, I don't know which one but I could find out. But it is one of one through four. You can see the up wind fence end in this picture. Right here. And the wind is coming in this direction, I think it is clear. You see a big 14:58 white cloud. Now, I have said before this cloud does not pose a toxicity hazard. If it weren't too cold, and it wouldn't be unless you were really, really close to it, it wouldn't hurt you, unless the concentration of the methane, for example, were high enough that you 14:58 could be asphyxiated. But that is not likely to occur very close either. So, the toxicity problem is not a current concern. You couldn't smell it. You couldn't see it.

14:59

What you see here is condensed water vapour. Now, this is in the desert and the humidity was only about 5%. But still, it was hot and that is enough water vapour to condense all of this white material. So, the next

question comes in. There is no assured coincidence
between the visible cloud and the flammable cloud. In
this case the visible cloud probably does not extend as
far as the vapour cloud. The vapour cloud, flammable
vapour cloud, probably extends further than the visible 14:59
cloud.

Now, you will notice that it is going in this
direction. What is happening is its building up inside
the fence, the wind is coming from this direction, you 15:00
can see it folding it over. It is running over the
top -- I mean the far end -- and then it is dropping
down on the ground. All of that is a clear indication
that the cloud is heavier than air.

15:00

Now, I come to the video. We are looking down into the
same enclosure and we are going to look at a video of
the last spill. The video will illustrate two or three
things that have been discussed. It will illustrate
the growth of the filling up of the enclosure. It will 15:01
also illustrate, and I will point out to you, a number
of Rapid Phase Transitions. Rapid Phase Transitions
are sometimes called flameless explosions. What
happens is if you take a super cold material and plunge
it into the water it will absorb the heat from the 15:01
water and it will do, what we call in thermodynamics,
it will super heat. It will get higher in temperature
than its boiling point. Then, when it reaches a kind
of instability, it will evaporate extremely suddenly,

which causes an explosion or a pressure wave.

Now, I want to show this film for three reasons. I think they are all important. The first one. You have already seen a still picture that shows you that this gas does not rise up in the air. This will be a motion picture that will show you the same thing. It will also indicate to you what Rapid Phase Transitions look like. We can discuss how violent they were and everything after you see the film.

Finally, however, this was the number five test in this series, which inadvertently caught on fire, and you will see the fire in this picture. The point that I would make with this is not to alarm you, to scare you or for any other bad reason, it is simply to tell you that it is a consideration, certainly is to me. I was involved in this test programme and I can assure you that we went to great lengths to see that we had no fire. And yet we had an accidental fire.

I think, maybe, the thing to do is run it all the way through and then if there are specific things that I can help with. You will see the gas forming. It is spraying out violently. The intent here was to have very rapid evaporation, that's why it was spilled on water. The climbing up the fences on the side, running over down there. Right over in this area (indicating), before very long you will see the first RPT, Rapid

Phase Transition. I don't know exactly where it is,
but it is somewhere around there. There's the first
one. Second one. Third one. You can count then, but
there are somewhere around a dozen that occur there,
generally all over the place, before it is over. Now, 15:05
watch over in this area. You will see a little flash
and then a fire. There is one more little piece on the
end of another camera angle and, unfortunately, that's
the best photographic coverage that I know that exists
of this fire. This ended that experimental programme. 15:05

There are voluminous reports on all of this that are
available, including reports that are available on the
investigation of the fire. I don't know that questions
like this are ever completely settled for everybody's 15:06
satisfaction, but there are more than one theory about
what actually happened. I can tell you that one of the
principle theories was that this was a plastic fence,
mounted on metal around the container, and the RPTs
through objects, including concrete blocks, and some 15:06
people think that the concrete blocks striking the
electrostatically charged fence started the fire.

Now, that's all I was going to do. I will be happy to
try and answer your questions. That's the only film I 15:07
have, too. I guess my point of this and reason for
showing it is simply that these are things that I am
sure we all would agree, an LNG cloud is reasonably
easily ignited. You have to take good care, and of

course they will, to try to ensure that it doesn't get ignited if it does give out. It does have some special characteristics. The number one, I would say, is the fact that it is a much denser than air gas. Even though methane gas normally is lighter than air. LNG vapour is not. 15:07

INSPECTOR: Okay, the questioner down the back.

UNKNOWN SPEAKER: Thank you, Dr. Havens. I would like to just, maybe, 15:08 bring your attention to another report, another article in that report I mentioned earlier. Mr. Schwartzenegger of California rejected even an offshore facility, LNG facility. I think it is also reported in the Irish Examiner a couple of days ago 15:08 that Senator Edward Kennedy from Massachusetts, at the other side of the United States, also objected to a facility, an onshore facility. Helped, I might add, by the Coast Guard, who were very concerned about it. So, have you any comments to make on that? I mean, both 15:09 sides of the United States are rejecting it and, you know, obviously there is something seriously wrong when Senators object to it. Thank you.

DR. HAVENS: I didn't understand all of your question, but the 15:09 first part, I think, had to do with Governor Schwartzenegger, who I am not going to fight with. He has made a ruling, as I understand it, I think this is on what is called the Cabrio Port Project, which

happens to be off of Malibu, which is the movie star
community. That community mounted an extremely
affective opposition, not much based on safety, but
mostly based on environmental concern, including even
things that they didn't want to be able to see from 15:10
their beach front homes. At the end of the day this
gets into much higher politics than I know anything
about. But I can tell you that, in my opinion, that
terminal, or any other exposed offshore terminal that
they are talking about, would not pose any hazard to 15:10
the people onshore.

UNKNOWN SPEAKER: Can I just come in on that?

DR. HAVENS: We have a similar situation
in New York, with the Broad
Water Terminal. I appears that when you go offshore 15:10
the concerns are more on the part of the environmental
issues and much less, in fact very few, on the safety
side.

UNKNOWN SPEAKER: I would just like to
continue on that. It has 15:10
been reported in the paper that the Coast Guard off of
Massachusetts, the State of Massachusetts, were very
concerned about, you know, the shipments in and out and
the community got together, with Senator Kennedy, to
object to it, basically. Thank you. 15:11

DR. HAVENS: Again, your question is a
bit broad. I know only
this: I have also worked on, in addition to the Long
Beach proposal, I have worked on the Fall River

Massachusetts Proposal, which is also a Hess project. That process has gone through the draft Environmental Impact Statement stage, the final Environmental Impact Statement stage and FERC has approved the terminal. Some of what I am going to say someone may want to 15:11 correct me. But in the United States, following FERC approval, one of the last things that has to be done is they have to receive what is called a "Letter of Recommendation" from the US Coast Guard. That Letter of Recommendation is essentially the Coast Guard's 15:12 control, as I understand it, over whether they consider acceptable all of the shipping aspects to and from the terminal. So, they are talking about safety of navigation and all kinds of things.

15:12

Now, it is a bit of a fluid situation. Some month or two or three months ago the Coast Guard issued a negative Letter of Recommendation and said that the Fall River site is not suitable for the navigational requirements that they need. Mr. Shearer could 15:13 probably tell you more than I know. But anyway, that's the status of that, as far as I know.

UNKNOWN SPEAKER: Thank you, Dr. Havens.

INSPECTOR: Does that conclude the questioning. 15:13

MR. J. McELLIGOTT: Yes, sir.

MR. O'NEILL: Sir, I have just one question arising out of those extra issues that were raised this afternoon.

Good afternoon, Dr. Havens. I just want to ask you in relation to the Sandia Report, and just to clarify, because there seemed a little bit of confusion in question that Mr. McElligott asked you, Sandia didn't seek to introduce or recommend the introduction of an 15:13 exclusion zone; isn't that right?

DR. HAVENS: That is correct.

MR. O'NEILL: And Sandia, you say, wasn't focussed or wasn't directed towards terrorist attacks. But it did look at multiple 15:14 attack scenarios, as you say perhaps predicated by 9/11.

DR. HAVENS: I don't think I said they didn't address it. I said they didn't address it exclusively. 15:14

MR. O'NEILL: It wasn't set up specifically for that purpose, that's correct. As I say, what Sandia did look at was multiple attack scenarios. Even in that scenario we are dealing with a heat hazard distance of 15:14 one mile. In other words, it didn't adopt a cascade effect. It can't anywhere in the report suggest that the heat hazard would extend to the two or three miles that you have mentioned; isn't that right?

DR. HAVENS: No. 15:15

MR. O'NEILL: That's correct you mean?

DR. HAVENS: That's not correct. They discussed in the 2004 report the potential for successive failures. They made the statement that in their opinion the successive failures would be limited, in their judgment, to no more than three times. But that's cascading failures. They also opined about what difference that would make. So that's the first point. I have forgotten the other ones. 15:15

MR. O'NEILL: Sorry, perhaps they did. Yes, they did talk about damage to up to three tanks. But they didn't extend the heat hazard distance any further than one mile, approximately 1 mile. 15:15

DR. HAVENS: I could find this out, but I think they made the statement that the affect would be primarily to prolong the fire rather than to increase the distance, importantly. That's what they stated. Now, on that issue. That was 2004 and since 2004 there has been a growing concern about whether the statements that were made in the 2004 report to the extent of it being limited to three tanks has been called into question. That was called into question in the GAO Report. The GAO Report recommends that we need to find out what is the real story about the potential for cascading failures that might lead to the entire loss of the ship. 15:16 15:16 15:16

MR. O'NEILL: And the GAO report is essentially dealing with terrorist issues?

DR. HAVENS: No, I don't think so. It deals with collisions as well.

MR. O'NEILL: Sorry, I say essentially, and indeed in your written précis the title talks about terrorist attack.

DR. HAVENS: It is fair to say, I think, 15:17 the concern is importantly related in the United States to terrorist attack.

MR. O'NEILL: What Sandia doesn't deal with, and, indeed, in any calculations you carry out, you must look at the risk. 15:17

DR. HAVENS: I am sorry?

MR. O'NEILL: You must consider what it doesn't -- what it doesn't do, it is talking about a consequence rather than looking at the risk. In other words, if it is a 15:17 terrorist attack or if it is an accident you have to consider the probability of that attack, that accident occurring; isn't that right?

DR. HAVENS: Well, I have told you here that my business is not 15:17 calculating probabilities, as important as I understand they are. I would, however, suggest that if you can tell me, or anybody else, how we can calculate the probability or estimate the probability of a terrorist attack it would be a very valuable thing to know. 15:18

MR. O'NEILL: Indeed. Isn't that really a matter for the security personnel in a particular administration, the An Garda Síochána, the Department of Defence in our case.

DR. HAVENS: Are you suggesting that there is no concern here for terrorists? Is that what you are saying?

MR. O'NEILL: I am saying that the risk assessment, would you not 15:18
agree that the risk assessment is not something, and you don't claim any expertise, and I fully accept that, in relation to risk assessment. But if one is talking about a terrorist attack, the person who is best placed to assess that risk, or the people who are best placed 15:18
are the security forces.

DR. HAVENS: The security forces? No, I don't agree with that. The reason I don't agree with that is because I don't see how the security forces can make a determination of 15:19
that unless they know what they are up against. All I am talking about here is the consequences that they might be up against.

MR. COUGHLAN: May I offer a clarification, please. As 15:19
Harbour Master I also happen to be the Port Security Officer for the Shannon Estuary. That authority relies very heavily on the issuing of threat level warnings from the State, the security services, the police, and the police are the only power with which we interact. 15:19
Now, if this project was to go ahead we would have to ensure that an incidents plan was put in place at the jetty to secure the ship and the jetty interface against unwanted intrusion. Secondly, if, as Port

Security Officer, it came to my attention that there
was heightened threat level to an incoming ship that
ship would remain outside, it would not be brought into
the port at all. Now, I know that Shannon LNG may not
like to hear this, but that's a fact. And the ship 15:20
would not come in until such time as the State military
arm, the police, the navy, the army, or anybody else,
had put resources in situ to deal with the situation.
That's our main mitigating factor against a terrorist
attack. Thank you. 15:20

DR. HAVENS: May I address that point?
What got the ball rolling
on all of this question was the fact that following
9/11 an LNG ship was held outside of Boston for several
days, because there was concern that they should not 15:20
let it enter Boston. This was right after 9/11. In
fact, it was made on the same day that it occurred.
Eventually, that ship did not go into Boston, but was
diverted Elba Island instead, I think, to off load.
There was a period of study which, presumably, was done 15:21
to determine whether or not they should start to allow
it to come back in. It was a rather rapid study and in
the end, in two or three weeks, they started bringing
ships in. They are continuing to come in. They come
in with very heavy security. There is a lot of 15:21
arguments about who is supposed to pay those bills,
etc. etc. etc. There is a growing concern, at least in
our country, about the requirements for bridge closing
and other up-sets and so on. I don't think you have

any bridges, but I am just talking about the fact that the provision of the security measures is not to be taken lightly. One of the concerns that I have is that, and I hesitate to get too far into the terrorist thing, because I fully understand, I think, that a lot 15:22 of you believe that you may not be as vulnerable to that as we are, for our own past behaviour, but I can tell you that in the United States right now it is getting to be a big concern, about whether or not somebody would ratchet up this threat and it would 15:22 begin to control the security requirements for ventures that are in downtown Boston.

I mean, they have already had bridge closes, where somebody has called in and said 'you better watch it, 15:23 in the next 15 minutes' etc. This king of stuff. Now, the emergency authorities have a hard time dealing with that kind of thing, and I don't want to go on too long about this. But I suspect, in fact I see in the newspapers all the time, that many of the LNG companies 15:23 are now coming and saying, you know, we can solve this problem, we are proposing to build one offshore. It is not me that wants to build it, they are lining up to build them. I certainly think that is something that suggests that. 15:23

My bottom line is I am not against putting an LNG terminal anywhere, except for the reasons that I feel that I have already discussed. But if it were me, and

I want to make it clear, if it were me and I had alternatives so that I did not have to endanger a population, and I did not have to bring it up in an estuary, or into Long Beach Harbour, I think that should be seriously considered. That's all I am saying.

MR. COUGHLAN: Well, the only comment I make on that is that there is a vast, vast difference between the two situations of which you are speaking.

DR. HAVENS: A vast difference between?

MR. COUGHLAN: Between the two locations of which you speak, downtown Boston and the Shannon Estuary. That's my only comment in reply.

DR. HAVENS: Absolutely. I acknowledge that and I don't want to leave the other impression. I acknowledge everything you have said about that.

MR. J. McELLIGOTT: Dr. Havens, I would just like to point out, first of all, that Hess LNG is an American company so there is some connotations to be taken from the American soldiers going through Shannon Airport. As somebody once interpreted that. The second point I really want to make is that, and we are going back now to the planning issue, the planning issue on safety grounds is that the HSA has done a land based risk -- well, Shannon LNG has done a land based risk assessment, there is nobody doing a QRA on the marine side and everybody seems to say 'oh, there is no real risk there', but my question would be how...(INTERJECTION).

MR. O'NEILL: Sorry, I think...(INTERJECTION) 15:25

MR. J. McELLIGOTT: Sorry, I have the microphone please. I am sorry, I am talking.

MR. O'NEILL: I think the question has to be accurate. Dr. Havens hasn't had the opportunity of looking at the EIS and all the documentation, I have no doubt, and in those circumstances I think it is only that if a question is being put it is an accurate question. There is an assessment of marine risk, as Mr. McElligott well knows. 15:25 15:25

MR. J. McELLIGOTT: Yes, purely for marine risk. But I am saying how can you calculate the probability of an accident on water, how can you know the probability of an accident going to happen if you do not calculate that probability? Would you agree that it is difficult to say it will never happen if you do not calculate the probability? 15:25 15:26

DR. HAVENS: You are asking me a question that, like a lot of questions, I have trouble with because I just got here last night and I have not looked at things. But I

quickly looked at, I think what you call the QRA, and it was very quick. It appeared to me that there were a number of -- I think this was prepared by Dr. Franks. It appeared me, and correct me if I am wrong, that there are numerous risk assessment calculations, 15:26
probability calculations in there. I did not see any that dealt with a major event like a half tank spill. If it is in there I would be interested in seeing it and considering it, but I didn't see it. So, I don't know whether it has been done or not. I believe that 15:27
if it hasn't been done it should be done. Because I believe that you should consider all reasonable, credible event that need to be considered. And if that one hasn't been considered then the only justification for not considering it is for you to decide that Sandia 15:27
is not a credible agency. Maybe they are not. But I am going to assume they are for one.

MR. J. McELLIGOTT: Thank you. No more questions.

INSPECTOR: Does that conclude the questioning of Dr. Havens? 15:27
It is half 3:30 now, maybe we will take a brief break. So five minutes. This time I would request that people be back by 3:35.

15:28

<u>SHORT ADJOURNMENT</u>

THE HEARING RESUMED, AS FOLLOWS, AFTER A SHORT ADJOURNMENT

INSPECTOR: Everybody it is now 3:40, if we could resume our seats. Okay, I will now call the applicant to commence their presentation in terms of health and safety. Mr. O'Neill? 15:41

THE APPLICANTS PRESENTED THEIR SUBMISSION ON HEALTH AND SAFETY AS FOLLOWS: 15:42

MR. O'NEILL: Thank you, Mr. Inspector. The first witness we are presenting is Mr. Leon Bowdoin, who is going to deal with design, construction operations, maintenance, safety, security and training. Obviously in context of the safety module that we are now in, there may be a little bit of overlap in the context that some description of the site has to be given for the purpose of assessing the safety aspects. 15:42 15:42
I think Mr. Bowdoin's report is being circulated and I would ask him to bring you through it, sir.

MR. BOWDOIN PRESENTED HIS SUBMISSION AS FOLLOWS:

MR. BOWDOIN: Good afternoon
Mr. Inspector. My name is
Leon A. Bowdoin Junior. I hold a Bachelor of Science 15:43
Degree in Mechanical Engineering from Northeastern
University in Boston MA, US, and a Masters Degree in
Business Administration in 1988 from Bryant University
in Smithfield, Rhode Island, also in the United States.
I am a member of the American Society of Mechanical 15:43
Engineers, the Instrument Society of America, the
National Association of Corrosion Engineers
International and the National Fire Protection
Association (NFPA), where I am a full voting member of
the Technical Committee on Liquefied Natural Gas, the 15:43
standards writing committee responsible or developing
the internationally recognised standard NFPA 59A,
"Standard or the production, storage and handling of
Liquefied Natural Gas (LNG").

15:44

I am Vice President of Operations the Weavers Cove
Energy, a subsidiary of Hess LNG. My main areas of
expertise are in the design, construction, operation,
maintenance, fire protection, safety and security of
LNG facilities in natural gas transmission pipelines. 15:44
Over the past 30 years I have been involved in the
design, operation and permitting of a number of LNG and
natural gas projects and in the compellation of a
number of EIS statements and applications for licensing

of both LNG and natural gas pipelines facilities in the
United States as well as in Canada.

I have over 35 years experience in the LNG and natural
gas industry in engineering, operations and management. 15:45
Before joining the Hess team five years ago, I was
employed by Duke Energy Corporation, a US energy
corporation, and its affiliates in various engineering
and operation and management positions for over 30
years, having responsible positions in LNG and natural 15:45
gas pipeline facility design, construction, operation
and maintenance, including holding positions as the LNG
Plant Manager for the company's LNG facility in
Providence, Rhode Island, in the 1980's and as Director
of Pipeline Operations for Algonquin Gas Company in the 15:45
1990's.

My evidence of brief will discuss the development of
the Shannon LNG project in the following areas:
15:46

- Design and layout of the facility
- Construction of the facility
- Operation of the facility
- Maintenance of the facility
- Safety, security and fire protection of the facility 15:46
- Personnel training

Involvement in the project

I have been involved in the Shannon LNG project beginning with the initial evaluation of the project by Hess LNG in 2005. I have overall responsibility for technical matters relating to the Shannon LNG project which encompasses facility design, construction and 15:46 operations. I have managed, overseen, conducted, participated in or reviewed the following engineering work and assessments, including:

- The preliminary suitability assessment of the site 15:46 in 2005 conducted by Hess LNG.
- Conceptual design performed by Chicago Bridge & Iron
- Civil and geotechnical engineering, seismic and environmental studies and analysis conducted or managed by Arup Engineering and by ERM in the US and 15:47 their subcontractors.
- Development of the project QRA by ERM for submissions to the HSA.
- Technical analysis and engineering covering facility layout, process selection, safety, security, fire 15:47 protection, operations, maintenance and training requirements for the Shannon LNG terminal
- Assessment of the impacts of the proposed development during construction and operation phase of the development 15:47
- Recommendations of the mitigation measures necessary to avoid, reduce or remedy the adverse environmental impacts identified.

This conceptual design work and engineering
investigations have been undertaken using world class
engineering design firms and have been performed in
accordance with Irish national and/or international
standards, codes, regulations and best practices for 15:48
the design, construction and operation of LNG
facilities.

I have participated in the development of or the review
of all of the sections of the EIS, and in particular 15:48
with sections 2, 3, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16,
17 and 18. As one would imagine, these sections were
prepared in conjunction with the input and advice of
many technical experts employed by Shannon LNG in the
various disciplines required to conduct a thorough and 15:48
complete assessment. A more complete list can be found
on pages VII through VIII, Volume 2 of the EIS.

Section 3 - Description of the LNG and proposed Shannon
LNG project design construction operation and 15:49
decommissioning

Description of LNG

I will begin my evidence with a short description of 15:49
LNG and natural gas.

LNG is natural gas that has been cooled to
approximately minus 160 degrees centigrade, at which

point it becomes a liquid at atmospheric pressure. As a liquid the volume of natural gas is approximately 600 times less than the volume of the equivalent amount in the gaseous state -- excuse me, the volume of LNG is 600 times less -- making it more manageable for storage and ocean transportation. LNG is stored and the transported in insulated tanks operating at pressures slightly above atmospheric pressure.

LNG is delivered to the regasification terminal by ship, is unloaded into storage tanks, converted back into gas and transported to consumers via the natural gas pipeline system.

Shannon LNG design objectives

The principle design objectives for the Shannon LNG terminal are:-

- Unload, store and regasify LNG at the site.
- Provide a gas supply to Ireland with a throughput of 11.3 Sm^3 per day or (400 MMscfd) 400 million standard cubic feet per day, readily expandable to 17 million Sm^3 per day or 600 MMscfd in the initial phase, eventually increasing to 28.3 Sm^3 per day or 1 Bscfd. There is a table of these energy unit conversions in Appendix 1A, Volume 4 of the EIS.
- Provide storage for between 200,000 m^3 and 400,000 m^3 of LNG in one or two tanks respectively, increasing

in later phases of the project up to 800,000 m^3 in four tanks.

- Comply with all statutory requirements.
- Connect to the BGE pipelines network in order to transport the natural gas from the site to the 15:51 National Grid.
- Provide a marine berth, LNG unloading facilities, process piping and equipment, vaporisers and related buildings and facilities to convert the LNG from liquid back to gas at pipeline pressures. 15:52
- Minimise the environmental impacts by incorporating Best Available Practices (BAT) (refer to section 3.11 of the EIS), and recognising Ireland's commitment to the Kyoto Protocol and the impact on CO_2 emissions. 15:52
- Optimise operational efficiency
- Provide security measures to deter, detect and prevent any attempts at unauthorised access to the jetty or the plant.
- Provide a minimum design line of 50 years. 15:52

Design constraints

As discussed in chapter 3, Volume 2 of the EIS, the Shannon LNG site design and layout has been undertaken 15:53 with careful consideration of the requirements of the Irish and EU regulations, recommended standards and good engineering practices. My colleague Ian Vinecombe will provide evidence concerning this subject.

The Shannon LNG Facility

As described in section 1.4, volume 2 of the EIS, the proposed Shannon LNG terminal will consist of a number of components as illustrated in figure 1.3, Volume 3 of the EIS and discussed below: 15:53

You can refer to the slide up there, which shows that figure. 15:53

LNG jetty - this jetty will be capable of receiving and providing secure berthing for LNG ships up to 265,000 m^3 cargo capacity. My colleague Blair MacIntyre has already provided the details of the LNG jetty design, construction, operation and safety so I won't repeat the information here. In fact, I believe he will be following me in some regards to that which he hasn't already discussed. 15:54

15:54

The LNG Storage Tanks

Again, you can see them on the figure. There will be up to four full-containment LNG tanks each with a usable capacity of 200,000 m^3. I will speak to the siting issues of the tank and their placement aboveground in a low terrace cut into the hillside on the site. Ian Vinecombe will provide details of their design and construction. 15:54

Vaporisation Process Equipment

This equipment will convert the LNG from a liquid to a gas state. This equipment will be located to the south 15:55 of the storage tanks. I will speak to the selection process to be used in the design. Ian Vinecombe will speak to the details of the vaporisation process, equipment, design and construction.

15:55

Administration building, security building, stores, workshop and various other buildings and process equipment, Ian Vinecombe will also provide details for their design and construction.

15:55

There will be a **pond and embankment**. A pond will be created to provide a water supply for construction and operation of the terminal. It will be located on the existing stream within the site, Eoghan Lynch will provide details of its design and construction. 15:55

Materials Jetty

Blair MacIntyre has already provided some information on this, I believe, and what he hasn't he will be 15:56 providing additional detail in this segment.

Figures 3.6 to figures 3.14 in Volume 3 of the EIS illustrate the various components listed above. Figure

3.8, Volume 3 of the EIS is a more detailed view of the LNG tanks and process areas where the individual locations of equipment can be easily identified.

A simplified schematic of the process is shown in figure 3.4, Volume 3 of the EIS and shows the major components of the facility. The schematic shows in general terms the flows of the main process streams in the facility and I am going to sort of walk through them right now. Unfortunately, I can only use my pointer on the slide behind you so I apologise if you have to look in both directions.

- LNG will be pumped from the ship to the shore tanks. The unload rate will be up to 14,000 m^3 per hour and will take approximately 16 hours to off load the cargo in the ship.

- there will be a cold vapour line -- this white line going back to the tank -- which will flow back to the ship, as shown.

- boiloff gas (gas that is produce from heat leaked through the installation systems) and any remaining vapour produced from ship unloading flows from the tank to the boiloff pressures and then on to pressure vessels to recondense the gas into the LNG pump out stream from send out. So, the boil off gas goes from the tank into the compressor, and from the compressor into the recondensers.

I am going to skip lines now.

LNG that is pumped from the tank will go to the boiloff 15:58 recondensers, where it will pick up the vapour and then move on to the high pressure pumps, on to the vaporisations and then on out to the natural gas grid.

the vaporisation system consists of the seawater flow 15:58 loop where seawater flows up to approximately 20,000 m^3 per hour, and that's at peak send out rates, it is taken in through inlet structures and then pumped to plate & frame heat exchangers, where the heat from the estuary is exchanged or transferred to a glycol (MEG) 15:59 system intermediate fluid.

The MEG is pumped in a closed loop between the plate & frame exchanger and the shell and tube vaporiser where the heat is exchanged for the LNG to warm the gas. So, 15:59 the water will come in here, be pumped to plate & frame exchangers, go back to the sea. The MEG system, which is this loop right here, is pump in a closed loop and exchanges heat from the sea to the gas to convert it back from a liquid to a gas. There is a supplemental 15:59 heating system here, these are fired heaters which are designed to provide heat during those period of time when the sea water system is insufficient.

Site Layout Alternatives

I will now direct my evidence to the discussion of the site layout alternatives. As described in section 2.5, Volume 2 of the EIS, and shown in figures 3.5 through 3.8 in Volume 3 of the EIS, the site layout of the Shannon LNG terminal was largely determined by the identification and avoidance of sensitive environmental areas and the proximity of deepwater along the shoreline of the site.

There are a number of designated areas of environmental concern located in the overall Shannon Development Landbank. The location of the proposed Shannon LNG facility was chosen after careful consideration to minimise the potential disturbances to these areas, minimise the visual impacts to the immediate neighbours to the south and to provide the safest, most efficient and economical plant design and layout.

The location of the designated areas of environmental sensitivity is shown in figures 10.1, Volume 3 of the EIS, which is slide 6, and discussed in chapters 10 and 11 in Volume 2 of the EIS. A number of people will be providing evidence relating to the site ecology and environment, including Simon Burrow, Stephan Craven, Karl Dixon, Eoghan Lynch and Dr. Rory Doyle.

As Blair MacIntyre has already discussed the jetty, I will not repeat his evidence here but refer to it in the siting of the remaining facilities.

I am going to discuss now the LNG tank location. As discussed in section 2 volume 2 of the EIS -- if you 16:03 were to give me one second I want to switch fonts here, I am having a little trouble reading the small print. Thank you.

As discussed in section 2.5, volume 2 of the EIS the 16:03 LNG storage tanks are best sited as close as possible to the jetty in order to minimise the length of piping through which the LNG is transferred from the ships to the tanks. The deep water is shown to be on the eastern end of the site and was elaborated in the 16:03 statement of evidence by Blair MacIntyre.

Figure 1.3 volume 3 of the EIS (slide 7) shows the proposed location of the tanks and the LNG jetty at the eastern end of the site. This location for placement 16:04 of the tank offers several advantages in addition to its proximity to the jetty. The tanks will be constructed in sequence with the first tank being built closest to the jetty and the subsequently tanks built to the west of the first tank. 16:04

Other potential locations and layouts for the LNG tanks on the Shannon Development Landbank given preliminary evaluation where areas to the west of the cSAC and pNHA designations, approximately one kilometre from the identified preferred jetty location. Referring to figure 3.2 volume 3 of the EIS, that's slide 8, this area is at the extreme western side of the property close to the road on the western boundary and that 16:05 would be in this area in here (indicating) so that area is the area we are talking about here. The western portion of the site was investigated and the rejected as it would bring several undesirable considerations into play; those being greater environmental impacts, 16:05 significantly longer jetty lengths and/or plant piping systems and increased visual impacts caused by locating the tanks where no screening was provided by adjacent higher ground.

16:05

Again referring to figure 3.2 volume 3 of the EIS a more central location on the site (Knockfinglas Point) including several layout options was evaluated as well and rejected for many of the same reasons. That is in this area in here (indicating), this area right in 16:06 here, (indicating) just to make sure I get it right and avoiding environmentally sensitive areas to the west. The sensitive areas to the west is this area in here that we are trying to avoid. (Indicating)

16:06

The proposed jetty length would be approximately 350 metres -- I am sorry, I skipped a line. The visual impacts of this location were also found to be greater with the tanks located at higher elevations to the

north of the stream valley and the cSAC and pNHA
affording little opportunity to incorporate features to
screen the view of the facility. Jetty lengths were
longer here than at the eastern end of the site and
process layouts and piping systems would remain 16:07
considerable.

The eastern end of the site near Ardmore Point was
found to be the best location in terms of efficient
process plant layout, minimising the visual impact by 16:07
utilising natural screening and by avoiding
environmentally designated areas to the west. As shown
in figure 1.3 volume 3 of the EIS, and this is on slide
9, the eastern portion of the site is also closest to
the natural deep water and preferred jetty landing area 16:07
along the shoreline. The proposed jetty length would
be approximately 350 metres as opposed to 600 metres or
more for the Knockfinglas Point or the western portion
of the site. This shorter jetty provides for efficient
plant design to improve ship security when berthed, 16:07
minimises visual impacts of the jetty and ship in the
estuary and provides a cost efficient design solution.

As is shown in figure 3.8, which is slide 10, locating
the tanks on the most eastern portion of the site 16:08
allows the designers to use higher ground directly to
the south to partially screen the tank from views to
the southeast, south and southwest. That's this hill
that sits right across here. (Indicating) On figure

3.9 volume 3 of the EIS, slide 11, the visual benefit obtained through this terracing feature can be seen in the cross section through the tank and process area.

I am referring to the illustration on the top of the 16:08 slide. You can see the (indicating) water line on the right and the top of the hill on the left and the effect that the terracing has. There will be more discussion of that in the visual impact sections.

16:09

I am going to move on to tank design. The selected design layout allows for the placement of up to four tanks along the shoreline, each of which is approximately 96 metres in diameter. In accordance with EU LNG design codes, the tanks must be separated 16:09 by a minimum distance of one half of the tank diameter. The tanks have been located as close as practicable to each other and to the shoreline so as to minimise visual impact. The resulting LNG tank area is in the order of 10 hectares or 25 acres in area, including 16:09 access roads, associated pipe-racks and equipment as well as required jetty structures and a security perimeter zone.

Selection of the base elevation of the tank was 16:10 considered from both a process and aesthetic perspective. Several alternative base elevations were considered with the final elevation selected to be at 10 metres OD Malin. This elevation was determined to be the lowest safe elevation that is sufficiently high above the predicted tides, wind generated waves and potential storm surges, plus an allowance for the projected impacts of global warming on sea levels during the planned operational life of the facility. 16:10

The selection of the 10 OD Malin for the tank area base elevation offers considerable impact benefits by reducing the tank visibility. To further illustrate visual impact, the proposed LNG tanks are proposed to 16:11 be of a low profile design meaning their height is lower than for normal LNG tanks of similar capacities offset by wider tank diameters, but consistent with confirmed technical feasibility. Ian Vinecombe will be providing evidence regarding the tank design and 16:11 conventional limitations.

As shown in figure 3.14 volume 3 of the EIS (slide 12) the Shannon LNG tanks will have a nominal outer diameter of 96 metres and a height at the top of the 16:11 outer wall of 40 metres above grade or above its base. The total height to the top of the domed roof will be circa 50.5 metres above grade. By comparison, a more 'normal' profile tank of this capacity would be approximately 86 metres in diameter, with a 45 metre 16:12 wall height and 60 metres to the top of the roof. The selection of the low profile design tank has the effect of reducing the overall tank height to the top of the dome by about 9 metres. My colleague Thomas Burns will be providing evidence as to the visual impacts of the higher tanks.

LNG storage tanks up to 96 metres have been designed and built at other locations and are proven from actual design construction and operating experience. There are at present no known tanks either in service or in construction with a diameter that exceeds 100 metres. Further description of the visual impact of the project is contained in Chapter 5 Landscape and Visual Assessment in volume 2 of the EIS.

Buried Tanks Alternative.

As discussed in section 2.5 volume 2 of the EIS, burying or partially burying the tanks was evaluated. Under certain soil and subsoil conditions LNG tanks have been built in-ground in Japan and Korea and a few other countries. The feasibility of an in-ground tank is largely dependent upon the geotechnical conditions at the site and a cost benefit analysis of that design approach as compared to conventional designs.
In-ground tanks can be placed in a pit partially buried or completely buried. In all cases the soil surrounding the tank must be free of excess water to prevent large lateral hydrostatic forces and buoyant forces being applied to the tank. The soil surrounding the tank must either be completely impervious or an impervious cut-off wall or curtain wall must be

installed around the tank to a sufficient depth to exclude water from the in-ground tank. Deep wells may be required to remove water from the surrounding soil.

In the case of the Shannon LNG site, the soils investigation work has shown that the ground below the initial overburden layer is essentially hard rock with some fracturing. The geotechnical analysis is found in chapter 12 volume 2 of the EIS. Designs utilised to date for buried tanks have been in softer soils that are more easily excavated. No known tanks have been constructed in subsoil conditions consisting of hard rock such as identified at the site. In order to prepare the site for a level tank base it will be necessary to remove the solid rock. This means that a buried tank would have to be built into the base of bedrock. To excavate or partially or wholly bury the tanks below the terrace elevations proposed would require significant below ground excavation and the removal of huge quantities of rock. Significant blasting would be required and it would be necessary to handle large volumes of ground water during the construction and operation of the tank (particularly because the tanks would be so close to the shoreline and the base of the buried tanks would be well below sea level). Because of the LNG thank bottom insulation systems are susceptible to certain low frequency vibration loads, blasting is not generally recommended in this close proximity to an existing tank. This means that rock excavations for all four tanks would be required in the initial phase of the project whether the additional tanks are ultimately built or not and at a considerable cost and ongoing expense to maintain the excavations in a dewatering condition. Lastly, removal of the massive amounts of excess rock from the site from the excavation for the four tanks would result in considerably increased road traffic during the site preparation phase of the project.

In addition, the glacial till and underlying near surface rock at the site is not impervious. An impervious cut-off wall or curtain would be required to extend down to solid impervious rock. The soil borings of the site encountered ground water near the surface and some artesian well conditions, that is water at the surface once the wells were drilled. Thus the ground water conditions at the site would be likely to significantly complicate the isolation and de-watering systems and render in-ground tanks impractical or uneconomical.

Most partially or completely buried tanks are surrounded by soil and cannot be readily inspected, maintained or repaired if required. In addition, a heating system is required not only for the tank bottom but also for all buried portions of the tank shell to keep the soil surrounding the tank from freezing. Freezing of soils would impose large uncontrolled forces on portions of the tank below grade. The heating system and control systems are difficult to maintain and repair and must be designed, therefore, to operate for the life of the tank. These conditions may require the tank to be taken out of service for maintenance which means Shannon LNG would have to install excess tankage beyond normal operating requirements to allow for uninterpreted service in the event of a major maintenance requirement rendering one tank unserviceable. Above-grounds tanks do not carry this risk.

Tanks placed in excavated pits do allow access to the outer tank wall for inspection and repair. A tank within an excavated pit does not need a heating system on the tank shell provided sufficient spacing is allowed to promote air circulation. However, pit excavations must then be larger than for similarly sized buried tanks resulting in even larger volumes of excavated rock, more blasting, more ground water handling and increased traffic to remove the excess material from the site. Additionally, the pit must be protected from surface water intrusion either with a sufficiently high retaining wall at the surface or a cover from the edge of the pit to the roof of the wall of the tank. The excavation pit must be designed and constructed such that they are stable over the life of the facility without risk of degradation and strength collapse or falling rocks any of which would have adverse impacts on the LNG tank located within its walls. Ground water management would be a major cost and reliability issue over the life of the facility. The curtain wall or cover must be designed to withstand any storm or wave surges that may be experienced during 16:20 the life of the tank.

Above-ground tank design and construction technology is well understood, tried and tested because it has been used extensively and successfully in the LNG industry 16:20 all over the world. There are fewer in-ground tank designs and these having often been developed for the site specific ground conditions. The design and construction of an above-ground tank is far less complex and less technically risky than a buried tank 16:20 or a tank in a pit. Construction time for above-ground tanks is significantly less than that required for buried tanks or tanks in the pit thereby minimising any temporary environmental impacts during the construction phase. 16:21

Above-ground tanks can be decommissioned and demolished in a conventional manner whereas the removal of a buried tank or a tank in a bit is problematic.

16:21

For all these reasons above-ground tanks were selected for this project.

Vaporisation Process Selection. Just to turn to slide

13. I will now turn to the subject of selection of the vaporisation process design for use at the proposed Shannon LNG scheme. LNG terminals commonly use one of several types of LNG vaporisers: Seawater Open Rack Vaporisers (ORV); submerged combustion vaporiser (SCV); 16:22 Shell and Tube Vaporisers (STV) or a combination or variation thereof.

As discussed in chapter 5, volume 2 of the EIS selection of the optimal vapour process design is 16:22 designed dependent upon many factors including size and type of facility proposed, local environmental conditions and technological constraints, local laws and regulations and technological constraints including availability and suitability of the various 16:22 technologies developed.

In the determination of the type of system we would propose to use for the Shannon LNG project, Shannon LNG engaged CB&I to review the available technologies 16:23 against the several design, environmental and legal and code and technological constraints to advise as to the benefits, drawbacks, cost and environmental cons of the several options.

16:23

As illustrated in the simplified schematic on figure 3.4 volume 3 of the EIS, Shannon LNG selected a hybrid Shell and Tube (STV) to heat and regasify the LNG. STVs are a popular process option in the natural gas industry for regasification of LNG and can use a variety of heat sources. Because of Shannon LNG's desire to minimise greenhouse gas emissions, the process was chosen to extract as much useful heat as practicable from the sea water throughout the year 16:24 whilst at the same time minimising operation of fire gas heaters and their production of greenhouse gases. The hybrid scheme was developed to maximise available heat energy from the sea water when temperatures in the estuary are sufficiently warm to vaporise the LNG and 16:24 use supplementary heat from natural gas heaters when the estuary temperatures are too cold to provide reliable operation. A glycol/water (monoethylene glycol or MEG) mixture is proposed for use as the intermediate fluid at the Shannon LNG terminal. The 16:24 MEG mixture is either heated by the sea water in a series of plate and frame heat exchangers, by a series of natural gas fired heaters, by any available waste heat sources or a combination of these heat sources depending upon seawater temperatures and operating 16:25 conditions. The system offers several operating and environmental advantages. While it represents a higher capital cost alternatives to the other methods such as SCV or a simple STV design, it will produce much lower greenhouse gas emissions than these designs, offer 16:25 excellent reliability and good process control and turndown capability. In addition, it has lower operational costs than a fired natural gas only solution. Further, the design allows Shannon LNG to capture waste heat from various internal heat generating sources thus improving the overall plant thermal efficiency and minimising the use of fired heat as a supplemental source of heat to the subsystem.

16:26

If a power plant was later proposed adjacent to the LNG terminal consideration would be given to incorporating waste heat from that plant into the LNG vaporisation process. However, no decision has been made on such a process and it would be speculative to pursue the 16:26 terminal design on this basis. If a power plant was developed we expect the overall facility design would be quite similar to what is now shown or what is now proposed.

16:26

Water supply and pond. Construction of an LNG facility requires large amounts of fresh water to be provided for construction and operations. Shannon LNG proposes to construct a pond and embankment for the purposes of storing sufficient water to meet construction and 16:27 operational needs. A pond size to hold approximately 150,000 to 160,000 cubic metres is proposed and is shown in figure 1.3 volume 3 of the EIS and is on slide 14. Eoghan Lynch will provide the details of the alternatives for the fresh water supply and the 16:27 construction of the pond in his statement of evidence.

Spill Impoundment.

The LNG process areas will be provided with a spill impoundment system and sump, designed to collect credible spills of LNG as defined by the Qualitative Risk Assessment. Refer to sections 3.10.1.1 for details of the provisions to control an LNG spill and 16:27 to appendix 3E for a summary of the QRA. Dr. Andrew Franks of ERM will be providing evidence regarding the QRA. Additionally, Dr. Phani Raj of TMS Inc. will be providing evidence regarding his assessment of the safety and suitability of the proposed site and layout. 16:28

Per EN 1473, the European standards governing LNG plant design, each process area spill containment sump is required to hold a minimum volume of $125m^3$ of LNG. Shannon LNG is proposing that the sumps be sized with 16:28 approximately $400m^3$ of capacity. The first sump will be centrally located just to the south of the LNG storage tanks, tanks 1 and 2, and north of the process area. A second sump is proposed between tanks 3 and 4 to collect any spills from piping systems associated 16:29 with those facilities when they are constructed. **Figure 3.8** volume 3 of the EIS shows the locations of the two sumps. One of them is right in that area (indicating) and the other one is right in that area. (Indicating) 16:29

Spillways will be designed to conduct any spilled LNG to the sumps and minimise spill surface areas. The sumps and spillways will be designed using low density concrete to minimise heat transfer from the ground to the LNG minimising vapour generation. Refer to CBI drawings C406 found in the Planning Drawing Set and shown on slide 16 for details of the design. You can see on slide 16 (indicating) that they are sort of highlighted out there in grey, (indicating) let me show them. They are right here and right there and again right here and right there (indicating) so those are the spillways.

LNG sumps will be fitted with high expansion foam system designed to blanket the sump and reduce the rate of vapour production should a spill occur.

The sumps will contain pumps to remove any collected storm water. Storm water collected in the spill containment system will be routinely pumped from the impoundment sumps to the site storm water management system. LNG sumps will be equipped with automatic level control activators and low temperature sensors and switches to prevent operation of the pump-out systems in the event of an accidental release of LNG to the sump.

Health and Safety.

As elaborated in section 1.8 in volume 2 of the EIS Shannon LNG recognises and accepts its responsibility for ensuring the health, safety and welfare of its employees, contractors, visitors and members of the public who may be affected by its activities. Shannon LNG is permitted to compliance with all applicable Irish health, safety and environmental HSE laws and regulations. 16:31

Shannon LNG will provide appropriate health, safety and environmental HSE training and guidelines to employees and contractors to enable them to meet the standards of performance. 16:31

Shannon LNG, through its training régime, will ensure every employee and contractor is aware of his or her responsibility to work safely, adhere the safety rules and work procedures, use safety equipment provided, is 16:32 environmentally responsible and play an active role in Shannon LNG's drive for continual improvement in HSE performance. Shannon LNG will implement a HSE management system and will use regular audits to ensure its controls are effective. Shannon LNG aims to 16:32 minimise the health, safety and environmental impact of its activities and prevent pollution by utilising a structured risk management approach which includes establishing standard operating procedures for all aspects of operation, personnel training of personnel 16:32 including for emergency preparedness and contingency planning. All new activities will be assessed for environmental impact and appropriate health and safety provision and ongoing activities will be subject to periodic review. Health, safety and environmental protection will be given equal priority to the business objectives of the company.

Shannon LNG is committed to effective communication and consultation on health, safety and environmental matters with all interested parties and will make its policies available to them subject to appropriate privacy and business confidentiality protections. Shannon LNG will routinely monitor, assess and report on its health, safety and environmental performance with data on the rate of lost time injuries and occupational injuries.

Construction safety as discussed in chapter 7 volume 2 of the EIS is also of vital importance to Shannon LNG. This subject will be addressed in the statement of evidence from Ian Vinecombe and Eoghan Lynch.

Construction Phasing.

It is anticipated that the terminal will be developed in several phases. During the initial phase one or two of the 200,000m^3 tanks will be constructed in addition to vaporisation equipment and other facilities. In the initial phase, the normal operating flow rate of gas from the terminal into the gas transmission grid will be approximately 11.3 Sm^3 per day or 400 MMsfd. In the initial phase sufficient capacity will provided to enable a peak regasification and send out of 17 million Sm^3 per day or 600 MMscfd.

It is expected that the construction for the initial phase will commence at the end of 2008, subject to planning and other factors as discussed by my colleague Gordon Shearer. It is envisaged that the terminal will be operational by the end of 2012.

Because of the synergies between the initial and later phases, the extent of additional process equipment required for subsequent phases will be somewhat less than that required for the initial phase. The planning application and the Environmental Impact Statement cover the initial and later phases up to a total of four tanks.

In the future between one and three additional $200{,}000m^3$ for an overall total of up to four may be constructed. Vaporisation equipment and other facilities will be installed to increase the sendout rate to 28.3 million Sm^3 a day or 1 Bscfd per day. To facilitate the phased development, Shannon LNG is seeking a ten year planning permission.

During the construction of the initial phase of the terminal approximately 650 people will be employed on site at peak. While some of the construction personnel will be specialists who will travel from the outside area, it is intended that many of the jobs will be filled by personnel recruited in the region with appropriate training provided as necessary. Economic benefits will arise during this phase in the provision of accommodation and services for construction workers. 16:36

The proposed LNG terminal will require certain permits and consents and Shannon LNG must give certain notices prior to commencement of construction and operation. **Section 1.4** volume 2 of the EIS provides a listing of the major permits needed. 16:36

Decommissioning.

Section 3.12 volume 2 of the EIS addresses general decommissioning issues associated with the proposed development. 16:36

Notification will be provided to the required Irish authorities of any plan to abandon all or part of the Shannon LNG facility. Prior to abandonment of all or part of the LNG facility, an abandonment plan that will include procedures covering decommissioning and site restoration will be submitted to the appropriate authorities. 16:37 16:37

The facility will be designed, built and maintained to operate safely and efficiently throughout its actual life span which is anticipated to be a minimum of at least 50 years. At the end of all or part of the facility's useful life, which will be determined at a future date, it will be decommissioned and the site will be restored in accordance with an abandonment plan that will be developed by Shannon LNG and approved by all applicable Irish regulatory authorities. The plan will incorporate measures to satisfy all regulatory requirements and to achieve targeted environmental goals. All abandonment works will be executed in accordance with a change management plan and with the requirements of ISO 9001.

The extent of decommissioning and restoration may be full or partial and in all cases will be as required by the approved plan. Items to be considered will include the LNG tanks, process equipment, utilities equipment and jetty, ship unloading equipment, seawater intake and discharge structures, all buildings and structures, roads, security fences and the fire water pond.

Decommissioning of the tanks and associated pipe work and process equipment may involve removing all LNG liquid and vapour, warming up to atmospheric temperature, purging with inert gas (nitrogen) and aerating. All hazardous and non-hazardous process substances will be removed from the system prior to progressive dismantling and removal of equipment.

Utilities will be drained of all potential pollutants such as lubricant oils or sealed to prevent leakage if being removed off site for re-use elsewhere.

The LNG unloading equipment may be removed from the jetty, the access trestle and jetty head decks may be removed and the piles extracted or cut below the mud line. The sea water intake and discharge structures may be lifted and floated off site or demolished in situ and removed as appropriate.

Building and structures may be dismantled for use elsewhere or demolished in situ and removed. Roadways may be broken up and removed and security fences and gates dismantled. Unused reinforced concrete foundations may be demolished and removed to below grade level where possible. The pond may be drained and the embankment may be removed to the extent that it will allow the original line of the stream to be re-established and to ensure that there will be no potential for the stream to become blocked. On completion of safe decommissioning of equipment, the domestic and fire water and electrical supplies may be disconnected, removed or abandoned in place.

Salvageable material will be disposed of or reused in other facilities. Solid waste will be disposed of in an approved manner and hazardous waste will be collected and disposed of at an appropriately licensed facility.

Restoration will in principle require that all disturbed areas be landscaped and revegetated in accordance with environmental standards applicable at the time. 16:41

Staffing of Personnel, Operations and Training.

As discussed in **section 3.8** volume 2 of the EIS Shannon LNG will employ about 50 permanent staff, some of whom 16:41 will work in shifts as the plant will be operational 24 hours a day, seven days a week. Additional contract staff and service personnel will be utilised as needed. Personnel will perform the following functions:

16:41

Management and administration; operations; maintenance; marine operations; health, safety security and environment; finance and accounting; sales and marketing.

16:42

Managerial staff will be experienced personnel from the LNG, petroleum, chemical or similar process industries. Operations, maintenance and support staff will be recruited locally to the extent possible prior to or during construction. Staff will be given extensive 16:42 training which will include in-plant training or experience in another operating LNG facility. All key personnel will be trained in the properties of LNG, handling cryogenic fluids, proper operation of all equipment, workplace safety and incident response, including leaks, spills and fires.

The LNG terminal maintenance staff will carry out routine inspections, maintenance and repairs as well as major equipment overhauls, where applicable. Certain major overhauls and maintenance will be handled by contract maintenance personnel. Security personnel, pilots, tug and mooring personnel and catering and cleaning personnel will be provided by third parties. Warehouse personnel may be contract staff. Shannon LNG will operate and maintain the LNG terminal to meet or exceed all applicable Irish and EU regulations. Shannon LNG will prepare, maintain and update a comprehensive set of operations, maintenance, safety and emergency response manuals. All operations and maintenance personnel will be trained in accordance with procedures in these manuals.

After the start of operations, Shannon LNG operating and maintenance personnel will be included in ongoing safety, operations and maintenance training. Operations, maintenance and emergency response procedures and manuals will be subject to regular review and will be updated to reflect the best industry practices or to reflect the addition of new procedures or equipment or other facilities at the terminal.

Fire Safety Certificate.

Fire safety certificates will be required from the Chief Fire Officer of Kerry County Council prior to construction of the facility for each building on the site. Shannon LNG has initiated discussions with the Chief Fire Officer regarding the facility's proposed fire protection systems and preparation of an Emergency Response Plan being implemented for the facility that includes training and firefighting responsibilities taking into account capabilities of both facility personnel and KCC fire department emergency responders. 16:44

I will now address responses to submissions to An Bord Pleanála.

Submission L037 Ballylongford Enterprise Association. *Commenter is relying An Bord Pleanála, the HSA and other regulatory bodies to ensure that all up to date safety procedures, work procedures, secure methods etc. are in place.* 16:45

Submission L009, Geraldine Carmody. *As a local resident as of now I am not entirely satisfied that international best practices for such plants in the area of safety is being applied to the planned Kilcolgan plant. I appreciate further assurances in this area.* 16:45

L024 John Fox. *Safety and environmental systems must* *be of the highest standard. Proper consideration given to health and safety issues. Proper written procedures for dealing with plant operations, emergencies and response training must be agreed and in place.*

16:46

Response: We agree. As stated in my evidence and in the EIS volume 3 section 2 of the EIS, Shannon LNG will repair and maintain operations, maintenance, safety, security and emergency policies and procedures, institute a comprehensive HSE plan at the facility and 16:46 ensure that all personnel are properly trained in those programmes. Also as stated in volume 1 of the EIS near the end of section 2 under the heading Best Available Practices:

16:47

"Best available techniques have been included in the design of the terminal and will be applied in its ongoing operation and control."

Shannon LNG has stated that it will prepare and follow operating manuals in the EIS. Reference EIS volume 2 16:47 page 3-16:

"Shannon LNG will operate and maintain the LNG terminal to meet or exceed all applicable European Union and Irish regulations. Shannon LNG will prepare, maintain and update a comprehensive set of operations, maintenance, safety, and 16:47 emergency response manuals. All operations and maintenance personnel will be trained in accordance with the procedures in these manuals."

Submission L009, Geraldine Carmody. *Also I have* *concerns regarding the levels of pollution emitting from the plant, both air, that is noise, and maritime. I would appreciate further assurances that maximum care be applied should the application be successful to minimising the level of emissions.* 16:48

Response: As stated in volume 1 of the EIS near the end of section 2 under the heading Best Available Practices:

16:48

> "Best available techniques are techniques recommended by the EU for use in designing plants to minimise pollution."

Submission L009, Geraldine Carmody; L018, Tarbert Development Association; L024, John Fox; L025 Ken 16:48 Murphy; L036 Kirbys Lanterns Hotel; L039, Thomas and Mary O'Connell; L040 Eamonn O'Connell. *Up to date technologies, all necessary precautions taken to ensure safety of all. Safety should be ensured inside the plant both during construction and operation and apply* 16:49 *to the immediate locality and a large radius of the surrounding area. Proper written procedures must be in place.*

We agree. As stated in this statement of evidence 16:49 above and in sections 2.1, 3.2 and 4.0 and as described in **sections 1.8, 3.8 and 7.0** of the EIS, Shannon LNG will employ best practices and all applicable national and international regulations and standards in the design, construction, operation and maintenance of the facility.

Submission L054, Kilcolgan Residents Association. *Object to any movement by road of LNG*. 16:50

Response: Shannon LNG has not proposed to move LNG by truck in this application. Refer to section 1.2 of volume 2 of the EIS page 1-2 where it says: 16:50

> "Once the LNG is delivered to the gasification terminal, the liquid will be unloaded into storage tanks, converted back into gas and transmitted via the gas pipeline system or distributed locally as liquid by road truck. (In the case of the Shannon LNG Terminal the gas will be transmitted by pipeline only - a road tanker distribution system is not proposed)." 16:51

Submission L051 Department of Environment. *During construction and operations ensure that a contingency plan is in place to deal with any eventuality of the introduction of petrochemicals from fueling etc. is in* 16:51 *place and made available to the NPWS.*

Response: We agree. As stated in section 1.8 and 7.13 of the EIS, Shannon LNG will develop and implement a comprehensive HSE system which will include handling of 16:51 oil spills during construction and operation. As stated in section 1.8 Shannon LNG will implement an HSE management system which will include setting of objectives and targets, measuring progress, reporting results as a commitment for continual improvement and fostering a culture where incidents are reported and investigated and lessons learned and shared through the organisation. We will use regular audits to ensure that its controls are effective. It will provide 16:52 appropriate health, safety and environmental training and guidelines to employees and contractors to enable them to meet the required standards of performance.

Shannon LNG aims to minimise the health, safety and 16:52 environmental impacts of its activities and prevent pollution by utilising a structured risk management approach, which includes emergency preparedness and contingency planning. All new activities will be assessed for environmental impact and appropriate 16:52 health and safety provision and ongoing activities will be subject to periodic review. Health, safety and environmental protection will be given equal priority to business objectives of the company.

16:53

Shannon LNG is committed to effective communication and consultation on health, safety and environmental management with all interested parties and will make its policies available to them subject to appropriate privacy and business confidentiality protections. 16:53 Shannon LNG will routinely monitor, assess and report on its health, safety and environmental performance with data on the rate of lost time injuries and occupational injuries.

As stated in 7.13.6 surface water and ground water on or adjacent to the site could become contaminated by silt or debris during the construction phase.

16:53

The employment of good construction practices will serve to minimise the risk of pollution of soil, storm water runoff or ground water. The Construction Industry Research and Information Association (CIRIA) in the UK has issued a guidance note on the control and 16:54 management of water pollution from construction sites, "Construction of Water Pollution from Construction Sites, Guidance For Consultants and Contractors". (Masters-Williams et al 2001).

16:54

The construction management of the site will take into account the recommendations of this document to minimise as far as possible the risks of soil, ground water or surface water contamination.

16:54

Submission L054, Kilcolgan resident association. *A detailed ruling must be made on the type of plant (onsite & offsite) must be made including information on early warning systems to all residents within a 12.4 kilometre radius.* 16:54

Response: Shannon LNG will develop an emergency response plan in cooperation with the Kerry County Chief Fire Officer. It will include all notifications as determined in these sessions.

L055. *Clare County question the mitigation measures for uncontrolled emissions venting towards Co. Clare*.

Response: The LNG tank and process plant is equipped with several vent systems which have been described in the EIS in section 3.6.8.4. As described in this section:

> "These systems are designed to safely collect and dispose of boil-off vapours that need to be handled during abnormal events."

There will be no deleterious effects from the operation of these vent systems on the residents of Co. Clare or residents more local to the site, hence no mitigation is required in the event of the operations of these systems.

L003, Adam Kearney Associates; L004, Mary Kelly-Godley; L054, Kilcolgan Residents Association. *Why cannot LNG be buried as is done in South Korea, Japan and Belgium? Tanks are buried in other locations because it is safer.*

Response: The answer to this submission has been addressed in my statement of evidence and has also been addressed in section 2.5.2.6 volume 2 of the EIS. To summarise these: Burying LNG tanks at this site is not feasible.

Submission L054. *Object to tanks being 50.5 metres high. Height of tanks versus level of tanks in the EIS states that tanks are 50.5 metres high but the drawings* 16:57 *show that the top of the tanks are 60.5 metres and the stacks are 70.1 metres high. This is very misleading.*

This was also the subject of oral discussion.

16:57

Response: The EIS describes the height of the tanks and its appurtenances in two different ways. The LNG tank heights are described in terms of their dimensions from their base as well as in terms of their relative height above the Irish land datum OD Malin. The 16:57 submitter's question here is seeking clarification between these two means of describing the tank height. The two numbers do not represent a change in tank dimensions, only in the reference point from which the height is measured. As shown figure 3.14 volume 2 of 16:58 the EIS the tank height measured from its base to the top of the dome is 50.5 metres. As described in section 2.5.2.5 and 2.5.2.6 of the EIS the tank is located on an excavated platform located 10 metres above the Irish land datum "Ordnance Datum Malin Head" 16:58 or OD Malin. Hence the tank height is expressed relative to OD Malin, the number is ten metres higher than the height of the tank as measured from its base. Figure 3.9 volume 2 shows the tank and appurtenances as measured in reference to OD Malin, thus the numbers to the top of the tank dome are correctly shown as 60.5 metres above OD Malin. In summary, both sets of numbers are correct, but measured from different references.

Submission L004 Mary Kelly-Godley and L054 Kilcolgan Residents Association. *Closed loop vaporisation system should be used as it has less environmental impacts. There are alternative vaporisation systems that were ruled out as too costly.*

Response: As discussed in section 2.5.3.6 closed loop vaporisers are not suitable for use in the Shannon Estuary as the build-up of marine organisms onto the exterior surfaces would render the devices inoperable after a short period of time and that would be loss of heat transfer capability from fouling. The example cited by the Kilcolgan Residents Association, the Bayou Casotte Energy project is located in the Gulf of Mexico which has completely different ecology and marine considerations than the Shannon Estuary. The EIS carries out at full comparison of the various systems that were considered and the rationale for the system chosen.

Submission L018 Joan Murphy and L024 John Fox. *Ensure safety systems and controls use best available technology is employed at the site.*

This issue has been addressed in section 3.9 volume 2 of the EIS and I will quote:

"The integrated control and safety system ICSS will be a distributed 17:01 control system that will provide process control, fire and gas detection, event logging and emergency shutdown ESD functions. The functions will be fully integrated in standardised hardware and software will be utilised throughout the system as far as possible. The system is intended the minimise the need for communication gateways or bridges 17:01 between software systems, thus improving system reliability and increasing operational flexibility.

The system chosen will be well proven but of up to date design.

The primary objective of the design of the ICSS is to provide high reliability and availability. The system will 17:02 provide safe, efficient and reliable equipment of proven design. The system will use current technology with modern diagnostic capabilities to increase failure reporting and maintenance requirements."

Submission L056 County Kerry. *All nickel steel used in* 17:02 *construction of gas tanks/pipelines to be independently certified as to nickel concentration and purity and compliance with specs. Summary of results of independent testing of site materials to be supplied to the planning authority on a quarterly basis. Any* 17:02 *digressions from specifications should be highlighted.*

Response: Shannon LNG agrees in principle with this recommendation with the following clarifications and explanations. All nickel steel (9% nickel and stainless steel) is subject to mill certification testing requirements of the applicable fabrication specifications to which it is formed. The mill's certification process involves the accreditation of the 17:03 mill inspectors by an independent body (such as the DMV or Lloyd's Register etc.), that the steels are manufactured as per the particular specification referenced. Regular inspection of the composition and purity of the steel is conducted by certified 17:03 inspectors (who may be either mill employees or third party personnel and accepted by the certifying agency). The documentation is available and can be supplied or a summary to any agency as appropriate.

17:03

Shannon LNG requests that these modifications be adopted in the recommendations of Kerry County Council. In the circumstances we suggest that the relative conditions should read as follows:

17:04

> "All nickel steel used in the construction of LNG tanks and LNG or gas pressure piping to be independently certified as to nickel concentration and purity in compliance to its specification by personnel holding accreditation from recognised third party agencies. Summary of results of the independent testing of site materials to be supplied to the 17:04 planning authority on a quarterly basis. Any digressions from specifications should be highlighted."

Submission L056, County Kerry. *All wells and fabrication of gas tanks or pipelines should be x-rayed* *as to quality and fitness.*

Response: Shannon LNG agrees in principle with this recommendation with the following clarifications and explanation. Shannon LNG agrees with the submitter 17:05 that all wells should be subject to an examination for fitness of service in accordance with the applicable regulatory requirements of the weldments being made. Additionally, Shannon LNG intends that all pressure components of the LNG tank and LNG and natural gas 17:05 piping should be subject to non-destructive testing (NDT testing) in accordance with the applicable standards of the weldments being fabricated. Shannon LNG would like to clarify that not all welds lend themselves to meaningful evaluation by the x-ray 17:05 technique and that some of the weldment types which may be examined by x-ray may be better evaluated by other techniques that are permitted by their construction specification. Shannon LNG intends to perform 100% non-destructive testing on all LNG and natural gas 17:06 pipeline girth welds. Shannon LNG requests that these modifications be adopted in the recommendations of Kerry County Council. The relevant condition could read as follows:

17:06

> "All welds in fabrication of pressure components in the LNG tanks and in the LNG and natural gas piping should be non-destructively tested as to their quality and fitness."

Submission L024, John Fox; L056, County Kerry. *An*

appropriate firefighting appliance and suitably trained
crew shall be provided on site and available at all
times in the event of an emergency. These measures are
to be agreed with the fire authority, fire
commissioning of the plant. The sizes and capabilities 17:07
of the proposed fire water pumps are to be agreed with
the fire authority prior to commissioning of the plant.
The Applicant shall provide and agree with the fire
authority the fire safety measures to be taken during
the construction phase of the plant. A comprehensive 17:07
management system is to be put in place for the safe
operation of the plant.

Response: Shannon LNG agrees. As stated in my
statement of evidence Shannon LNG will have both fixed 17:07
and portable fire protection equipment on site.
Shannon LNG employees will be trained in all emergency
response actions including LNG and natural gas spill,
leak and fire situations. Fire safety certificates
will be required from the Chief Fire Officer of Kerry 17:08
County Council prior to construction of the facility
for each building on the site. Shannon LNG has
initiated discussions with the Chief Fire Officer
regarding the facility's proposed fire protection
systems, training and firefighting responsibilities 17:08
taking into account the capabilities of both the
facility personnel and Kerry County fire department
emergency responders and the preparation of a
comprehensive emergency response plan to be implemented

for the facility and community that includes notification of the public and response to potential instances.

Conclusion. Accordingly I am of the view that the proposed LNG facility can and will be designed, constructed, operated and maintained in accordance with Irish and European laws and regulations in a safe environmental acceptable manner.

Mr. Inspector, I have two other verbal submittals I would like to respond to. One was: *How will LNG of different densities be managed into the land storage tanks.*

Response: As discussed in section 3.6.4 volume 2 of the EIS each LNG storage tank will be provided with tank internals and piping connections so that the LNG can be filled either from above (top fill) or from below (bottom filled) the volume of liquid already in the tank. This will provide operational flexibility to permit the mixing of LNG cargo being unloaded which may be of a different density and/or composition.

The basic procedure is to determine the composition of loaded cargo. From this the LNG density and temperature and composition upon arrival can be predicted. Measurements of the LNG cargo at unloading will confirm these values. This information, along with information on the composition temperature and density of the LNG in the tank, can be used to determine whether to top or bottom fill the cargo being received. To promote mixing it is generally considered desirable to top fill heavier LNG using gravity to promote mixing and to bottom fill lighter LNGs.

Additionally, and described in section 3.9.1 volume 2 of the EIS, specific application software will be used for tank level and roll over monitoring. This type of software which is available from several vendors uses tank level density and temperature measurements made in the liquid column to model and predict mixing behaviour. These systems are used throughout the industry.

The second verbal submission. *Regasified LNG introduced to the Washington Gas Light Company (WGL) distribution system was responsible for leaks that developed subsequently in that system.*

Response: In November 2005 it was alleged in a Federal Energy Regulatory Commission filing by Cove Point LNG that regasified LNG from the Cove Point terminal was the cause of an increase in leaks in its distribution system. The claim triggered a comprehensive investigation and multiple submissions by Washington Gas Light and Cove Point as well as by the supplier of the coupling identified as being the cause of the leaks. In June 2006 FERC issued a certificate for Cove Point to expand its operation and issued its determination dismissing Washington Gas Light's claim. In a June 15, 2006 press release FERC stated:

> "The Commission is convinced that Washington Gas Light's use of hot tar as a method of corrosion protection was a significant contributing factor that resulted in an increase in leak rates through Prince George's County MD."

The Commission said:

> "We find the application of hot tar and the increase in operating pressures on WGL's distribution system were more significant causative factors of leaks experienced in Prince George's County since the reactivation of the Cove Point LNG terminal.
>
> In view of these considerations we find that the claims raised by Washington Gas Light's November 2, 2005 filing provide no basis to deny authorisation requested for the Cove Point expansion project."

Mr. Inspector, that ends my submission.

<u>END OF SUBMISSION OF MR. BOWDOIN TO THE ORAL HEARING</u>

INSPECTOR: Thank you, Mr. Bowdoin.

MR. O'NEILL: The next submission is by Mr. Ian Vinecombe who will deal with design construction and commissioning. I know this is slightly removed from health and safety, but it does form the basis in which a health and safety assessment is then undertaken.

INSPECTOR: Mr. O'Neill, how many more submissions you have?

MR. O'NEILL: I have going to have five, after Mr. Vinecombe I am 17:14
going to have four more submissions.

INSPECTOR: Okay.

MR. O'NEILL: The next submission after that will be safety and design construction and operation of the terminal, then 17:14
marine safety and then the QRA and then the independent assessment of the QRA by Dr. Phani Raj. Subject to your ruling I think it would be preferable. I know it's a long stint of many submissions, but I think it would be more helpful from everyone's point of view if 17:14
the submissions were finished before the questioning started and then the appropriate expert can be identified and questioned.

INSPECTOR: It is just that the Health and Safety Authority wish 17:15
to make a statement sometime tomorrow morning.

MR. O'NEILL: Obviously they can be fitted in at any stage that is convenient to you, Sir.

INSPECTOR: Okay, we will go on with 17:15
your next submission.

MR. VINECOMBE ADDRESSED THE HEARING AS FOLLOWS

MR. VINECOMBE: Mr. Inspector, my name is Ian Vinecombe. I hold a Bachelors Degree in Chemical Engineering from the University of Exeter in the UK, awarded in 1992. I am a Chartered Engineer registered with the Engineering Council of the UK since 2000 and hold full membership of the Institution of Chemical Engineers of the United Kingdom.

I am a Project Engineering Manager working for CB&I UK Ltd. and have worked in this capacity since 2003. Prior to working as an Engineering Manager I was employed as a process engineer for twelve years, seven years of which was spent leading on-project process engineering teams. Whilst employed by CB&I I have worked on three world class LNG Import and Regasification Terminal projects, during both the design and construction phases as well as leading a number of conceptual design studies for new LNG facilities including the LNG terminal development at Shannon. Before joining CB&I UK Ltd. in June 2006, I was employed as a process engineer by Fluor Daniel UK Ltd. and prior that by Snamprogetti UK Ltd., also as a process engineer.

CB&I builds on average more than 500 projects each year and is one of the world's leading engineering, procurement and construction EPC companies specialising in projects in the energy and natural resource industries. With more than 70 proprietary licensed technologies and 1,500 patents and patent applications, CB&I is uniquely position to take projects from conceptual design through technology licensing, engineering and construction and final commissioning. Drawing upon the global expertise and local knowledge of approximately 17,000 employees in more than 80 locations CB&I safely and reliably executes projects world wide.

CB&I specialises the refrigerated liquid gas storage and handling terminals. These applications extend from low temperatures refrigerated system to cryogenic storage and processing applications. Refrigeration is typically used for liquid gas storage terminals handling LPG, propane, propylene, butane, butadiene, anhydrous ammonia and other similar products. Storage terminals for cryogenic products such as LGN and methane, ethylene, ethane, liquid elements of air and other similar products having critical temperatures below normal ambient temperature usually include boil-off handling or reliquefaction process systems. These products are stored at or near atmospheric pressure and are not refrigerated.

CB&I has extensive experience and is a leader in the design and construction of turnkey LNG, LPG and other liquefied gas storage facilities including LNG import, export, transfer and storage terminal facilities. CB&I's turnkey liquid gas storage experience includes: 17:19

Low temperature and cryogenic terminal facilities; Low temperature and cryogenic field erected tanks. The combined total of such facilities is more than 1,000 facilities and tanks. 17:19

The purpose of my evidence is to provide an overview of the preliminary design, construction and commissioning aspects of the LNG storage tanks and the LNG receiving, regasification, vaporisation and export facilities of the Shannon LNG Terminal development specifically: 17:20

LNG storage tanks; processing system vaporisation; alternative vaporisation system evaluation; process support facilities; seawater system; process control and monitoring system; emergency shutdown system; and 17:20 fire and gas detection and protection system.

My involvement in the project.

I have been involved in the Shannon LNG Terminal 17:20 development since January 2007.

I was responsible during the initial design study phase of the project for the leadership of a multidiscipline

CB&I engineering team which contributed the following initial engineering work and assessments for the development including:

Basis of design development; preliminary process design studies; plant layout studies; assessment of a proposed process control and monitoring system; emergency shutdown system and fire and gas detection and protection and system for the Shannon LNG Terminal; assessment of the construction options for the LNG storage tanks and process facilities; assessment of the potential impacts of the process plant/development options during the construction and commissioning phases of the development; recommendations for the mitigation measures necessary to avoid, reduce or remedy any potential adverse environmental effects identified; provision of support to other specialists employed by Shannon LNG covering other aspects of the project development.

The conceptual design work and engineering studies have been performed in accordance with national and/or international standards, codes, regulations and best practices for the design and construction of the LNG facilities.

My team participated predominantly in the development of sections 2, 3 & 7 of the EIS. These sections were prepared in conjunction with many technical experts employed by Shannon LNG in the various disciplines required to conduct a thorough and complete assessment.

Main findings. This section of my brief of evidence addresses the design, construction and commissioning of the LNG facilities, specifically the LNG storage tanks, processing and plant and site buildings.

Design. Sections 1.4, 3.4, 3.5, 3.6 and 3.7 of the development EIS address the generation design overview and details of the proposed development. The initial design of the facilities, specifically in LNG storage tanks and processing facilities, has been undertaken at a level of sufficient detail to allow the potential impacts to the environment to be assessed.

The proposed Shannon LNG Terminal design comprises a number of significant components, specifically:

LNG storage tanks. There will be up to four full containment LNG storage tanks, each with a useable capacity of 200,000m^3;

Process plant. The process plant receives LNG pumped from the LNG storage tanks, vaporises the LNG from a liquid to a gaseous state and conditions the gas for export. The equipment will be located to the south of the storage tanks;

Administration and security building, stores, work shops, various other buildings and utility equipment.

Other areas of design, such as marine facilities design and ground works designs are addressed in the brief of 17:23 evidence of others.

The site layout and scheme description is provided in detail in chapter 3, Site and Scheme Description, of the EIS. It is further illustrated in figures 1.3 and 17:24 3.8of the EIS. The overview and details of the site layout has been covered by the brief of evidence of Mr. Leon Bowdoin of Shannon LNG.

LNG Storage Tank Design. 17:24

Section 3.6.4 of the development EIS addresses the general design overview and details of the initial design of the LNG storage tanks for the proposed development. 17:24

The size of the LNG storage tanks is determined primarily by the throughput capacity of the terminal, the frequency and the size of the LNG ships that would service the terminal and LNG storage capacity which may 17:24 be required to serve peak demands. Up to four 200,000m^3 LNG tanks of the proven, high integrity, above ground full-containment design are proposed for installation on the site.

As can be seen from the EIS figures 3.9 and 3.14, each LNG storage tank will comprise an inner tank and an outer tank. This is known as 'full-containment' as both the inner and the outer tank are independently capable of containing the LNG. Thus, the outer tank will provide 100% back-up in the event of the leakage from the internal tank wall or floor. The inner tank, fabricated out of the 9% nickel steel, will be the primary container for the LNG. The outer tank base will be constructed using a reinforced concrete with the wall being constructed of prestressed concrete. The roof will be constructed using steel and reinforced concrete. The outer tank will be internally lined with a steel vapour barrier, which will be the integrated with a cryogenic quality secondary bottom-thermal corner protection system. The outer tank will also serve to contain the pressure at which the LNG is stored, that being slightly above the atmospheric pressure which is noted slightly later in my evidence.

The insulated tank will be designed to store LNG at a temperature of approximately minus 160. The annulus between the inner and outer tanks, approximately one metre wide, will be filled with perlite insulation material and a fibreglass blanket will be installed on the outside of the inner tank wall. The deck covering the inner tank will be suspended from the roof of the outer tank. The top of the deck will be insulated with fibreglass blanket or rock wool. The bottom of the tank will be insulated from the tank base with foam glass insulating blocks.

This type of tank has been proven in service in many 17:27 facilities around the world. It is been chosen for this project because it complies with the highest standards of safety and because there are tried and tested European design codes for LNG facilities and LNG tanks to which this type of tank complies. 17:27

Each tank will be provided with tank internals and piping connections so that the tank can be filled either above or below the level of the LNG already present in the tank. This capability, which is in 17:27 accordance with recognised proven practices, will provide operational flexibility to permit the mixing of LNG cargoes of different densities.

All piping connections into and out of the tank will be 17:27 through the roof, avoiding any penetrations through the tank walls or floor, therefore eliminating the potential for leakage at such locations. The LNG tanks will be protected and vacuum and overpressure relief devices and will operate at slightly above atmospheric 17:28 pressure. Typical tank operating pressure will be in the 100 to 275 mbar gauge range. These are gauge pressures, that is pressures above atmospheric pressure.

Each tank will be provided initially with three in-tank low pressure LNG send out pumps for transferring the LNG from the tank to the process equipment. These pumps will be installed in the tank wells which allow the pumps to be located at the bottom of the tank while installed from the top of the tank. Provision will be made for the installation of a fourth and fifth pump in the future, to meet the future gas export rate.

The proposed tanks will be located as close as practicable to the LNG jetty at the eastern end of the proposed site. This will minimise the length of the cryogenic LNG pipework.

To minimise the visual impact, Shannon LNG proposes to cut a bench (a flat area) into the side of the hill on the site to lower the base elevation of the tanks as far as practical, to approximately 10 metres OD Malin (above ordnance datum Malin Head). Due to the nature of the ground conditions on the site (predominantly rock below the glacial till at the surface), its proximity to the estuary, and construction and operational complications it would create it is not considered feasible to construct the tanks below ground level, (this is discussed in detail in section 2.5.2.6 of the development EIS) and has been addressed in the brief of evidence of Leon Bowdoin of Shannon LNG.

To further minimise visual impact, the tanks will be of low profile design. They will have a nominal outer diameter of 96 metres and a height at the outer wall of 40 metres. The total height to the top of the domed roof will be 50.5 metres above the adjacent tank grade. 17:30 The chosen diameter and roof tome radius are nominally industry maximums which are in keeping with current technology of historically completed projects. This diameter and roof radius combines to provide the lowest feasible profile for the tanks. 17:30

Process System Design. Section 3.6.5 of the development EIS addresses the general design overview and details of the initial design of the processing system for the proposed development. 17:31

Low Pressure LNG Sendout Pumps.

As detailed in the section 3.6.5.1 of the EIS, three low pressure LNG pumps will be provided in each LNG 17:31 tank. Provision will be made to add two pumps per tank to meet the future gas export rate. LNG from the storage tanks will be pumped to a pressure of approximately 8 barg. The LNG discharge from the low pressure LNG sendout pumps will flow through process 17:31 piping where it will go to either the boil-off gas condenser, the BOG condenser vessel, or to the jetty unloading line for recirculation to keep the line in a cooled down state. During the initial phase at peak send out it is expected that only three of the in-tank LNG pumps will be required to be operating at any one time

Boil-Off Gas BOG Handling.

As detailed in the section 3.6.5.2 of the EIS, the LNG storage tanks will be highly insulated to minimise heat ingress. Since 100% efficient insulation is not achievable, a small amount of heat, often referred to as 'heat leak' will enter the tanks and cause a small portion of the LNG to boil off, be converted from a liquid to a vapour. This resulting gas will be the main contribution to the normal boil-off gas flow rate in the terminal.

During the unloading of a ship, the LNG discharged from the ship will tend to warm up because the pumping energy supplied to the LNG and because of the heat leak into the unloading lines. These factors contribute to the further generation of boil-off gas in the facility. In addition, during ship unloading, natural gas will be physically displaced from the LNG tanks by the incoming LNG. Because of these additional contributions the boil-off rate during ship unloading can be significantly different than that during normal, i.e. no ship unloading periods.

The purpose of the boil-off gas handling system will be to collect the process all of the boil-off gas in a closed system. All boil-off not returned to the ship during ship unloading will be compressed by the BOG compressors and directed to the BOG condenser where it will be absorbed into the LNG or will be used as fuel in the process operation. Initially four low pressure approximately 8 barg discharge pressure BOG compressors will be provided. Up to five BOG compressors will be installed in the final phase. Additionally it is anticipated that a single high pressure compressor will be required to process normal boil-off gas volumes in the event that there is an interruption in gas sendout.

No venting of boil-off gases will occur under normal operations conditions.

Boil-Off Gas Condenser.

As detailed in section 3.6.5.1 of the EIS, the LNG from the low pressure sendout pumps is sent to the BOG condenser either directly or via recirculation of the jetty unloading line. In the BOG condenser boil-off any required nitrogen for gas quality conditioning known as BTU ballasting will be recondensed (absorbed) into the LNG, which will then flow to the suction of the high pressure LNG booster pumps. Initially one BOG condenser will be provided. In the final phase a second BOG condenser may be required to process the volumes of boil-off gas generated from operations and any nitrogen for BTU ballasting of the sendout gas.

High Pressure LNG Booster Pumps. As detailed in section 3.6.5.1 of the EIS, the LNG exiting from the BOG condenser, which will include the absorbed boil-off 17:35 gas and any nitrogen injected will flow to the high pressure LNG booster pumps. The high pressure LNG booster pumps will increase the LNG to a pressure of approximately 100 barg and will discharge into the process piping going into the LNG Shell and Tube 17:36 Vaporisers, STVs. Three high pressure LNG booster pumps will be installed during the initial phase and up to two more in the later phase or phases.

Shell and Tube Vaporisers, STVs. 17:36

As detailed in section 3.6.5.1 of the EIS the pressurised LNG will be vaporised in three Shell and Tube Vaporisers STVs. This process involves converting the LNG back to a gaseous phase and warming to it 17:37 approximately 4 degrees Celsius. This type of vaporiser will be constructed as stainless steel tubes through which the LNG/vaporised gas flows surrounded by an intermediate heating fluid between the tubes and the vessel shell. After leaving the vaporisers the high 17:37 pressure gas, now at sufficient pressure to be introduced into the national gas transmission pipeline system, will be metered and will flow into the pipeline connecting the terminal to the existing natural transmission system.

Process Heating (Vaporisation)

As detailed in section 3.6.5.1 of the EIS, heat for the STVs will be provided by a closed water/monoethylene glycol MEG mixture with a temperature of up to approximately 17 degrees Celsius circulating through the heat exchanger shell. The MEG fluid temperature will be maintained by either heat exchange with sea water in plate and frame heat exchangers or when the sea water is not warm enough by additional heat to the MEG mixture via up to seven gas fired heaters.

The heaters will each be rated for approximately 23 MW and will be equipped with low nitrogen oxide burners.

Alternative Vaporisation System Evaluation.

Section 2.5.3 of the development EIS addresses the studies undertaken into alternative vaporisation systems before the initial design was arrived at.

A number of options were considered by the design team before selecting the proposed vaporisation design. LNG terminals commonly use one of several types of LNG vaporisers: The Seawater Open Rack Vaporiser (ORV), Submerged Combustion Vaporiser (SCV) and Shell and Tube Vaporisers (STV) or a combination thereof.

Open Rack Vaporiser ORV.

An ORV system is designed to extract heat from the sea water and use that heat to vaporise LNG. Sea water quality and the range of sea water temperatures are critical requirements for successful utilisation of an ORV system. 17:40

ORVs were considered for use in this project because they offer several attractive design attributes. They have relatively low environmental impact, produce low greenhouse gas emissions and have relatively lower operating costs than many other schemes. However, ORVs also have a design limitation in that they require a minimum sea water temperature to be feasible. If the sea water is too cold, an ice layer can build up on the tubes resulting in reduced heat transfer from the sea water to the LNG so ORVs have generally only been selected for areas of the world where the sea water temperature can be guaranteed to be above 8 degrees Celsius throughout the year. Whilst the Shannon Estuary remains above 8 degree for much of the year, records show that it can be lower than this minimum threshold for some periods of the winter. Because the water temperature during the winter months in the Shannon Estuary is known to be low as 6 degrees Celsius there is uncertainty about the performance, efficiency and viability of the ORVs during the coldest days of 17:40 17:40 17:41 17:41

the year.

Consideration was given to piping hot sea water from Moneypoint power station. The power station is some 3 kilometres away from the Shannon LNG site on the other side of the estuary so to bring the water to the LNG plant would require a large insulated pipeline to be laid, either on or under the seabed. Whilst technically possible, it was considered that this could have a considerable environmental impact on the estuary, as well as being difficult and extensive to install and operate. The water would need to be pumped which would require considerable electrical horsepower.

Because the power station and the LNG terminal would have to be able to operate independently, some form of supplemental heating would in any case still be required in the event that the power station was shut down temporarily or permanently. The ORV option as a sole means of vaporisation has, therefore, been discounted.

Submerged Combustion Vaporisers (SCV)

An SCV vaporises LNG inside stainless steel tubes immersed in a heated water bath. A portion of the vaporised gas is combusted (burned) in a burner system and the hot products of combustion are bubbled through the water bath thus providing the necessary heat for vaporising natural gas. The SCV can be started quickly and thus provides a good response to load fluctuations. It is also easily controlled over a wide range of operating throughput. These features combine to make it popular for use in both base load and peak shaving 17:43 LNG applications.

As a source of heat SCVs use natural gas as fuel. Thus the SCV option has a higher operating cost than ORV designs, especially if that fuel has significant 17:44 economic value, as it will have in this case. Although they require the combustion of fuel, SCVs have inherent design features that ensure a thermal efficiency approaching 100%. Furthermore, the missions from the SCVs are relatively low compared to other fuels since 17:44 they use clean natural gas for combustion.

One variation on using only fired heat is to introduce hot water into the bath from other sources and to supplement the heat by firing only when the water 17:44 temperature drops. Consideration was given to piping hot sea water from Moneypoint power station on the other side of the estuary. For the reasons noted above this was discounted.

17:44

The combustion gases from the SCVs are discharged to the atmosphere, at a temperature close to ambient temperature, which can give rise to the steam plume under the certain atmospheric conditions.

The SCV option both by direct firing only, or combined with taking hot sea water from the Moneypoint power station are viable schemes, but were not selected due to the impact on the estuary that a large sea water 17:45 pipeline laid on the river bed would have as well as the volumes of greenhouse gases produced as compared to alternative schemes.

Combination of OVRs and SCVs. 17:45

Consideration was given to using ORVs for the summer months and SCVs for the winter months. Because the units operate in entirely different ways, two complete sets of equipment would be needed to process the full 17:46 required sendout capacity of the plant. This scheme is an expensive and inefficient process design option requiring two systems and their requisite capital and operating costs. This option was discounted as a result. 17:46

Shell and Tube Vaporiser Configurations

Shell and Tube Vaporisers are a popular option in the LNG industry for regasification of LNG. STVs come in a 17:46 wide variety of design configurations, but normally employ one of two systems to provide the heat source required. Seawater can be utilised as the heat source similar to the ORV design discussed previously.

Alternatively, an intermediate fluid can be used to exchange the heat between the sea water and the LNG. This is often done to improve the operability and efficiency. One of the benefits of an intermediate fluid STV is that lower sea water temperatures can be utilised to extract useful heat. In this alternative, the heat source for the exchangers is provide by hot water supplied from industrial gas fired heaters. Finally, supplemental heat from the fired heaters or other sources can easily be accommodated into the sea water exchanger design providing a combined solution using both processes in combination.

Because of Shannon LNG's desire to minimise emissions of greenhouse gases to the atmosphere, a system was chosen to extract as much useful heat from the seawater throughout the year as practicable whilst at the same time minimising operation of gas fire heaters and their production of greenhouse gases. A hybrid scheme was developed where heat from the estuary sea water is used to vaporise LNG when sea water temperatures are sufficiently warm and supplementary heat from the natural gas heaters is used when the estuary water temperatures are too cold.

A glycol/water (monoethylene glycol or MEG) mixture is proposed for use as the intermediate fluid at the Shannon LNG Terminal. The MEG mixture is either heated by the sea water in a series of plate and frame heat exchangers or by a series of gas fired heaters or a combination of these heat sources depending on the sea water temperatures. The system offers several operating and environmental advantages. While we estimate it represents a higher capital cost 17:49 alternative to other methods, such as SCV design or simple STV design, it will produce much lower greenhouse gas emissions than for these designs, offers excellent reliability and good process control and turndown capability. In addition, it has lower 17:49 operational costs than a fired natural gas only solution.

Further, the design allows Shannon LNG to capture waste heat from various internal heat generating sources, 17:49 thus improving overall plant thermal efficiency minimising the use of fired heat as the supplemental source of heat to the subsystem. The design, therefore, meets a primary design objective being to minimise as far as possible the impacts on the 17:49 environment.

Other Vaporiser Options Considered.

Three other options were considered for supplying all 17:50 or part of the heat requirements for the regasification of the LNG.

The fourth option was the installation of a small commercial electric power plant with a single cycle gas turbine generator. Heat from the gas turbine exhausts would be extracted and used to provide heat to an SCV water bath or the glycol water loop. These units are less thermally efficient than SCVs alone so their use throughout the year is not attractive because of higher CO_2s. With the glycol water loop because supplemental heating is only required for a few months of the year, the power plant would only be in operation during the winter months and would be a significant incremental investment for only a limited additional electrical supply.

The fifth option considered was to circulate the MEG through a heat exchanger located on the seabed. This design scheme would enable the heat to be extracted from the sea water without the need to circulate sea water through a pumped circuit. However, additional pumping capacity and additional inventory of MEG would be required to operate the scheme. A very large heat exchanger surface area would be required and dispersion and mixing of the cold sea water in contact with the heat exchanger would be limited to natural convection resulting in a large zone of low temperature sea water around the unit. Fouling of the heat exchanger would be virtually impossible to prevent and underwater cleaning would be extremely difficult or impossible to perform. Because of these problems this approach was considered not to be feasible. Consequently this approach was not pursued further.

The sixth option considered was to extract heat from the atmosphere. In some particularly hot climates this has proved to be effective. The Shannon project site does not have the necessary air temperatures during most months of the year to make this process efficient or feasible so this option was not considered further.

Process Support Facilities Design - gas conditioning system.

Section 3.6.8.1 of the development EIS addresses the initial design of the nitrogen generation system to provide any gas conditioning required for the proposed development.

It is anticipated that the LNG will come from a number of different locations each of which will have its own composition. Some compositions of the LNG may not meet all the gas quality requirements specified by Bord Gáis Networks, BGN Code of Operations. In order to bring the vaporised LNG quality to within the BGE specifications, a small volume of inert gas such as nitrogen may need to be added to the send-out gas.

The nitrogen required for this purpose will be generated on site by either the use of cryogenic or membrane type air separation units or other appropriate technology. The nitrogen used will be compressed to a pressure of approximately 8 barg and introduced into the BOG condenser along with the boil-off gas.

Vent System. Section 3.6.8.43 of the development EIS addresses the initial design of the vent collection system for the proposed development.

The vent systems will be designed to collect and safely dispose of boil-off gas vapour that needs to be processed during abnormal conditions when normal boil-off handling using the BOG compressors is either not adequate or the BOG system is not operational. Redundant system, (systems with installed operational back-ups) will be installed and each is described here. During normal operating conditions all gas generated in the processes will be recovered through the BOG system and no venting will occur. Venting of gas is not expected other than in emergency or upset conditions.

The warm gas vent system has been designed and incorporated into the facility layout to release gas safely into the event venting may be required. Additionally a back-up cold gas discretionary vent system will be provided on each tank giving redundant venting capacity should it be required. The warm vent system will be designed to safely handle discharges from the LNG tanks and related low pressure equipment and piping when the pressures in these low pressure systems approaches the tanks relief valve set point which would otherwise would start to operate.

The cold gas vent system will be a redundant tank relief system provided on each LNG tank and will 17:55 operate in the event that the warm boil-off gas system is not available or unable to handle the gas volumes being generated.

The third safeguard on the tanks will be the tank 17:56 overpressure relief valve systems that will be provided on each tank. These pressure relief valves, designed in accordance with applicable regulations, will discharge the maximum volume generated in an upset condition and prevent the tanks from being subjected to 17:56 overpressure.

Any gas released from these systems will not be ignited in a flare.

17:56

Seawater System.

Section 3.6.3 of the development EIS addresses the initial design of the sea water system which supports the proposed vaporisation system. Figure 3.6 of the 17:56 development EIS shows the location of the proposed intake and outfall.

In the LNG vaporising process, the sea water will be circulated through plate frame heat exchangers to exchange heat with the LNG process system intermediate fluid. The sea water circulation system will include an intake and pump house structure and an outlet structure, each situated adjacent to the jetty access trestle. Piping connecting the intake pumps to the plate frame exchangers and back to the discharge structure will be installed along the east side of the trestle. 17:57

17:57

It is intended to install three 4,000 m^3/hr pumps initially to circulate up to 12,000 m^3/hr of sea water for the initial peak LNG vaporisation capacity of 17 million Sm^3 per day, that is 600 MMSCFD peak. With two spare bays for expansion to accommodate two 17:58 additional similar sized pumps to be able to vaporise 28.3 million Sm^3 per day, that is 1BSCFD, the maximum rated capacity of the pumps will in the order of 20,000 m^3/hr, that is 5.6 m^3/s utilising five pumps.

17:58

The jetty pumphouse intake structure will have two 20,000 m^3/hr capacity, that is 5.6 m^3/s, resolving band screens to prevent the debris in the sea water entering the heat exchangers. It will be possible to take one screen out of service while the other screen is in 17:58 operation. The screen mesh will be approximately 3 millimetres by 3 millimetres.

The band screens will be protected by a raked bar

screens. The bar screens will extend across the whole
width of the front of the pumphouse. The material,
primarily seaweed collected from the screens, will be
returned to the estuary. It is expected that any silt
entering the sea water circulating water system will 17:59
remain in suspension and be carried right through the
system.

An electrochlorination unit located at the pump house
will generate sodium hypochloride from sea water for 17:59
injection at a controlled dosage rate into the sea
water circulation system. This will act as a biocide
to reduce and control the level of fouling within the
system. The unit will consist of cells housing
platinised titanium electrodes between which a direct 18:00
current (DC) electric current will flow. The sodium
chloride salts in the sea water passing between the
electrodes will disassociate to form sodium
hypochlorite without the addition of any chemicals. As
it passes through the system and is discharged back 18:00
into the estuary, the hypochlorite will dissipate back
into the sea water from which it is produced.

The proposed water management system, including the
anti-biofouling mechanism proposed, is based on the 18:00
fact that the system is designed to be a cold water
circuit with temperatures somewhat lower than ambient.
This has the double effect of significantly reducing
reaction rates and normal cooling water circuit

bio-fouling where the circuit is elevated in the temperature relative to ambient. However, should more detailed evaluation indicate that further measures such as pulse dosing, which is the most common additional step used in similar circumstances, be required the 18:01 project will be address this in full prior to the application for the IPPC licence as it pertains to an emission related matter exclusively and is subject to direct control under IPPC regulations. At present it is not possible to ascertain accurately what such a 18:01 requirement might be. Any such proposal would be subject to full EPA scrutiny and approval under the pertinent regulations as a separate statutory process.

The pumps and associated equipment will have a weather 18:02 proof structure for protection, maintenance and sound attenuation. The structure will be of sufficient rigidity to withstand exposure to high wind forces.

Up to two outlet pipes will discharge into a concrete 18:02 caisson sited on the east side of the LNG jetty trestle approximately 100 metres sea ward of the pumphouse. Initially, for the 17 million Sm^3 (600 MMSCFD) design case it is anticipated that only one pipe will be required. Ultimately for the 28.3 million Sm^3 per day, 18:03 that is 1BSCFD, maximum output case, an additional pipe will be installed to discharge into the caisson. To limit the environmental impact of discharging treated water into the sea the returned sea water will be discharged into an open basin within the caisson. The presence of light within the basin even in the intensities of only a few percent of full midday sun will significantly affect the mechanism and increase the rate of dissipation of chlorine in seawater.

The discharge ports of the caisson will be at an elevation of between -13 metres and -20 metres relative to OD Malin Head with outset velocities circa 1.5 metres per second directed outward along the jetty trestle axis. The ports will be designed to promote initial dilution without causing a localised jet which could cause scour in front of the outlet structure or affect a berthed ship. Because of the free surface in the outlet box there will be no influence on the pumped water system by variations in head due to tide and wave height.

The sea water discharge outfall location has been confirmed by three dimensional mathematical models (by others) (refer to aqua-fact report appendix 11B of the development EIS) to ensure no adverse environmental or operational impacts will result from the proposed design. Refer to chapter 11 marine and estuarine ecology of the development EIS.

A seawater discharge monitoring system will be provided to ensure that an acceptable chlorination dilution and temperature stabilisation have been achieved.

Other Plant Utility Systems

Section 3.6.10 of the development EIS addresses the initial design of the supporting plant utility systems for the proposed development. 18:05

Diesel powered emergency generation capability will be installed on site to provide power for essential uses in the event of a failure of the site power supply. 18:05

Diesel fuel tanks for both emergency generator and fire water pumps will be stored in bunded areas. The area where the diesel trucks will be parked during refueling operations will also be bunded. Thus, any accidental 18:06 spillage during refilling operations will be contained within the bunded areas.

Nitrogen will be used for purging and inerting of various items of equipment and piping during both 18:06 operation and maintenance activities. Nitrogen for purging and inerting and gas conditioning will be produced in the nitrogen generation plant.

Fuel gas will be needed mainly for the fired heaters, 18:06 and also for certain other minor uses such as domestic heating. The fuel demand will be either met by withdrawing a small stream from the high pressure sendout or by using a portion of the compressed boil off gas or by a combination of the two.

Compressed air for instrument use and for service and maintenance use will be generated on site. 18:07

Buildings. Section 3.6.6 of the development EIS addresses the initial designs of LNG terminal facility buildings.

The terminal will have an administration building, 18:07 process buildings, electrical substations, security buildings, a maintenance warehouse equipment buildings. The administration building will also accommodate a visitor centre. The buildings will be constructed using three main building types. These are: 18:07

All buildings will be type 1 with the exception of electrical substation buildings and administration buildings. These will be steel framed buildings with a combination of concrete strip, raft and piled 18:08 foundations. The walls will consist of a composite PVC Plasticol laminated, insulated vertical and profiled modular steel cladding. The roofs will consist of a composite PVC Plasticol laminated insulated membrane with integral steel supporting decking. 18:08

The electrical substation buildings will be type 2. These buildings will be similar to the type 1 except that the transformer bay walls will be constructed using reinforced concrete with fair finished formwork or similar.

The administration building will be type 3, predominantly masonry and steel frame construction with 18:08 a cut stone and rendered external finish and a zinc roof. The foundations will be a combination of concrete strip, raft and piled.

Process Control and Monitoring. 18:09

Section 3.9 of the development EIS addresses the initial Process Control and Monitoring System.

The plant will be operated from a main control room 18:09 (MCR) which will be located adjacent to the process area. From the MCR it will be possible to monitor and adjust all of the plant equipment and instrument control systems including all safety control systems.

18:09

The process and utility systems will be automated to support centralised monitoring and operations. Local controls to start, stop, or adjust instrumentation set points will be provided where local operations are desired. All actions will be under the supervision of 18:10 MCR operations staff. All critical process operations will be monitored and recorded. An integrated control and safety system (ICSS) will be provided.

It is anticipated that some process equipment will operate with its own control system hardware and software which will be integrated into or interfaced with the main ICSS system.

18:10

Specific application software will be used for tank contents level and density monitoring. Fire protections systems and the facility's emergency shutdown systems. Adjacent to the MCR will be the main equipment room that will house the ICSS main control 18:10 and safety system processing hardware and software.

A ship mooring line tension monitoring system will be installed at the jetty. A jetty monitoring room will monitor the systems at the jetty. The jetty monitoring 18:11 room will house control and safety system processing hardware and software for this system.

Integrated Control and Safety System.

18:11

As detailed in section 3.9.2 of the EIS, the Integrated Control and Safety System, ICSS, will be a distributed control system that will provide process control, fire and gas detection, event logging and emergency shutdown ESD functions. The functions will be fully integrated 18:11 and standardised hardware and software will be utilised throughout the system as far as possible. The system is intended to minimise the need for communication gateways or bridges between software systems thus improving the system reliability and increasing operational flexibility.

The equipment chosen shall be well proven but of an up to date design. 18:12

The primary objective in the design of the ICSS is to provide high reliability and availability. The system will use current technology with modern diagnostic capability to increase failure reporting and reduce 18:12 maintenance requirements.

Dual redundant architecture will be used to avoid common mode failure points and increase availability.

18:12

Alarm Management.

As detailed in section 3.9.3 of the EIS, the alarm system will form an essential part of operational interface with the ICSS. It will provide vital support 18:13 to the operators managing complex systems by warning them of situations that need their attention.

If there are significant disturbances that may push the terminal into the upset state, from which the control 18:13 system is not able to effect a recovery without operator intervention, an alarm or alarms will be provided to enunciate the need for operator intervention and action.

If the upset is not corrected satisfactorily by the operator and the terminal condition approaches a state where the process sup upset cannot be returned to normal operations or where damage or danger to the specific equipment or process can occur, the ESD systems will intervene and suggest down the process affected. The operator's role will be to take complementary action to minimise the size of any process upset, check that the automatic shut down action takes place safely and initiate manual shutdowns or other process equipment or the entire LNG facility if required. The operator will be trained to take the necessary steps to bring the terminal to a safe state. Alarms will be provided to inform of shutdown conditions or other abnormal situations requiring operator action.

Additionally the ICSS will provide for recording of all critical process parameters and the state of all critical operating and valves and equipment.

Emergency Shutdown System.

Section 3.10.1.5 of the development EIS addresses the general design overview and details of the initial emergency shutdown system for the proposed development.

The proposed LNG terminal will have an emergency shutdown EDS systems that will isolate and shut off sources of flammable gas and automatically shut down process equipment. ESD push buttons will be located at various locations through the LNG terminal to manually activate a shutdown of the ship unloading facility or a shutdown of overall LNG nerm original. The ESD could also be activated automatically by the fire and hazard detection system (see section 3.10.1.2 of the development EIS). Upon confirmed detection of a fire or a release of combustible gas, when an ESD is activated audible alarms will be activated throughout the facility and visual alarms will be activated in the main control room and jetty control room. After an ESD normal operations will be suspended until the emergency is resolved.

Fire and Gas Detection and Protection System.

Section 3.10 of the development EIS addresses the initial design of the fire and gas detection and protection system for the proposed development.

Hazard Detection System

As detailed in section 3.10.1.1 of the EIS, a hazard detection system will be provided which will include flammable gas and low temperature detectors to monitor for potentially hazardous conditions arising from LNG spills, gas leaks or fires and to quickly indicate the general location of a release or fire. High temperature, smoke and ultraviolet/infrared flame detectors will be provided to monitor for fire. The integrated hazard detection system will be monitored from the main control room and will affect emergency shutdown via the ESD system in the event that a hazard is detected. 18:17

Detectors will be installed on the storage tank relief valves, the warm gas vent system and the cold gas vents of each LNG storage tank to detect a fire at any of the discharges. Low temperature detectors will be installed in the spill impoundment sumps and spillways to detect the presence of LNG and to prevent the start-up of the storm water discharge system should an accidental release of LNG be defected. Additional low temperature detectors will be installed in the spill collection trenches, process/vaporisation areas, unloading platform, jetty, storage tank roof platform. 18:18 18:18

18:19

Shannon LNG will install a closed-circuit television, (CCTV) monitoring system to provide additional visual monitoring of all the process areas, the LNG storage tanks and ship unloading platform. CCTV monitors will be installed in the guard house and main control room. This system will be used to provide observation of normal operations and visual evidence of LNG releases, fires and/or other emergencies as well as to monitor for site security. 18:19

Hazard Control Sytem.

As detailed in section 3.10.1.2 of the EIS, both passive and active measures for hazard prevention or 18:19 control will be incorporated into the design of the LNG terminal. Passive measures will be designed to prevent or minimise a hazard and will include spill impoundment systems, ignition source control and fireproofing. Active fire protection control measures will be 18:20 implemented in the event of a release of LNG or a fire and will include the following firefighting systems and equipment:

An underground fire water system; local high expansion 18:20 foam systems; portable, wheeled and skid pointed dry chemical units will be placed strategically throughout the process areas and jetty for fire fighting capability; a dry chemical extinguishment and/or nitrogen gas snuffing system will be located on the 18:20 pressure relief valves and cold vents on the LNG storage tanks and the warm vent discharge to extinguish a potential fire.

Fire Protection 18:21

As detailed in the section 3.10.1.3 of the EIS, the LNG terminal will be designed and constructed so as to minimise the possibility of a loss of containment of flammable or hazardous substances. In the unlikely event that an LNG leak does occur, the spill will be channelled to a secondary containment structure to minimise both the liquid surface area and the size of any vapour cloud. Flammable gas and fire detection 18:21 systems will be installed throughout the facility where leaks or spills or fires could potentially occur. A fire water system will be installed in the on shore terminal. The fire water system will consist of fire water pumps, a 600 mm 24 inch diameter approximate ring 18:22 main to serve hydrants, hose line cabinets, fire monitors and other fire water needs of the facility. The pond constructed within the site will provide the fresh water supply for fire fighting. Additionally, the terminal will install high expansion foam systems 18:22 at spill containment sumps to mitigate and control vapour generation or radiant heat flux levels. The design of the spill containment sumps has been addressed in the brief of evidence of Leon Bowdoin of Shannon LNG. 18:23

Portable fire fighting extinguishers and emergency response equipment will be also provided for first aid firefighting and for support of energy response personnel. 18:23

Construction. Section 7 of the development EIS addresses the general construction issues associated with the proposed development. The initial design of the facilities has been undertaken at a sufficient level of sufficient detail to allow the potential impacts of the construction phase to be assessed. My brief of evidence covers the construction aspects of the LNG facilities for three specific areas of work: 18:23

LNG storage tank construction; installation and erection of process utility equipment, piping and instrumentation; construction of buildings and site landscaping. 18:24

Site construction will follow a traditional sequence consistent with LNG industry practices:

Earthworks and site preparation will be the early focus 18:24 of activities commercing with site set-up, access roads, bulk earthworks to create the various benches, graded areas, for the LNG tanks process equipment and building foundations. These construction aspects are covered in the brief of evidence of Eoghan Lynch of 18:24 Arup.

Marine works will comprise the construction of the LNG jetty, mooring dolphins and associated equipment and the materials jetty. These construction aspects are 18:24 covered in the brief of evidence of Blair MacIntyre of Poten Partners.

Drainage system and power, instrumentation conduits will be installed along the placement of concrete foundations for the LNG tanks, process equipment and the terminal buildings.

The erection of LNG storage tanks and steel structures and associated buildings will follow. 18:25

Later stages of the initial phase will see the installation of major mechanical and electrical equipment, instrumentation and process piping. 18:25

Final stages of the initial phase will see the fit-out and completion the buildings, completion of site access roads and landscaping.

18:25

The facilities will then be ready for testing and commissioning prior to the facilities commencing operations.

The overall construction duration for the first phase of the development is covered in the brief of evidence of Eoghan Lynch of Arup. 18:25

Construction Safety.

18:25

As required by the Irish regulations, a Health and Safety Plan will be prepared which will address health and safety issues from the design stages through to the completion of the construction and maintenance phases.

This plan will be reviewed as the development progresses. The contents of the Health and Safety Plan will comply with the requirements of the Safety, Health and Welfare at Work (Construction Regulations) 2001-2006.

Safety on site will be of paramount importance. During the selection of the relevant main construction contractor and the respective sub-contractors their safety records will be investigated. Only contractors with the highest safety standards will be permitted to bid on construction work.

Prior to working on site, each individual will receive a full safety briefing and will be provided with all the safety equipment relevant to the tasks the individual will be required to perform during his employment on site.

Safety briefings will be held regularly and prior to any onerous or special task 'toolbox talks' will be held to ensure all workers are fully aware of the tasks to be undertaken and the parameters required to ensure that the task will be successfully and safely completed.

All visitors will be required to wear PPE (personal protective equipment) prior to going on to the site and will undergo a safety briefing by a member of the site

safety team.
Regular site safety audits will be carried out throughout the construction programme to ensure that the rules and regulations established for the site are complied with at all times.

At any time that a potentially unsafe practice is observed the Site Safety Manager has the right as well as the responsibility to halt the work in question, until a safe system of working is again put in place.

LNG Storage Tank Construction.

The LNG storage tanks will comprise a tank of 9% nickel steel housed within a second tank of reinforced concrete with a steel vapour barrier liner. The concrete outer tank, which will be constructed first, and will be post-tensioned, i.e. have a prestressed wall. The tank foundations will be a mat, slab or pad type of reinforced concrete. Piling is not expected as the existing grade will provide the necessary supporting capacity without piling.

Construction of the LNG tanks is specialist work. Shannon LNG will permit only contractors with a proven track record of constructing these types of tanks in a safe and timely manner to bid on this phase of the construction.

Typically the construction of the LNG tanks will begin with the placing of the reinforced concrete foundations. After the foundation has gained sufficient strength, the construction of the reinforced concrete walls will begin. The walls may be constructed using a slip form technique with approximately 1.5 metre of vertical wall height completed per day. The slip-form operation, if used, will continue for up to 30 days, without interruption for each tank. 18:29 18:29

The steel dome roof of the tank will then be fabricated within the concrete tank. The roof will be constructed from steel plates and will be a fully welded structure. Once the roof is complete it will be the raised using high performance fans and upon reaching the top it will be securely fastened to a steel collar preinstalled at the top of the concrete outer wall. A steel liner will then be welded to embedments on the inside of the concrete outer wall to form a vapour barrier. 18:29 18:30

On top of the steel roof an outer concrete roof will be poured in situ. The steel liner will be an integral part of the composite roof, as it will be connected to the concrete with preinstalled shear connection studs, the roof will be constructed with openings to allow the pipe and pumps to be fitted within the tank. 18:30

On completion of the concrete roof, the 9% nickel steel inner tank will be fabricated inside the concrete tank. The inner steel tank will be of fully welded fabrication and will be mostly welded using an automatic welding technique. The area below the secondary tank bottom and the foundation will be 18:31 insulated with high density foam glass blocks.

The tank will be hydrotested by filling it with fresh water from the pond to approximately 5/8ths its depth. This test usually takes about 28 days which includes 18:31 filling, emptying and cleaning. The annulus between the inner steel tank and the outer steel membrane will then be filled with the fibber glass blanket and then filled with the perlite insulation and the deck blanket insulation will be installed. 18:32

The in-tank pumps and risers and associate piping and equipment and instrumentation installation will commence after placement of the concrete roof. This work will be on-going until after the hydrostatic test. 18:32

The tank will next be ready for nitrogen purging and commissioning.

Process Plant and Equipment Construction. 18:32

Consideration will be given to the modularisation of some of the facilities, standardisation of components and prefabrication of equipment in order to reduce on-site construction time and to minimise local disruption during the construction phase.

The prime objectives will be to maintain the highest safety standards, to achieve high quality and productivity and to minimise work at height and scaffolding requirements.

Prefabrication works will generally be carried out at the various vendor/supplier facility. Consideration will be given to:

Skid mounting the vessels; skid mounting pumps; predressing vessels (that is equipping them with pipes, valves and electrical/instruments); preassembling vents in transportable sections; prefabricating and preinsulating piping for the jetty and on-shore pipework; prefabricating pipe racks; delivering equipment paint and finish-coated; prepackaging assembled process heaters and heat exchangers.

Structural Steel Pipe Rack and Pipe Supports

Extensive structural steel pipe racks and supports will be required to carry the piping from the unloading arms at the jetty head to the storage tanks and from the tanks to the process areas. Details of the anticipated major structures are included as elevation drawings in the planning application and are shown on the cross section drawings.

Building Construction

The building types, as noted above, will be constructed in accordance with the normal good practice.

Equipment for Construction on-Shore.

As detailed in the EIS section 7.3.7 typically the construction equipment would include compressors, mobile cranes, tower cranes and generators, hoists and gantries and various types of excavators, loaders, trucks trailers advance etc.

Other equipment required will include a concrete batching plant, a rock crusher and screening plant, diesel fuel tanks, gas storage cages, electric power supply, mechanical repair shops etc.

A number of tower cranes and a second concrete batching plant will be required for the erection of the LNG tanks, hard standings will be required for these.

Fuel will be required for the diesel power plant and equipment. To minimise the numbers of fuel deliveries, one or more sizeable diesel fuel tanks will be installed on site to contain the fuel for the diesel powered plant. These will be strategically located on a concrete plinth and will be bunded.

Commissioning

Section 7.11 of the development EIS addresses the general commissioning phase issues of the proposed development.

The initial design of the facilities has been undertaken at a level of sufficient detail to allow the potential impacts of the commissioning phase to be assessed.

Following completion of construction and installation of equipment, and before the terminal commences operations, there will be a testing and commissioning phase. This phase will comprise:

Installation compliance checks; precommissioning activities; commissioning tests; pre start-up safety audit; cool down of ring main, tanks and process systems; performance demonstration tests.

Installation Compliance Checks

This will be a process of systematically checking that all systems and equipment have been constructed, assembled aligned and installed correctly, in accordance with the design specifications and drawings and that all interconnecting pipe work cabling and wiring has been installed in compliance with the design specifications and drawings.

Pre-Commissioning of Systems 16:44

After the various systems are constructed and the installation checks completed, these systems will be subject to pre-commissioning activities.

16:44

Pre-commissioning is defined as an activity or a group of activities that are performed for the cleaning, testing and excitation of each equipment item and system to verify the manual, automatic and sequence controls and interfaces. 16:45

All electrical and instrumentation systems will be checked, process and utilities lines cleaned mechanically or by blowing, flushing etc. to verify cleanliness of each systems to prepare the 16:45 equipment/systems for further tests to ensure that each system complies with its design functional intent.

Commissioning Tests

16:45

The function of each item of equipment and each system will be tested and verified in a systematic manner, as being in accordance with the design and specifications. All the alarm and control systems and instrumentation will be tested to demonstrate that they are functioning correctly. Following these tests each system will be checked to ensure that it is ready to be commissioned under operating conditions including using real process fluids, temperatures, pressure and voltages.

Pre Start-Up Safety Audit

Prior to the admission of hydrocarbons into the facility an audit will be conducted to ensure that all systems are ready for commissioning and start-up.

Cool Down of Ring Main, Tanks and Process Systems

The piping between the LNG unloading arms and the storage tanks will be progressively cooled down using either nitrogen or LNG vapour from the LNG tanker ship to the required temperature and checked for leaks as the piping cools down. This will be followed by the cool down of the LNG tanks to the required temperature by either introducing nitrogen or LNG into the tanks and the eventual filling of the tanks. This operation will be carried out over a period of approximately one week. Following cool down of the initial LNG storage tank, the process facility will be cooled down, using LNG from the storage tanks.

Performance Demonstration Tests

In the start-up phase the individual items of equipment and systems will be operated using the normal process fluids and temperatures, pressure and voltages monitored for various pieces of equipment and systems.

An operations/performance test shall be conducted when all parts of the facility are at design conditions. Satisfactory completion of these tests will confirm that the design intent of the facility can be achieved.

The terminal's safety and fire prevention systems and the emissions monitoring systems will be subject to the same rigorous testing protocols as the other systems in the plant.

Commissioning Phase Impacts

The impacts on the environment from the installation compliance and commissioning tests will be insignificant. In the performance test phase, the impacts will be similar in nature, but smaller in scale than the impacts from the terminal in full operation.

Response to submissions to An Bord Pleanála

A number of LNG storage tank and process facilities design, construction and commissioning related submissions have been made to An Bord Pleanála. In several instances the same issue was raised in a number of submissions. The following, where appropriate, combines and paraphrases the issues, and provides Shannon LNG's response.

Submission: A number of submissions have raised an issue that the selected vaporisation scheme may not be the most appropriate environmentally and some suggest the selection may have been driven purely by economic considerations. This was raised in submissions L002 by Kathleen Kelly; L003 Adam Kearney Associates; L004, Mary Kelly-Godley; L014, Chloe Griffin; L034, Morgan Heaphy and L054, Kilcolgan Residents Association.

Response: Shannon LNG completely disagree with these suggestions. Any potential vaporisation scheme will have some form of environmental impact. The studies undertaken have assessed the estimated impacts and have been used to develop the design for the facility. The primary criteria for evaluation was a desire to have as low an overall environmental impact as practical but not choosing one set of impacts at the expense of all others. Clearly the use of sea water as a warming medium allows greenhouse gas emissions to be minimised, but sea water was only selected after the extensive impact studies had been completed and the impacts were judged to be insignificant. The environmental impact of the sea water usage at the facility is addressed until the brief of evidence of others. Having established a preferred technical solution with minimal environmental impact, Shannon LNG next sought to cost optimise the design. It is, therefore, both unfair and incorrect to suggest cost rather than environmental considerations were the primary driver for selection of the proposed vaporisation scheme. Indeed, the cost to install the sea water system exceeds the cost to construct a solely gas fired vaporisation system. Shannon LNG have, to the best of their ability, selected the most appropriate vaporisation scheme for the location of the terminal.

Submission: The HAZOP study is not available and this was raised in submission L054 by the Kilcolgan Residents Association.

A HAZOP study, which is an industry abbreviation for Hazard and Operability study, is one of a number of techniques used during the design phase of a project to assess the potential hazards and operaability issues associated with the design of a process facility. The HAZOP study is only part of a programme of safety, environmental and operability controls and reviews employed on a well executed project. The design work undertaken to date in definition of Shannon LNG Terminal has yet to reach the appropriate stage for a HAZOP study to be conducted. This study requiring a detailed design which can be analysed using formal HAZOP techniques. A HAZOP will be undertaken at the appropriate phase of the development.

Submission: All vehicles leaving the construction areas of the site shall pass through the wheel wash, this was raised in submission the KCC report. 17:57

The response is that is agreed.

Submission: Proposed condition - all tank and drum storage areas on the sites shall as a minimum be bunded 17:58 to a volume not less than greater of the following (a) 110% of the capacity of the largest tank or drum within the bunded area or (b) 25% of the total volume of substances which could be stored within the bunded areas. 17:58

All fuel storage areas and cleaning areas, particularly for concrete trucks, shall be rendered impervious to the stored or cleaned materials and shall be constructed to ensure no discharge from the areas. 17:58

The response is agreed. However, in certain circumstances double wall tanks will be used in reference to bunding.

17:58

Submission: Proposed condition - the developer shall main on the sites for the duration of the construction period, oil abatement kits comprising of booms and absorbent materials. The precise nature and extent of the kits shall be agreed in writing with the planning authority prior to commencement of development. This was raised by Kerry County Council.

The response is agreed.

Submission: Proposed condition - wash out of concrete mixers shall be contained and properly disposed of. Again raised in submission KCC report. The response from Shannon LNG is agreed.

Submission: Proposed condition - powered compressors shall utilise sound attenuation, raised in the Kerry County Council report. The Shannon LNG response is agreed.

Submission: Proposed condition - concrete used in the construction of the tanks, foundations etc. should be independently tested and a summary of results highlighting any problems encountered and remedial measures taken forwarded to Kerry County Council and the Health and Safety Executive on a quarterly basis raised in submission KCC report.

Shannon's response is agreed.

Submission: Proposed condition - the size and capacities of the proposed fire water pumps are to be agreed with the fire authority prior to commissioning of the plant. Raised by Kerry County Council. Shannon LNG's response is agreed.

Submission: Proposed condition - the Applicant shall provide and agree with the fire authority the fire safety measures to be taken during the construction phase of the plant. Raised by Kerry County Council in their report. Shannon LNG's response is agreed. 18:00

Conclusion 18:01

The design work undertaken in support of the proposed development has been completed in line with international best practices. The design work has studied and assessed alternatives to arrive at a proposed plant and facilities which, in outline, is the best solution for developing an LNG import facility at the Shannon site. The design work has applied national and international codes and standards as well as good engineering practices having been completed by competent and professional engineers well experienced in the design of world class, safe and environmental conscious LNG facilities. 18:01 18:01

The initial design of the facilities has been undertaken at a level of sufficient detail to allow the potential impacts of the construction and commissioning phase of the development to be assessed. The construction and commissioning impacts have been 18:01

assessed by competent and professional construction personnel well experienced in the safe and environmentally conscious construction of world class LNG facilities.

Accordingly, I am of the view that the potential impacts of the proposed LNG terminal development as presented in the development EIS are accurate given the commitment by Shannon LNG to employ competent and well experienced engineering and construction contractors to develop the facility.

That's my submission.

END OF SUBMISSION OF MR. VINECOMBE

INSPECTOR: Thank you, Mr. Vinecombe. Mr. O'Neill, I am a bit doubtful about the value of reading lengthily from reports such as these which to an extent duplicate what is in the EIS and also in this case duplicated a lot said by the previous speaker so maybe you could adopt a more focussed approach tomorrow.

MR. O'NEILL: Yes. Most of the statements are in reasonably final form, but perhaps if we could take areas that have been covered by other speakers or indeed in the EIS, perhaps it could be taken as read and we can deal with that as we go along, but I will pass on the message.

INSPECTOR: I appreciate that.

MR. O'NEILL: It is taking a long time certainly to go through the statements and I do appreciate you sitting a little bit late this evening to finish this statement. 18:34

INSPECTOR: Right. Sorry, you wish to make a brief statement?

MR. McELLIGOTT: Yes, it's a quick comment as well. We are listening to that for the last two hours. It is just that they are slipping in a few comments here and there that are not in the EIS. Like everything should have been accepted as read and it has made a few people leave now that couldn't actually ask the questions so there is a tactic going on there too which is boring us to death. They are the experts, they should know, you had already written that it was supposed to be accepted as read so we object to that. 18:34 18:35

INSPECTOR: Okay. 18:35

MR. O'NEILL: There is no tactic of the type suggested by Mr. McElligott and he knows that is incorrect.

MR. McELLIGOTT: Eileen O'Connor just wants to ask one question. 18:35

INSPECTOR: Sorry, I can't hear you.

MR. McELLIGOTT: Eileen O'Connor wants to ask one question because she has been waiting for the last two hours to ask.

INSPECTOR: Okay.

25 Q. **MS. O'CONNOR:** In section 3.9 page 19 of Leon Bowdoin's statement he states that Shannon LNG accepts responsibility for the health and safety and security of the facility for employees, contractors and visitors, so I want to ask Mr. Bowdoin would he consider it appropriate, as the person in charge of health and safety and security, would he consider it appropriate to have myself and my children and my husband John O'Connor, vets, agents for the Department of Agriculture, traversing the site while it is under construction and forevermore while it is in operation? If we are will we be required to wear the personal protection equipment and to go through the wheel wash etc. Partly that question is for Shannon Development. 18:35 18:36 18:36

MR. BOWDOIN: I believe your question raises the issue of the existence of a right of way across the property and the use of the right of way if it does exist. Let me address it in two ways: If there is a right of way that does exist, and that issue has been raised but I think unresolved at this point, there will be an appropriate pathway made that will avoid the construction areas of the facility and again that is subject to the right of way being shown to be in existence. 18:37 18:37

To answer the second half of the question which was would you be permitted or your family be permitted to walk freely upon the areas of the construction of the site, all persons, visitors, employees, guests will be required to comply with all of the health and safety requirements while they would be on the active areas of 18:38 the LNG site.

MS. O'CONNOR: In response I would like to say that if we were given a right of way we would presume that it would not be through a construction area as that would not be 18:38 acceptable to us and I think that you are presuming agreement, an agreement which has not even been started. Also it has been stated that construction will begin by the end of 2008, I am not presuming any agreement will be forthcoming before then. It should 18:39 not be presumed that an agreement will be forthcoming.

MR. O'NEILL: Perhaps I can deal with that, Sir. That is something that has been raised and it has been suggested that this issue in relation to the right of 18:39 way of which Shannon LNG don't have any knowledge is something that has to be resolved with Shannon Development. The position is clear legally, if the right of way exists it has to be respected and of course it will be respected. In circumstances where 18:39 there would be any interference, temporary interference with that right of way an appropriate path getting from the first point to the second point; in other words, where the right of way leads of course will be provided. Clearly that will be provided in circumstances where it didn't interfere with the construction or indeed expose the users of the right of way to any unnecessary risks.

INSPECTOR: Mr. McElligott. 18:40

MR. McELLIGOTT: Yes. There was a pre-consultation meeting between Shannon LNG and An Bord Pleanála and there are two versions of the minutes of that meeting. The first version of the minutes are the minutes that An Bord Pleanála took down and the second version of the minutes are the requested amendments by Shannon LNG to amend the minutes of the meeting. The An Bord Pleanála version said: 18:40

> "The prospective Applicant explained the ownership issue. See the rectangle outlined on page 5 of the display board's booklet and stated this area is owned by a local person." 18:40

After the meeting it came back and they asked it to be changed to: 18:41

> "Is claimed to be owned by a local person."

Now, we feel that the real minutes were what was actually said and that what the amendments that were requested to be changed were requested on legal advice so we are saying that that was already an admission of total ownership by somebody else, but now they know the consequences of that land being owned by somebody else. 18:41

Thank you.

INSPECTOR: Do you want to say anything on that?

MR. O'NEILL: I don't know if any response is needed to that. 18:41 The reality of the matter and the position has been clear from day one -- first, the ownership issue. As I understand it Shannon Development do not claim to be the owners of this 1.8 acres of land, somebody else has to be the owners. Who they are is not of great 18:41 significance, it's an ownership outside the ownership of Shannon LNG and obviously Shannon Development. What we have been talking about, however, is a right of way presumably leading from some public area to the lands in question, that's a different matter altogether and 18:42 I am not sure if that was addressed at the meetings. The issue in relation to the different versions of the notes, or memos of the meetings, is something I think that has been addressed already by the Board.

MR. McELLIGOTT: It is becoming like 18:42 Lesotho in the middle of South Africa, it is surrounded by the site so they say they can do what they like inside in the site, but it is completely surrounded.

MR. O'NEILL: I think that would come 18:42 better from the owner of the lands rather than Mr. McElligott.

MS. O'CONNOR: May I speak. I think Shannon Development should give a response at this stage. They have made no contact with us for 18 months. We have attended all the public consultation meetings and we have spoken to Shannon Development and Shannon LNG representatives and we have been referred to An Bord Pleanála and to 18:43 Shannon Development and we have had no contact with Shannon Development and I am wondering if Shannon Development would care to comment at this point.

MR. MORAN: If I may. My colleague has gone away, but I will tell 18:43 you what I do know about it. My name is Ogie Moran, sorry, Shannon Development. The land that we have optioned to LNG, we own all of that land ourselves. I think the land that Ms. O'Connor is referring to is a right of way that may go through our land and I think, 18:43 I understand I could be wrong on this, I think you have written to Shannon Development through your solicitor claiming a right of way through that and I think that they are looking for you to provide evidence of that right of way, I could be wrong on that, but that's my 18:43 understanding of it, that you have written to us, they have written to us claiming a right of way and we have responded back saying there is no evidence on that.

MR. O'CONNOR: I am landlocked [Inaudible]. 18:44

MR. MORAN: The land that you own yourself is your own business, I suppose, the land we own, we have optioned our land to LNG and only our land.

MR. O'CONNOR: We have a right of way down through it.

MR. MORAN: As far as I know we have no evidence of that.

MR. O'CONNOR: We are [Inaudible]. 18:44

MR. MORAN: If you produce the evidence.

INSPECTOR: I think we need to terminate this discussion now. It has been indicated by the Applicants that if a 18:44 right of way exists it will be maintained in some reasonable form so can we conclude matters for this evening and we will meet again at 10 o'clock tomorrow morning. Thank you, everybody.

18:44

THE HEARING WAS ADJOURNED TO THURSDAY, JANUARY 24TH 2008 AT 10:00 A.M.

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