

ENSREG/ONR Stress Test Submission Neptune Licensed Site Executive Summary

This report presents a summary of the stress testing of the Neptune Licensed Site at Rolls-Royce Raynesway Derby, required by the ENSREG/ONR stress test requirements. The site has been assessed against a selection of challenging performance requirements. A brief description of the site is provided.

The strategy and approach adopted in performing the stress tests are discussed. The report summarises the capabilities and performance of the site and its facilities against a range of potential extreme events. The specific extreme events addressed are earthquake, flooding, snow and wind loading, fire/explosion and complete loss of all off-site power supplies.

The resilience of the site against the selected potential extreme events and combinations of events is summarised. It has been concluded that there are no areas where significant off-site consequences could arise from combinations of these events with the exception of some combinations of beyond design basis events (very severe earthquake and flooding).

The report indicates that a number of recommendations have been made to consider actions to be taken to enhance the emergency response capability.

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1 Introduction and Scope

1.1.1 Rolls-Royce Marine Power Operations Limited (RRMPOL) in Derby, Derbyshire, carries out the manufacture of nuclear fuel for UK Naval Nuclear Propulsion Programme. They also operate a low energy naval research reactor (Neptune). This submission in response to the ENSREG / ONR stress tests (Reference 1) considers only the Neptune licensed site.

1.1.2 The Neptune site exists to support the UK Naval Nuclear programme, and as such details relating to its operations are subject to limited disclosure in the interests of national security. This report is a summary of detailed work conducted by the licensee.

1.1.3 The Neptune site comprises a low power test reactor and two associated facilities. The licensed site was constructed in the 1960s, and whilst it was not designed with external hazard resistance in mind, it has been shown in recent assessment to be robust to these challenges.

2 Approach

2.1.1 The operations at the Neptune site have been subject to systematic examination against the ENSREG / ONR stress test requirements. The performance of facilities and emergency arrangements against progressive increases in challenge has been considered, including:

- a) Earthquake;
- b) Flooding;
- c) Post Earthquake Flood;
- d) Prolonged Loss of Off-Site Power.

2.1.2 In addition to these, the screening exercise included reviewing the applicability of other single events, and combinations of events, which include:

- a) Snow / Wind Loading;
- b) Fire;
- c) Earthquake with Snowfall;
- d) Earthquake with Fire.

2.1.3 The effect of these events on the safety functional objectives specified in the ENSREG / ONR stress tests specification was examined, with the exception of the safety function associated with need for an ultimate heat sink, as a low power reactor has no decay heat removal requirement.

3 Performance of the Facilities

3.1 Earthquake

Design Basis

3.1.1 Buildings and equipment on the Neptune site are qualified against earthquakes where the potential for significant consequences could arise. The site design basis earthquake has been established at 0.25 g pga, which is equivalent to a 1×10^{-4} per annum event. This design basis event level is consistent with the ONR's Safety Assessment Principles (both 1992 and 2006 versions).

Evaluation of the Margins

3.1.2 The site has also been examined for more onerous events and shown to remain safe; for areas where off-site consequences could arise, the performance in

response to earthquakes has been examined both for the design basis level, and for the Seismic Margins Event (design basis loading plus 40%).

3.1.3 In the event of a beyond design basis earthquake concurrent with flooding of the site there is a potential for consequences at the site boundary.

3.2 Flooding

Design Basis

3.2.1 The Rolls-Royce Derby site is located in Derbyshire more than 50km from the coast. Flooding from seaward inundation can be readily dismissed as a concern.

3.2.2 The site is located on the floodplain of the River Derwent. The site is protected by flood defences which offer resistance to site flooding for river flows up to the 1 in 100 year event. Potential causes of flooding on the site are from the River Derwent, failure of dams on the River Amber and River Derwent upstream of the site and heavy rainfall.

Evaluation of the Margins

3.2.3 The most recent flooding assessment identifies that the site is resilient to a 1 in 100 year flooding event. Additionally, arrangements are in place for the Environment Agency and Severn Trent to supply the site with early warning of extreme flood events. In the event of such a flood warning being received operations would be suspended.

3.3 Other Extreme Natural Events

Wind/Snow

3.3.1 The robust earthquake performance of the reactor building subjectively implies that there will be reasonable resistance to snow and wind loadings. Other buildings are not expected to have robust withstand against very extreme events, however consequences of failures will be negligible.

Fire/Explosion

3.3.2 The reactor building has adequate resistance against credible external fires and explosions, including following a design basis earthquake. Such events will not cause any off-site consequences.

Earthquake and Snow

3.3.3 The consequences of post earthquake snowfall are bounded by those of post earthquake flood; although the potential for off-site consequences is lower than for flooding.

3.4 Loss of Electrical Power

3.4.1 The Neptune facilities are not susceptible to prolonged loss of off-site or on-site power. The site possesses backup power supply capabilities; there is, however, no dependence on these backups to prevent any consequences.

4 Severe Accident Management

4.1.1 Some enhancements in equipment, facilities and infrastructure have been proposed to ensure effective resilience of emergency response capability for extreme events (particularly for flooding and severe earthquakes)..

5 Key Findings

5.1.1 Opportunities for improvement have been identified with regards to performance against the stress test conditions where the potential for off-site consequences could arise. Recommendations have been made to enhance the licensed site.

6 Glossary/Abbreviations

AOD Above Ordnance Datum
ENSREG European Nuclear Safety Regulators Group
ONR Office for Nuclear Regulation
RRMPOL Rolls-Royce Marine Power Operations Limited

7 References

1. Declaration of ENSREG, Annex I, EU “Stress Tests” Specification