Site Drainage Systems and Containment
Witness Statement of Dr Nigel Peters to the Corrib Hearing

Personal Introduction and Experience

1. My name is Dr. Nigel Peters. I have worked in Shell as a Senior Consultant in the HSE (Health, Safety, Environment) Consultancy Group since 2005. Prior to joining Shell I gained my Doctorate in Physical Geography, and subsequently was a Director of Environmental Consultancy Services Ltd which I helped establish in 1985, based in Aberdeen, Scotland. My work experience has included special interest in the environmental performance of offshore and onshore oil and gas facilities, and since 2001, the application of the Integrated Pollution Prevention Control (IPPC) Directive to the oil and gas sector, and in particular the area of site drainage and containment.

2. In 1991-92 I prepared Integrated Pollution Control (IPC) permit applications for the oil terminal at Flotta, Orkney, the BP Forties oil pipeline reception facility at Cruden Bay, Aberdeenshire, and the Amoco gas terminal at Bacton, UK. These were submitted to comply with the UK’s Environment Protection Act (1990), which introduced the Integrated Pollution & Control (IPC) regime, a precursor to the IPPC (Integrated Pollution Prevention Control Directive) that now applies to the Corrib Terminal.

3. More recently, between 2002-2004 I managed the first IPPC permit application in the UK oil and gas sector for the Goldeneye Project at the St. Fergus Gas Terminal in Scotland, and was part of the team that prepared the IPPC application in 2005-2006 for Shell’s Bacton Gas Plant in Norfolk.

4. My primary role with the Corrib Project has been to assist in the preparation of responses to the EPA’s Requests for Information, dealing particularly with site drainage and containment issues.
Introduction

This document has been prepared in response to a number of objections raised against the Proposed Determination of Shell E&P Irelands Limited IPPC licence application to the EPA that refer to the potential for the water environment, including the vicinity of the outfall to sea and Carrowmore Lake, to be affected by contaminants in effluent and drainage from the Terminal at Bellanaboy Bridge.

Objections have been raised concerning the following issues:

(1) The use of firefighting foam containing PFOS and zinc and the potential impact on the environment that this could have if contaminated firewater, which could also include PAHs (polycyclic aromatic hydrocarbons), was permitted to be discharged from the site.

- Objection example from William Walker, 15th February 2007, states the following:

  There is no doubt that two of the likely contaminants of firewater (i.e. zinc and PAHs) show acute and chronic toxicity to aquatic life, and are able to bio accumulate in some organisms. Furthermore, recent discoveries (Ankley et al, 2005; Sanderson et al., 2004; Boudreau et al., 2003a&b) have shown that the common foam ingredient PFOS is persistent, bio accumulative and toxic to fish and crustaceans". (Quoted from a report commissioned from Prof Matthiessen)

(2) Concern for the quality of Carrowmore Lake due to its importance to regional water supply and its ecological and conservation status, arising from water discharges from the site.

- Objection example from Edward Moran, 19th February 2007, includes the following:

  The current proposed licence adds to the cumulative threat by permitting water from the site, which may well be contaminated, to flow into the lake
The refinery site drains into the Ballinaboy River and then into Carrowmore Lake which is the drinking water supply for 10,000 people. It is also a designated site and very important for tourism and fishing. No less than five protected sites, all within two kilometres of this refinery will be subjected to pollution.

My intention is therefore to address these concerns and explain how the design and planned way of operating the Terminal takes appropriate account of them.

I have also distributed copies of a number of plans and drawings included as Appendices B and C of SEPIL's submissions on Objections to the proposed determination submitted to the EPA on 10 April 2007. The drawings of the catchment area plans were also included in SEPIL's response of 13 June 2005 to the EPA's request for further information of 7th February 2005.

I will first address the issue raised by William Walker in his objection in relation to firewater runoff, and then move on to the concerns expressed by Sean McDonnell and other objectors about Terminal water effluent and drainage in relation to Carrowmore Lake.

Response to (1)

I acknowledge the observations made by Professor Matthiessen in his report entitled “Predicted effects on local fisheries of the proposed produced water discharge from the Corrib gas field, Republic of Ireland”, dated January 2007, regarding the acute and chronic toxicity of fire fighting foams, and of the potential for the creation of PAH’s during fires; Shell has been aware of the importance of specifying foam that minimises potential environmental impact in the event of its use in the Terminal.

As outlined in SEPIL’s submission of 10 April 2007, the Angus Fire foam that will be used at the Terminal is not formulated with the PFOS (perfluoro-octanyl sulphonate) component, nor with zinc. PFOS has conventionally been required in firefighting...
foam to guarantee the safest and most effective firefighting performance in facilities, such as the Terminal, where both liquid hydrocarbon (condensate) and industrial alcohol (methanol) are present. Its manufacture, by 3M, has ceased since 2000. The necessary firefighting performance that PFOS provided in this type of situation is now provided by a replacement fluorosurfactant, as indicated in the Material Safety Data Sheet that formed Appendix A of SEPI’s submission on objections to the Proposed Determination submitted to the EPA on 10 April 2007. There is no fire fighting foam on the market that can duplicate the performance that the use of fluorine based chemistry provides. It is however recognised that this newer fluorosurfactant has similar properties to PFOS that lead to its persistence and bioaccumulation in the environment.

The short term, or acute, eco-toxicity of the foam has been independently tested, and the results are given in the Material Safety Data Sheet. This shows that for all the test exposure periods, the test organisms had an LC50(96hr) (which is the concentration at which 50% mortality observed after 96 hour exposure) or EC50(48hr) (which is the concentration at which some specific effect, usually mortality, is observed after 48 hours exposure) values that are no lower, respectively, than 3300ppm (parts per million), or a 0.3% solution, for rainbow trout, and 9800ppm (or a 0.98% solution) for water flea, respectively.

The lower the LC50 or EC50 value, the more toxic the substance, as it means that less of the substance is needed to cause death, (in the case of LC50), of half the test organisms.

The values that have been obtained from the Angus Fire foam can be compared with the internationally accepted OECD (Organisation for Economic Co-operation and Development) acute aquatic toxicity rating for chemicals. This states that substances with a LC50 (96hr) for fish, or EC50 (48hr) for crustaceans (such as water flea) of less than 0.1 milligramme per litre (mg/l) are classed as Acute I (which can be considered as highly toxic). Values between 1 and 10 mg/l are classed as Acute II (which can be considered as toxic), and between 10 and 100 mg/l as Acute III (which can considered as harmful). Milligrammes per litre are equivalent to parts per million (ppm).
Therefore substances that have either LC50 (96hr) for fish, or EC50 (48hr) for crustaceans greater than 100mg/l are considered by the OECD rating to be less than "harmful" in the aquatic environment. The Angus Fire foam is therefore almost 30 to 100 times below this threshold value for acute aquatic toxicity.

It is fully recognised therefore that the primary concern with these types of firefighting foam is not so much their potential for short term impact on the environment, but the potential for impacts due to persistence and bio-accumulation.

The Project has therefore always recognised that the uncontrolled discharge of untreated foam-contaminated firewater from the Terminal would be unacceptable. The prevention of such a discharge has been a significant factor in the design of the site drainage systems, which I will deal with next.

As the fire fighting foam is provided for emergency situations at the Terminal, its is expected that its use would be very infrequent. In the event that it is used, the drainage system is designed so that contaminated firewater will not leave the site through the drains systems. On this basis the risk that it presents can be considered to be as low as reasonably practicable.

Response to (2)

The Terminal’s bulk storage and drainage systems have been designed to minimise the risk of potential pollutants entering the environment in runoff from the site. This has been achieved by having:

- Appropriate containment for bulk storage of potential harmful substances
- Segregated drainage system and treatment facilities

Containment

Bulk liquid chemical and hydrocarbon storage tanks at the Terminal will be bunded to contain at least 110% of the volume of the largest single tank in each bunded area.
The bulk storage area is located at the northwest of the Terminal, and comprises three separate bunded areas. The largest holds the three “raw” methanol tanks, each of which has a maximum design capacity of approximately 1,430 cubic metres. These will contain a 35% methanol : 65% water mixture that has been returned from offshore in the pipeline. The raw methanol is routed to the methanol still in which through distillation the methanol is separated from the water component, when it is termed “product” methanol.

The other two bulk storage areas are located in the plot immediately to the east, one for two product methanol storage tanks, the other for three condensate tanks. The product methanol tanks each have a maximum design capacity of approximately 550 cubic metres, and will contain a 98% methanol solution. Of the three condensate tanks, two are for product condensate, which has been produced with the gas, and one is an off-specification condensate tank. These tanks each have a maximum design capacity of approximately 750 cubic metres.

The concrete bund walls are specified to withstand the extreme event of a tank failure, and the 110% sizing of the bund capacity is designed to allow for a blanket of foam to be deployed over the surface of a spill that results from the failure of a tank. The foam deployment may be either during the event of fire inside the bund, or to minimise the risk of fire from unignited liquid contained within the bund.

The bund wall heights have also been designed to contain the “slop” effect that can occur in the event of a tank failure.

To enhance the integrity of the bunds, the base of the tanks are underlain with an impervious layer of bitumen. Under tank leak detection has been designed to provide early warning so that investigation of a suspected leak can be carried out, and appropriate repairs and remediation carried out to minimise the duration and scale of the leak, and to prevent potential escalation.

Rainwater that collects in the bunds will be removed by portable pumps, or drained through valves exterior to the bund walls into the Open Drains Sump. To maintain the spill containment integrity of the bund, these valves are Normally Closed and locked. The Terminal’s Permit to Work procedure will cover the operation of these valves. At a minimum, the state of the bunds’ contents will be checked by Operators on a daily
basis and also during rainfall events. Gross contamination of the surface of any water, or a spill on the bund floor, will be dealt with by the use of absorbent materials, which would then be disposed of as hazardous waste. After removal of gross contamination, the remaining water would be evacuated from the bund into the Open Drains system which I describe in more detail below, and ultimately into the Terminal’s water treatment system, as described in section 2.5.8 of the EIS and section F.1.2 of the IPPC Application.

Dedicated bunds are also provided for individual storage tanks containing diesel fuel, the tri-ethylene glycol heating medium, and methanol still acid wash tank. These tanks have maximum design capacities of approximately 100, 80, and 14 cubic metres respectively.

Dosing, injection and cleaning chemicals will be stored in small quantities and any spillage will be contained locally in bunding or drip trays for re-use or disposal. Any other potential sources of spillage (e.g. pumps, sample points, level gauges, etc.) will be provided with local shelter and collection trays, sumps or interceptors as appropriate.

Segregated Drains Systems and Water Treatment

There are two fundamental types of drains in the Terminal design. A description of their design and function has been provided in section 2.5.1 of the EIS and A.3.2 of the IPPC Application.

Closed Drains System

The Closed Drains system, which are not open to atmosphere, are integral components of the process, and are designed to “drain” fluids from one process vessel to another. This is a fully welded carbon steel system, which is provided with a “cathodic protection” system. This involves bonding “sacrificial anodes” to the drains, which are then protected from corrosion because the anode is more reactive than the steel. Man-ways are installed at each anode location to allow inspection of the anodes. Additional corrosion prevention in underground sections is provided by the application of an epoxy coating and a protective wrap.
Open Drains System

Rainwater runoff generated within areas of the Terminal where materials are stored, used or processed that could cause contamination during Terminal operations is collected in the Open Drains System that convey it to the onsite waste Water Treatment Plant. Figure 1 (Appendix B of 10 April 2007 submission) shows the Open Drains System in schematic form.

In addition to the rainwater collected within the bulk storage tank bunds, which has been mentioned earlier, these drains also serve the following paved areas:

- Main process area
- Slugcatcher area
- Waste storage facilities
- Road tanker access roads
- Road tanker unloading/loading bays
- Firewater retention pond

Figure 2, entitled “Catchment Areas Plan” (Appendix C of 10 April 2007 submission, comprising 2 sheets, and also submitted in SEPIL’s response dated 13 June 2005 to the EPA’s RFI of 7th February 2005) shows the extent of the paved areas served by the Open Drains System. The hatched areas, predominantly comprising the bulk storage tank areas, and the firewater retention pond located on the east of the Terminal are controlled drainage areas. I described bund drainage arrangements earlier. An outlet from the firewater retention pond is also fitted with a Normally Closed and locked valve that when opened permits discharges into the Open Drains system. Under normal operations, the firewater retention pond would be expected only to accumulate rainwater that requires periodic draining.

The speckled areas are those where drainage from paved areas flows unimpeded into the Open Drains System under gravity into the Open Drains Sump.
The Open Drains System is a fully piped system that is open to the atmosphere at points of entry and in collection sumps. It is a spigot and socket jointed system with acrylonitrile butadiene rubber (NBR) joint-ring seal. Pipes up to 300mm diameter are ductile iron pipe, in accordance with BS598, and are internally and externally epoxy coated for corrosion protection. Larger pipes are in reinforced concrete, according to BS5911, and also use NBR seals.

The runoff from all the areas served by the Open Drains System is treated in dedicated facilities within the Water Treatment Plant, as described in section 2.5.11 of the EIS and section A.3.2 of the IPPC Application. Here a Tilted Plate Separator will provide primary removal of any trace hydrocarbons droplets, and the clarified effluent is then passed through a multimedia filter for polishing, followed by passage through an Ultra-Filtration (UF) unit.

The treated effluent from the Open Drains System is then discharged through the outfall located 2 km north of Erris Head in almost 70 metres water depth. The treated effluent will be subject to monitoring to ensure compliance with the IPPC licence.

A dedicated Klargester petrol/oil interceptor serves the car park near the entrance of the Terminal. The car park is paved, and all surface water is routed into the Klargester unit. A bar drain across the entrance of the carpark that drains into the main Surface Water Drains system ensures that drainage from car park and from the main access road is segregated, and therefore removes the risk of a spill in either area extending into the other.

Clean Surface Water System

Section 2.5.11 of the EIS has described the Clean Surface Water System. This caters for drainage from the remainder of the Terminal, and includes rainwater from buildings roofs, from paved areas such as walkways and paths between offices and other buildings, and roadways that are not used for tanker access. These areas therefore do not include potential pollutant sources, and are therefore considered to be non-hazardous areas for drainage. Open ditches collect this water from drains along the roadways, and the roofwater flows are collected in a piped network. The Clean Surface Water System is show schematically in Figure 3 (see Appendix B of SEPIL’s 10 April 2007 submission).
These runoff sources are fed into the third main drainage system, which is the subsurface perimeter drainage system. This is designed to control the level of the groundwater below the site.

The combined flow from the non-hazardous areas and the groundwater is discharged into a pair of Settlement Ponds that are located to the southwest of the Terminal. Oil skimmers are incorporated into the Settlement Ponds as a precautionary measure to ensure any accidental discharges that occur (e.g. from vehicular leaks) are contained.

The settlement ponds will allow suspended solids to settle out from the surface water. The outflow from the Settlement Ponds is via the discharge point SW2 on the R314 road drainage ditch (referred to as Drain 16 or D16). This drain (D16) feeds into the Muingingaun River which is a tributary of the Bellanaboy River which ultimately discharges into Carrowmore Lake.

As there are no operational or maintenance activities that take place within the catchment of the Clean Surface Water System, only an exceptional event could result in their contamination. However, the particular water supply, ecological and conservation status of Carrowmore Lake, has justified the inclusion of a further level of environmental protection within the Terminal drainage system. An inline Emergency Holding Tank (EHT) has been designed so that in the event of contamination in any of the four arms of the Clean Surface Water System, the flow is held in the EHT and pumps are actuated to divert the contaminated water back to the firewater retention pond. While this is being pumped back for treatment, drainage from the 3 unaffected arms of the system can continue to flow through the EHT and on into the settlement ponds.

A Total Carbon analyser will be used to continuously monitor the flow from each of the 4 arms of the system into the EHT and will provide a 2 minute response time. This provides the most precautionary approach to potential contamination, as both hydrocarbons and organic chemical, such as methanol would be rapidly detected. An elevated TC value will result in automatic activation of the diversion valve, which will close within 30 seconds, and subsequent re-routing of the contaminated stream to the contaminated firewater retention pond. Under very low flow conditions, the retained water can also be removed by gully sucker. A separate continuous on-line
analyser will monitor Total Organic Carbon in the flow into the EHT to comply with the Condition 6.14.2 of the Proposed Determination requiring online TOC metering in this discharge stream.

**Firewater Management**

The sizing of the firewater runoff control system has been based on a worst case scenario fire involving one of the condensate tanks. Although it is recognised that methanol is highly flammable, the intensity of the condensate fire would be greater. Therefore the design sizing for the condensate tank fire would also be adequate for a methanol fire.

A key requirement for firewater runoff management at the Terminal is that contaminated firewater must not be unintentionally discharged offsite through the site’s drainage systems.

This requires that there is sufficient firewater retention capacity, pump sizing and drains capacity to cater for the amount of water that would be deployed in the event of a condensate tank fire occurring at the same time as a worst case reference rainfall event.

The EPA Draft Guidance on Fire-water Retention Facilities (LC-10) has been used as a design reference, and has been deviated from only when the Project has required more stringent specifications. The most significant deviation is that the Project has specified a maximum daily rainfall of 67.8mm over 24 hours, compared to the 50mm over 24 hours in the LC-10.

The deluge water application rate and duration for the condensate tank fire is based on National Fire Protection Association Standard 15, "Standard for Water Spray Fixed Systems for Fire Protection", which was referred to in our response of 13th June 2005 to the EPA’s RFI of 7th February 2005. The firewater retention facility has therefore been sized accordingly, with an additional 10% capacity contingency.

To ensure that firewater deployed within the bunds is contained and returned to the firewater retention facility, a weir system has been designed within each bund to direct firewater to the Open Drains system once it reaches the 110% level. Dedicated
firewater return pipes sized to keep up with the deluge rate transfer the firewater from the overspill side of the weir into the Open Drains Sump. Appropriately sized pumps within the Open Drains Sump operate to transfer the firewater into the contaminated firewater retention pond.

Conclusion

The design measures described above, together with the proposed monitoring and control measures and the application of relevant operational procedures, will provide robust effluent and drainage management at the Terminal. Consequently the potential for contaminated water from the Terminal to reach Carrowmore Lake and to cause measurable negative impact is minimal.
Isolation Valve on gravity drain. Normally closed.

Surface Water from Emergency Holding Tank if contamination detected.

T-3001 a/b
T-3002
T-4001 A/B/C
T-4002 A/B
T-4003
T-5001
T-8803

Main Tank Bunds:

Isolation Valves (Normally closed)

Waste Storage / Admin Roads & N. Access Rd

Access Road South

Pumped return from main entrance.

Process Area (Inc Compressor Bldg Roof)

Slug Catcher Area

Drainage Schematic – Open Drains System

Used Firewater Pond.

Overflow Pump.

Waste Water Treatment Plant.

Pumped return from main entrance.

Contaminants to filter cake disposal.

Used Firewater Pond.

Treated Produced Water to Outfall.

Oil returned to process

Contaminants to filter cake disposal.

Pumps.

Overflow Pump.

Used Firewater Pond.

Treated Produced Water to Outfall.

Pumped return from main entrance.

Contaminants to filter cake disposal.

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Drainage Schematic - Surface Water Drains System