Ministry of Defence

Vulcan Naval Reactor Test Establishment (NRTE)

Report of Assessment of the Hazard Identification and Risk Evaluation

Radiation (Emergency Preparedness & Public Information) Regulations
Regulation 6 & Schedule 5

1. INTRODUCTION

The Radiation (Emergency Preparedness and Public Information) Regulations 2001 require a Hazard Identification and Risk Evaluation (HIRE) be undertaken for any premises containing more than the quantity of radioactive material specified in the Regulations. This document is the Report of Assessment of the HIRE of the Vulcan Naval Reactor Test Establishment (Vulcan NRTE). The Report of Assessment, together with such supporting information as deemed necessary by the Health and Safety Executive (HSE), is provided to enable the HSE to assess the risk to the health or safety of persons who could be affected by the work with ionising radiation undertaken at Vulcan NRTE.

NOTE : Some sections of this report of assessment necessarily contain information in an abbreviated form and with limited technical detail. This has been done in the interests of national defence and public security and with the agreement of the Health and Safety Executive (HSE) who have exercised their powers under Regulation 16(6). The HSE have access to the fuller and more detailed classified information to satisfy themselves on the acceptability of this assessment.

2. LOCATION AND ENVIRONMENT

2.1 **Operator Name:** Naval Superintendent, Vulcan NRTE

2.2 **Operator Address:** Vulcan NRTE, Dounreay, Thurso, Caithness, KW14 7TY

2.3 **Site Address:** Vulcan NRTE, Dounreay, Thurso, Caithness, KW14 7TY

2.4 **History:** Construction began on site in 1957 with the first reactor Operational in 1965.

2.5 **General Description:**

2.5.1. The Vulcan NRTE carries out evaluation of the safety, reliability and performance of the Naval Reactor Plant and components of that plant, prior to introduction in Royal Navy submarines. The site is comprised of a number of facilities, the majority of which do not hold radioactive material. The site is located on the north coast of Scotland approximately 15km from the town of Thurso. The site lies approximately 20m above sea level. The meteorological conditions are typical for the north coast of Scotland with a prevailing north-westerly wind and above average UK rainfall. There are no significantly sized lakes, dams or rivers situated near the site. Geological conditions are typical for the north-east coast of Scotland

2.5.2 The local authority responsible for the area surrounding the Vulcan NRTE is the Highland Council.

2.5.3 The population distribution around the Vulcan NRTE is shown on Figure 1.

3. SITE ACTIVITIES

The facilities within the Vulcan NRTE site containing more than the quantity of radioactive material specified in Schedule 2 of the Regulations are detailed in Table 1. A HIRE has been conducted for each facility. A brief description of each facility is given and the containment arrangements for the radioactive material are detailed.

Table 1: Facilities with a Hazard Identification and Risk Evaluation

Facility	Description	Containment
Shore Test Facility (STF)	Pressurised Water Reactor (PWR). Fission of uranium, contained in fuel elements, takes place in the reactor core. The resulting fission products, including radioactive isotopes of iodine, caesium and krypton, are contained within the fuel cladding. The heat generated by the fission process is removed from the core by water contained in a sealed circuit. This water is pumped through steam generators where the heat is transferred to a separate, secondary circuit.	The fuel elements are contained within a high integrity cladding, designed to prevent the release of radioactive fission products. Should the cladding fail, the primary coolant system, a pressurised, sealed circuit, would contain the fission products. Beyond the primary coolant system, a third containment boundary exists which is designed and constructed to meet the rise in pressure that could result from a failure of the primary coolant system. The entire facility is housed in a dedicated building.
STF Pond	Underwater storage for used fuel removed from the core of the STF during the plant overhaul.	Fuel clad integrity remains high. Should any release of fission products occur, the storage water would limit dispersion. The pond is contained within a dedicated concrete structure within a second outer building.
Dounreay Submarine Prototype 1 (DSMP1) Pond	Underwater storage for used fuel removed from the core of the DSMP1 reactor during its decommissioning.	Fuel clad integrity remains high. Should any release of fission products occur, the storage water would limit dispersion. The pond is contained within a dedicated concrete structure within a second outer building.
Decontamination Waste Treatment Facility (DWTF)	DWTF was used to decontaminate the STF Facility and is under a care and maintenance regime. The facility was designed for and contains active resin which was generated during the decontamination process.	All resins within the facility are contained in specially designed Resin Catch Tanks which are held in a bunded, shielded area of the facility. This facility is contained within a dedicated concrete building.

4. SAFETY ASSESSMENT PROCESS

4.1 Naval Pressurised Water Reactor

The Design Authority for the Naval PWR, Rolls-Royce, is charged with producing a Facility Safety Case (FSC) for the Shore Test Facility. This safety case is based on deterministic and probabilistic safety assessment of the PWR and its associated systems. The FSC is independently peer reviewed and then undergoes Independent Nuclear Safety Assessment (INSA) by Serco Assurance (formerly part of AEA Technology). They produce a Nuclear Safety Clearance Document which is formally reviewed by the Chairman of the Naval Nuclear Regulatory Panel supported by Suitably Qualified and Experienced independent experts. When satisfied, the Chairman of the Naval Nuclear Regulatory Panel (CNNRP) issues a Safety Clearance Letter to MoD's Central Plant Control Authority who authorise the operation of the Shore Test Facility.

4.2 Authorisation of the Vulcan Naval Reactor Test Establishment

The Vulcan NRTE, as a Ministry of Defence establishment, is not subject to licensing under the Nuclear Installations Act. However, the MoD operates a parallel nuclear regulatory function through an internal regulator, the Naval Nuclear Regulatory Panel, which utilises a similar system that mirrors the Nuclear Installations Inspectorate licensing approach. It permits nuclear activities to take place on the site and authorises operations at the Vulcan NRTE. This is known as Site Authorisation. The Naval Superintendent is appointed as the Site Authorisee. The Site's Authorisation encompasses the Site Safety Management Arrangements and the authority to operate all facilities. Each Facility is supported by a Facility Safety Case (FSC) demonstrating compliance with MoD Safety Principles and Safety Criteria (SPSC). The MoD SPSC encompass all statutory requirements.

4.3 Safety Controls and Engineering Design

The containment arrangements for each facility are detailed in Table 1. In addition, there are engineered and procedural safeguards to prevent and mitigate any accident scenario. All equipment is robustly designed, constructed to a high specification and undergoes thorough examination, testing and regular, planned, routine, scheduled maintenance. Operation of all equipment is conducted according to rigorous operating procedures, by suitably qualified and experienced staff. The safety justifications for the equipment, its operation and any changes to these are subject to internal and external review.

4.4 Site Safety Management, Staffing and Training

The safety responsibilities of all personnel are defined in Site Safety Management Documentation. All personnel at Vulcan NRTE are suitably qualified and experienced for the work that they are expected to perform. A Nuclear Training Requirements Plan specifies the requisite qualifications and experience for each role. A continuous process of audit and review is used to ensure that procedures remain current and effective. Minimum manning levels have been assessed and are documented in Site Safety Management Documentation. The Site Safety Management Systems ensure that there are adequate staff and resources available at all times to enable safe plant operation and provide a robust emergency response capability.

5. HAZARD IDENTIFICATION AND RISK EVALUATION

5.1 Introduction

The Radiation (Emergency Preparedness and Public Information) Regulations define the terms "radiation accident" and "radiation emergency". A radiation accident requires immediate action to prevent or reduce the exposure to ionising radiation of employees or other persons; a radiation emergency is an event which is likely to result in a member of the public being exposed to ionising radiation, as defined in the Regulations. Hence a radiation accident may, but will not necessarily, result in a radiation emergency.

5.2 Shore Test Facility Pond, Dounreay Submarine Prototype 1 Pond and Decontamination Waste Treatment Facility

The Facility Safety Cases for the facilities on the Vulcan site each incorporate a Hazard Identification and Risk Evaluation (HIRE). The HIREs for the DSMP1 Pond, the STF Pond and the Decontamination Waste Treatment Facility have determined that the potential for a radiation accident exists however no radiation emergency, as defined within the Regulations, can result from these facilities.

5.3 Shore Test Facility

The HIRE for the Shore Test Facility has identified a number of scenarios with an extremely low probability of leading to an off-site release of radioactive material. A radiation emergency, as defined within the Regulations, can result from this facility, although it is an exceptionally unlikely event.

A range of potential accident scenarios have been analysed, the majority of which would not result in a release of radioactivity by virtue of the engineering and procedural safeguards described previously. The analysis considered those factors which could lead to a loss of cooling capability, as well as those which could give rise to an unintended self-sustaining nuclear chain reaction or the loss of control of an intended self-sustaining chain reaction. For a significant release to occur it is necessary for there to be a plant failure followed by breach of the multiple containment barriers between the radioactive fission products contained within the fuel and the outside environment.

These barriers include the high integrity fuel cladding, the primary coolant sealed circuit, the containment structure (designed and constructed to withstand the rise in pressure that could result from a failure of the primary system) and the building structure.

Accidental releases from the site could occur over periods varying from a few minutes to several hours, depending on the circumstances and the level of damage.

In order to develop an accident response strategy, the analysis has considered the probability of each accident sequence occurring and the consequences of the fission product release resulting from that sequence.

A two stranded approach has then been used to determine an appropriate strategy: an analysis of the probability and magnitude of any radiation exposure given that a radiation accident has been declared; and an analysis of the optimum countermeasure strategy for protection of individuals from any potential radiation exposure. Both analyses have considered all of the identified accident sequences. The appropriateness of introducing countermeasures has been determined on the basis of published advice from the National Radiological Protection Board. This multi-faceted approach has resulted in a recommended accident response strategy based on a range of accident scenarios and analyses.

6. IMPLICATIONS FOR RADIATION EMERGENCIES

In the improbable event of a radiation emergency, the likely exposures to those members of the public within the zone extending approximately 2 km from the location of the plant could exceed 5 mSv. It is very unlikely that exposures in excess of 5 mSv could be received beyond this zone, however a small number of low probability scenarios have been identified with more significant consequences. In deriving the recommended countermeasures strategy, due account has been taken of all identified accident scenarios, however improbable.

The recommended response strategy to a radiation emergency would be implemented in two stages. Immediate countermeasures are set out within the Emergency documentation, affecting only those personnel within the 550m automatic countermeasure zone. Implementation of the recommended off-site response would affect individuals in the pre-planned countermeasure zone out to approximately 2 km from the Shore Test Facility. These individuals would be advised to shelter to reduce any potential radiation exposure and to take stable iodine tablets to minimise the radiation exposure received as a result of inhalation of any radioactive iodine released. Both the on-site and off-site plans would be implemented as precautionary measures prior to the detection of any release of radioactivity.

The basis for food controls applied by the FSA will be against food intervention levels required by EC Regulations.

These arrangements were developed and approved in consultation with all local Authorities, and are articulated within the Multi Agency Initial Response Plan specific to Vulcan NRTE.

7. CONCLUSIONS

A hazard identification and risk evaluation has been conducted for each of the facilities at Vulcan NRTE holding radioactive materials, as required by the Regulations. These assessments have indicated that one facility on the site has the potential to lead to a radiation emergency, albeit with an extremely low probability.

The probabilities and consequences of the full range of potential accidents have been analysed and a response strategy developed to address them. To cope with the unlikely event of a radiation emergency, Vulcan NRTE has a Site Emergency Plan in place detailing the on-site response. The appropriateness of implementing countermeasures off-site has been assessed in the light of national and international legislation and guidance, and a precautionary strategy has been recommended to a distance of approximately 2km from the site. The recommended pre-planned countermeasure zone is shown on the map at Figure 1.

Emergency planning for the Vulcan NRTE is addressed by the multi-agency Emergency Planning Co-ordination Sub-Committee meetings. This enables the co-ordinated response strategy to be regularly reviewed and updated as required.

Vulcan NRTE has in place engineered and procedural safeguards to prevent a radiation accident from occurring, and to limit the consequences of any accident which could occur. The safety management systems at Vulcan NRTE are robust, appropriate and regularly reviewed. Personnel are suitably qualified and experienced to control the radioactive materials held on the site. A programme of internal and external reviews and audits is in place to ensure that safety standards, management and implementation remain appropriate and robust.

Figure 1: Recommended Pre-Planned Countermeasure Zone for the Vulcan NRTE