

**Statutory Assessment of Pipeline Design re:
Application for Consent to Construct a Pipeline
(Section 40 of the Gas Act, 1976, as amended)**

Corrib Onshore Gas Pipeline

Application for Consent to Construct

Statement by:

Peter Waite

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On behalf of

**Department of Communications, Energy and Natural
Resources**

Statement

Qualifications of the Author

My name is Peter Waite. I am Technical Director at Entec UK Limited and lead the Risk and Safety team

I am a Chartered Engineer with 29 years experience of world wide consulting on safety and risks from oil and gas installations, including pipelines. I have advised oil and gas companies, state and local governments as well as landowners and developers of land in the vicinity of installations and pipelines. I have advised on safety, and assessed the risks at Pipeline landfalls and associated terminals in the UK, Australia, Middle East and Europe. I was a member of the Institution of Gas Engineers (IGE) working party revising edition 3 of the High Pressure Pipeline Design Code TD/1. I am a registered Safety Professional and Environment Professional with the Institution of Chemical Engineers (IChemE). I have contributed to IChemE training packages and guidance on risk assessment and safety.

I am also a Member of the Institution of Gas Engineers and Managers, a Fellow of the Institute of Mathematics, a former founding Fellow of the Institute of Risk Management and former member of the Oil and Petrochemical Risk Association.

I have assessed risks from pipelines including work for Bord Gáis (BGE), National Grid (formerly Transco), Statoil, SABIC, BP, Amoco and also for Development Corporations with “Major Hazard Pipelines” in the UK.

Purpose

This statement has been produced for the purpose of describing the Statutory Assessment of the Corrib pipeline design documentation accompanying the Application for Consent to Construct a Pipeline (Dated 30th May 2010) in accordance with Section 40 of the Gas Act, 1976, as amended.

Approach Adopted

I am undertaking a review (together with my team) of the Application for Consent to Construct (May 2010) and the accompanying documentation (principally the Corrib Onshore Pipeline Environmental Impact Statement, Volume 1 and Technical Appendices Volume 2, in particular Appendices M and Q) against industry practice, codes, standards and other regulators’ criteria. I have sought additional comments from colleagues specialising in pipeline design and those familiar with tunnelling projects and slope stability issues.

Additional information and clarifications have been requested from Shell Exploration and Production Ireland Limited (SEPIL) on some matters.

Scope of the Review

The review is required to examine the Section 40 submission (and accompanying EIS and other documents), review previous concerns and identify any new issues that may have significant impacts on safety and the local environment.

Against each of the identified issues Entec will list how the proposed pipeline design addresses the concerns whether by avoidance or mitigation; finally Entec will note its opinion on the adequacy of the proposed solution.

The issues were grouped under four headings in the scope and although there is some cross over between these areas, they are listed individually below:

Pipeline Integrity Management Scheme

Integrity Management includes all the processes by which the operator should ensure that the pipeline will not release any of its contents by having adequate procedures throughout the pipeline life-cycle, from specification and design, through construction, installation, commissioning, operation, modification to decommissioning.

The submissions demonstrate that SEPIL have a scheme which has:

- a specification and design that provides an onshore pipeline of greater strength and resilience than required by codes and standards by means of the pipe wall thickness, materials of construction and a pressure control system to ensure that the increased factor of safety is maintained;
- systems to protect against external corrosion and damage (although further details of the design of stream and debris channel crossings have been requested);
- a process of monitoring the pipeline and route to avoid or detect any damage before it gives rise to leaks which meets or exceed industry standards;

The submissions have not provided details of:

- third party verification of the reliability of the pressure control system;
- safety management systems procedures for control of modifications (management of change, control of work) which will need to be in place before operations;
- specific procedures for testing of isolation valves and emergency shut down valves although the test frequency has been given;
- the response to any defects detected in the pipeline within the tunnel after installation;
- the detailed design of slab protection at the minor water crossings, particularly those that could be debris channels and verification of their construction on adequate supporting strata;

This information has been requested and needs to be available and in conformance with good industry standards before the Department advises that Permits can be issued.

Quantified Risk Assessment

The Quantified Risk Assessment (QRA) is the analysis that presents the likelihood of major accidents arising from leaks in the pipeline together with the effects that they might have and compares them with the regulators' criteria or other standards of safety. The QRA should state clearly the assumptions that have been made in calculating the risks and therefore enable interested parties to identify the key features of the design, construction, operation, monitoring, testing, maintenance activities and equipment that are required to keep the risks within the required criteria.

The submission includes a Quantitative Risk Assessment that has been carried out in more detail than is normal for pipeline risk assessments. In particular it incorporates site specific hazards. The likelihood of some of these has been assessed as so low that it does not have any effect on the analysis, in particular external damage where protection against the hazard is provided. This can be justified where the design of the protection and its construction can be verified.

The QRA demonstrates that the safety risks from the pipeline are extremely low and well within the "broadly acceptable" region of published criteria even in the open near the pipeline. The separation between pipeline and dwellings fulfils the criteria set by ABP. The sensitivity analysis demonstrates that these are robust conclusions.

Landfall Valve Installation Design Overview

The Landfall Valve Installation (LVI) is a key component in the pressure control system to ensure that the pressure in the downstream, onshore pipeline does not exceed the Maximum Allowable Operating Pressure (MAOP) of 100 barg. Note that this does not imply that a leak will occur if the pressure control system fails because the pipeline is designed to withstand the test pressure of 504barg, but the pressure control is designed as a mitigation measure to reduce both the likelihood of a leak and the consequences of a leak should it occur. The pressure control system has been designed as a very high reliability system and SEPIL state that this reliability has been independently verified by an accredited body, although this verification has not yet been submitted.

The LVI provides one of the two major sets of pressure control. There are also valves offshore in the wells, well heads and flow lines that also provide a high reliability pressure control and shutdown system. The LVI provides a further, independent high reliability system of pressure control and shut down.

Although the LVI was introduced as a safety system it does increase risk (over and above the pipeline risk) in its immediate vicinity because of the presence of additional equipment (pipework, valves and instrument connections). There is therefore a trade off between the risk very close to the LVI and the reduction in risk downstream along the remainder of the

pipeline. However the QRA has shown that the area of risk above the broadly acceptable level is limited to less than 100 metres and even under worst case sensitivity analysis, the outer zone for land use planning restrictions would extend only to 132 metres from the LVI. The LVI equipment is provided with additional protection beyond that normally provided at gas pipeline Above Ground Installations (AGIs).

SEPIL have provided a justification of the design based on the availability of high reliability isolation valves which are capable of allowing the passage of pipeline inspection tools (PIGs). Given these concerns then the design of the facility represents the minimum level of equipment necessary to provide the highest level of reliability and allow for maintenance and testing. The installation allows for testing and maintenance including, the replacement of the shut-down valves to ensure that its reliability can be sustained.

Corrib Pipeline Design Basis

The pipeline design is based on the requirements of Irish and International Standards. It has followed the advice of the Technical Advisory Group, supported by analysis of codes by reputable international design companies, to combine aspects from different standards so that the most rigorous requirements have been applied.

The pipeline design parameters (wall thickness and material of construction) are such that it would meet the requirements of the codes and standards at a design pressure of 345 barg (the maximum well head shut in pressure). The proposed maximum allowable operating pressure and high reliability pressure control systems introduce a further “factor of safety” and reduction in maximum hazard distances.

Other Issues

In the course of the review the following issues have been identified concerning the construction of the tunnel:

- A) The ground conditions in the sediments and bedrock beneath Sruwaddacon Bay had not been determined in detail along the proposed tunnel alignment at the time of submission of the EIS; therefore there was some uncertainty over the requirement for the Tunnel Boring Machine (TBM) to cope with the interface between sediments (sand and gravels) and the hard bedrock, together with the presence of hard rock inclusions or compressible layers which may influence the tunnel stability. The results of the detailed surveys will seek to enable verification that the tunnel can be driven through relatively consistent sand and gravel sediments and that the rock is within the specification of the TBM. Details about control of over mining, air pressure, bentonite slurry and grout have been requested to ensure that loss of control leading to adverse impacts cannot occur.

[The material in the Addendum submitted to the Oral Hearing provides further information and assurance that the sand and gravel layer is continuous along the main part of the proposed route beneath Sruwaddacon Bay.]

- B) Concerns have been expressed as to whether vibrations from tunnelling could trigger further land slips on Dooncarton Mountain. Although there will be vibrations, these are predicted to be much less than those from heavy traffic at the dwellings along the road and several orders of magnitude lower than those which are stated to give rise to potential instability. Presentation of an analysis of the conditions under which slips are possible together with the results of monitoring during the borehole drilling investigations would provide additional assurance.

Conclusions to Date

The pipeline design and its route are acceptable on the basis of the ABP proposed risk criteria and all other similar criteria used internationally. The QRA upon which these conclusions are founded is acceptable and includes sensitivity analysis to show the conclusions are robust.

The Pipeline Integrity Management System covers the elements required for construction but requires further development for the operation and decommissioning phases, as would be expected at this, pre-construction stage. Some further evidence has been requested to support claims made in the submissions or demonstrate that satisfactory verification has been carried out.

The Landfall Valve Installation is capable of providing a high reliability means of pressure control and emergency shut down. The QRA of the LVI is conservative and demonstrates that it imposes a low level of risk to the surrounding area and a worst case accident hazard no greater than the pipeline.

The pressure control system for both offshore and onshore pipelines is enhanced by the link from the terminal pressure sensors to the offshore manifold and well shut down systems. The automatic shut down of several valves in series by alternative systems (electrical and hydraulic) provides additional integrity.

The current proposal to place the pipeline in a tunnel beneath Sruwaddacon Bay satisfies distance separation criteria but raises some questions of feasibility and possible unwanted impacts if problems arise during tunnelling. Additional information has been requested in order to assess the significance of these.

The outstanding matters include:

1. Details of verification of pressure protection system reliability.
2. Identification of TBM suppliers who have met similar specifications previously and contractors who have successfully completed tunnels in similar ground conditions. (This is part of the on-going tendering process for the construction work).
3. Demonstration that surface intervention during tunnelling (involving constructing an access chamber in Sruwaddacon Bay) is a low probability event based on more certain knowledge of the ground conditions. The likelihood of surface intervention

being required decreases as the number of boreholes and other investigations increase the density of information available.

4. Details of the assurance scheme for construction of concrete slab protection at water course and potential debris channel crossings.
5. Clear demonstration that continuous vibration from tunnelling will not induce instability on the face of Dooncarton Mountain.

Other minor matters require clarification but would not constitute reasons for withholding a permit to construct. Further information would be required before issuing a permit to operate but this is a normal approach in Safety Case Regimes where there are two separate stages of submissions, pre-construction and pre-commissioning.