Annexe B to
NBC letter N.2510/4
dated

Defence Logistics Organisation

HM NAVAL BASE CLYDE

NUCLEAR SITE SAFETY STANDARD

SJ-STAN-013

BASE STANDARD NUMBER : 13

NUCLEAR SAFETY EVENT REPORTING AND OPERATIONAL EXPERIENCE FEEDBACK POLICY

SPONSOR: DSA

CONTENTS Page

REFERENCES:

1. BR 3018, Nuclear Safety Management of Naval Reactor Plant
2. JSP 538, Regulation Of The Nuclear Weapon Programme
3. JSP 471 Defence Nuclear Accident Response
4. NP-ACCS-001, Authorisation Condition Compliance Statement No.1
5. JSP 518, Regulation Of The Naval Nuclear Propulsion Programme
6. HSE-POL-014, Reporting and Investigation of Accidents/Incidents Policy
7. PROTO-001, NBC/CAPFASFLOT Protocol
8. HSE-PM-034, Special Investigation/Board of Inquiry
9. FPN 023, Technical Instructions for Submarines
10. JSP 392, Instructions for Radiation Protection
11. HSA-POL-002
12. PROTO-003

INTRODUCTION

Background

1. The Nuclear Safety Event Reporting system is the means by which nuclear and radiological events and incidents occurring in HM Naval Base Clyde are recorded, investigated, assessed, findings actioned and lessons learned disseminated. The Defence Nuclear Safety Regulator (DNSR) requires the Authorisee to define the arrangements under Naval Base and Nuclear Weapon Authorisation conditions (AC7 and AC23). The processes are essential tools for continuous improvement and the maintenance of a robust safety culture.

Scope

2. This Policy is applicable to all nuclear safety related incidents and events within HMNB Clyde Authorisee's delegation. It does not change reporting requirements stipulated by other Authorisees and other reporting systems, but does call for all incidents and events within the site or aboard vessels within a facility to be captured within the Naval Base's Nuclear Safety Event Report system. Thus an incident may be reported by more that one means but will normally be the subject of a single investigation. The reporting system is not a means for attaching blame to any person making a mistake which leads to an event. Nuclear Accident Arrangements are outside the scope of this policy.

Definitions

3. The naval reactor programme categorises events into Accidents and Incidents. Incidents are separated into 3 distinct groups based on potential consequence; Serious Incidents, Incidents and Incidents which may affect other NRP or Sites. Examples are given in Reference 1. The NRPA's definition of Incident is:

"An Incident is any occurrence within the NNPP which could give rise to a serious radiological consequence, on or off a NRP or NNPP Site, or which could significantly affect the NRP Safety case or Site Safety justification."

4. The nuclear weapon programme also categorises events by potential consequence into Accident, Incident and Anomolous Event. Reference 2 definitions are:

Incident.

"Any unplanned occurrence falling into any of the following categories:

a. any event which JSP 471 Chapter 1 Annex A defines as an incident:

b. any unplanned occurrence involving a nuclear weapon, nuclear warhead assembly or nuclear explosive which does notfall within the definition of nuclear weapon accident but which merits a formal record and investigation in the interests of safety or reliability"

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Anomalous Event.

"Any occurrence not severe enough to be reported as an Accident or Incident but which nevertheless:

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a. resulted in loss of control of a nuclear process or activity
b. did or could have resulted in an unintentional release of radioactive material, a failure of a line of defence/protection or a similar occurrence
c. could have given rise to a significant radiological consequence, on or off site.
d. Could significantly prejudice the requirements of a safety case or which is a breach of safety case requirements.
e. May have affected the safe operation or safe condition of a nuclear weapon, facility or plant.
f. Was an event of equivalent safety interest or concern, including:
  i. human error.
  ii. equipment or process failures resulting in a near miss.
  iii. abnormal occurrences.
  iv. discovery of a significant deficiency in a design procedure.
  v. discovery that a design or design intent has not been correctly implemented. "

5. In explanation of the JSP 538[2] definition of Incident, the Annex to JSP471[3] defines 2 incident types as follows:

Nuclear Reactor Incident.

" An abnormal occurrence which poses a potential threat to, or causes serious concern for, reactor plant safety, but where reasonable grounds exist for concluding that a reactor accident is not likely to occur.

Defence Nuclear Material Incident.

"----an unplanned occurrence involving defence nuclear material which does not constitute a nuclear material accident or security incident(JSP440), but which needs to be reported in the interests of safety or because it is likely to come into the attention of the public or media.

6. The definitions adopted by Clyde are published in ACCS1. Event is the generic term for an occurrence irrespective of its further categorisation by potential consequence. Incident is the term for a significant event which is judged to meets a legislative or Authorisee's mandatory/statutory reporting requirement. The definitions are as follows:

Event (ACCS 1)[4]

"An unusual occurrence that could have the potential for leading to an incident."

Incident (ACCS1 & JSP518)[4&5]

"Any occurrence which could give rise to a serious radiological consequence on or off site, or which could significantly affect the NRP Safety Case or the Clyde Site Safety Justification where an Incident Report is required in accordance with BR3018 or JSP 392."

RESPONSIBILITIES

7. Naval Base Commander Clyde (NBC(C)) is responsible for ensuring that nuclear safety management, organisation and administrative arrangements exist to achieve full compliance with the Naval Base Authorisation Conditions. The arrangements for AC7 compliance are delegated by NBC(C) to Director of Safety Assurance (DSA) for both nuclear propulsion safety and nuclear weapons safety.

8. The responsibility for reporting nuclear safety events befalls all Naval Base users.

9. The Submarine Commanding Officer is responsible for raising a submarine Incident Report iaw BR3018 and informing the Facility Operator (and other appropriate Site Authorisee representatives e.g. PAG Chairman, Control Engineer, Duty Health Physics Officer, Nuclear Weapons Safety Officer) that an incident has occurred on his facility.

10. It is the responsibility of all Facility, Utility and production managers to ensure that there are trained Investigating Officers employed within their area of responsibility.

11. The responsibility for monitoring the closure of accepted findings is with HSA/HNWSA.

REQUIREMENTS

12. Nuclear Safety Event Report (NSER) processes are to ensure that all unexpected occurrences having an actual or potential nuclear safety and/or radiological safety significance are formally notified, recorded, investigated, reviewed and assessed for significance, so that appropriate corrective/preventive action is taken, verified and closed out to prevent recurrence.

13. The processes are not to supersede the need to render any report required by law or any Authorisees' reporting requirements, but to supplement them. Investigation and corrective action is to be conducted at a level and in a timescale appropriate to the safety significance of the event and meet the requirements of:

a. Ministerial Reporting.
b. NRPA's Incident Report system.
c. Authorisation Condition 7.
d. Operational experience feedback.
e. NBC DNSR Protocol.
f. Radiological Incident Reports.
g. Authorisation Condition 23.

14. Where injury to personnel or damage to equipment has occurred an NSER may be raised to track the Nuclear Safety significance. However, this should be in addition to Health & Safety Incident and Near Miss reporting procedures, in accordance with Reference 6, not an alternative.

Ministerial Reporting.

15. The MoD's Directorate of Safety and Claims set a requirement for notification of significant nuclear incidents to ministers within a 24 hour period from event initiation. The criteria for notification are published in References 1 & 2. The Nuclear Safety Event Reporting systems in Clyde are to include adequate arrangements for the out of core hours duty personnel to fulfil the Ministerial reporting requirement.

16. Although the NRPA has separate arrangements for Ministerial Reporting, submarine incidents meeting the criteria which occur on the Authorised Site, fall to the Clyde Authorisee to report[7].

Categorisation of Events

17. To make efficient use of resource and target significant shortcomings, events are to be categorised in accordance with their potential consequences, by a SQEP body, such that appropriate depth and speed of investigation can be applied.

18. The International Nuclear Event Scale (INES), JSP 538[2] Annex S, was introduced by the IAEA as a means of communicating to the public in consistent terms the safety significance of events reported at nuclear power plants. The scale ranges in order of decreasing severity, from level 7, Major Accidents, through level 3, serious Incidents, to Level 0, Below scale. Examination of the detailed criteria at the lower severity end of the scale show that it is highly likely that events captured in the NSER systems will all fall into the level 0, below scale group. Thus, INES is too coarse a scale to drive out the significance of events and incidents in the Naval Base. However, the NSER system must be capable of reporting a higher scale event however unlikely its occurrence may be.

19. JSP 518[5] guidance looks at consequence in terms of Off Site release, On site release, Contained release, and potential release. As can be seen from the definitions provided above, NWR guidance similarly categorises by potential consequence, but has used the groupings of Incident and Anomolous Event.

20. The consequences of radiological release or exposure best fit the needs of a reporting system for the Naval Base and align with historical practice. However, in terms of the arrangements for investigating a potential release, there appears to be no benefit in separating on site and off site into different categories. The table below defines the Categories to be applied for Nuclear Safety Event Reporting in Clyde. It has been designed to meet the intent of all the guidance References, by categorising against a consequence level that can easily be aligned to appropriate investigating and reporting requirements. While the categorisation process is to be implemented using QEP judgement, it can be seen that in general an event of significance to meet a mandatory or statutary reporting requirement is likely to fall into the B Category, while management or process improvement would be a C. Events that are likely to generate no corrective actions by themselves but may indicate a trend, would be Cat D.

Category	Consequence	Description	Reporting Scale
A	High Potential for or actual radioactive release to the environment or overexposure of radiation	Major failure of site or reactor plant/weapon services in the performance of their nuclear safety function, that has a major impact on nuclear and/or radiological safety.	- Detailed and independent investigation required. - Possibility of being on scale against INES. - Statutory report requirement likely. - Regulatory Action / Censure possible. -Ministerial Reporting requirement. -exposure limits in IRR99
B	Actual or potential for a contained release within Building or submarine. Or Any unplanned/unexpected level of radiation exposure	Major failure of site or reactor plant/weapon services while not called to perform their nuclear safety function or failure of administrative control, that has significant actual or potential impact on nuclear and/or radiological safety or regulatory compliance.	-Investigation required to maintain compliance. - Likely to align to NRPA Incident report reqts for Site and NRP. - Below scale INES. - May require Ministerial Reporting.
C	Potential for future release or exposure by failure to adopt good practice and continuous improvement.	Some impact on existing nuclear and/or radiological safety standards, compliance or operational performance has resulted, but there has been no serious compliance breech.	Investigation required to improve practices. NRP Incident report may be appropriate. Routine reporting to DNSR Ministerial reporting unlikely to be required.
D	No or little potential for release or exposure	Very small or no impact on nuclear and/or radiological safety, compliance or operational performance.	An observation where little or no corrective action required. Recorded for trend analysis.

Notification of Events

21. DSA is required to provide notification of Events to DNSR in a timescale appropriate to the scale of Event. HSA and HNWSA will normally discharge this responsibility as appropriate. The PAG Chairman will normally provide notification to NRPA for Events concerning the NRPA in the course of normal business arrangements. For DSA to discharge responsibility adequately, the NSER system must ensure that Events are reported in sufficient time and detail to provide notification to the following DNSR Requirement[1] tabulated below. The Category of Event is included as general guidance, but SQEP judgement will be applied on a case basis:

NSER Category	DNSR Notification Requirement
A	Immediate notification by pager,telephone or Fax
B	Notification the next working day

C	Notification on the next Inspector's visit
D	Notification during the Inspector's review of the Authorisee's event reporting process

22. Notification procedures must also address any requirement for Signalled Incident reporting and Ministerial Reporting.

Investigation of Events

23. For serious events (Category A and appropriate Cat B) an investigating team and their Terms of Reference will be appointed by the Authorisee or delegated Director. For Less significant Event reports a SQEP judgement on the appropriateness of conducting Root Cause Analysis (RCA) or Trend Monitoring (TM) is to be made and an appropriately trained Investigating Officer is to be appointed. It is expected that the Investigating Officer will normally be appointed from the line management of the Section or Facility from which the event emanated.

Category	
A	BOI/SI
B	RCA
C	RCA/ TM
D	TM

BOI/SI - Board of Inquiry / Special Investigation (HSE-PM-034)[8]
RCA - Full Root Cause Analysis Investigation
TM - Trend Monitoring – Basic Investigation

Level of Investigation

Investigation Level		Report Requirements	Suggested Investigation Time	Investigation Completion (Reporting Date)
TM	Trend Monitoring Basic Investigation	Immediate investigation by Supervisor to gather evidence and make recommendations for prevention if appropriate.	Up to 6 hours	Within 7 days of event
RCA	Appropriate Root Cause Analysis Investigation	Detailed investigation by a SQEP investigator to determine root causes and make recommendations to prevent recurrence	Up to 10 days	Within 6 weeks of event
BOI/SI	Board of Inquiry/Special Investigation	As directed by Authorisee or responsible Director in accordance with HSE-PM-034	Greater than 10 days	Within 6 months of event

Nuclear Safety Event Reports (NSERs)

25. An NSER can be initiated by anyone on the Base, including Submarine personnel, and must be raised for any of the following circumstances:

a. Where nuclear safety is concerned, propulsion or weapon:

i. Failure of a Nuclear Safety Implicated (NSI) site service, when providing its nuclear safety function, including facilities which handle, process or store RBAs.

ii. Failure of Nuclear Safety Implicated (NSI) equipment, when providing its nuclear safety function. This includes Tool/SSE failure/breakdown during RBA/RBA component processing/handling operations and false alarms from safety monitoring systems.

iii. Failure to carry out maintenance of NSI equipment (that has not been concessed).

iv. Repeated concession of maintenance on NSI equipment.

v. Departure from a Nuclear Procedure requiring corrective action by an Authorisation Group or Test Group. This includes procedural/operator error during RBA/RBA component processing/handling operations

vi. Failure of administrative controls regarding nuclear work.

vii. Abnormal berthing and/or movement or docking affecting a Nuclear Submarine.

viii. Non conformance finding with nuclear safety implication from audit or inspection.

ix. Failure, departure from procedure or problems with any system or action, which could have Nuclear Safety Implications and is not detailed above.

b. Where radiological safety is concerned:

i. Any unplanned or unexpected level of exposure to radiation

ii. The detection of contamination outside a supervised/controlled contamination area.

iii. Any loss of radioactive source or radioactive material.

iv. Any spillage or release of radioactive material.

v. Any failure of an engineer control, administrative arrangement or personal protective equipment .

vi. The malfunction of equipment used in industrial radiography.

vii. Any occurrence likely to generate press or media interest

26. Reports are to be presented in a common format, including at least the following detail to enable trend analysis to be conducted:

a. Time, Date and Location of Event.
b. Sections/Facilities and Vessels involved.
c. Systems affected.
d. Equipment Failure mode.
e. Personnel failure mode.
f. Administrative control failure mode.
g. Brief summary of event, causes and rectification proposals.
h. Cross reference to any parallel reporting action.

Where an Incident report is required, the Investigating Officer is to ensure that the reporting requirements of the principal guidance has been met.

Investigating Officer

27. Where required, Investigating Officers are to be appropriately trained in Root Cause Analysis.

28. The Investigating Officer is to ensure that the event is investigated to the prescribed Level of Investigation, in the designated timescale, in the correct format and include the appropriate detail i.e. stating the Immediate and Root Causes and recommendations and Corrective Actions required to prevent recurrence.

NRPA's Incident Reports

29. The NRPA arrangements for compliance with AC 7 are fulfilled by the Incident Report system. described in References 1 & 9. Raising an NSER does not supersede nor mitigate the requirement to raise an IR, nor vice versa. Where the Site operator takes the lead for raising an Incident Report. the Event is to be appropriately Categorised and investigated in accordance with the requirements of this policy. The report should include any information specifically required by Reference C.

30. Where appropriate, for an incident involving an NRP alongside in a Clyde Facility, an Incident Report may be used to form the investigation phase of an NSER. However. the NSER is to take account of any contributing factors external to the submarine and capture Site specific corrective actions. These actions should also be reviewed when the NRPA reply has been received.

31. It is the NRPA's requirement that the Commanding Officer ensures that an IR is submitted whenever the NSRP has been put at risk. in the Authorised Site. This applies even when the crew

has no responsibility or involvement in the incident. Where the Site have the lead for investigation, the CO's responsibility may be limited to initial reporting and the provision of CO/MEO comment.

32. A submarine IR is forwarded by FWO FASLANE for comment from the appropriate authorities within HMNB Clyde. The Assurance Department is to co-ordinate Base comments. The IR will be assessed by NRPA. Specific occasions for raising Incident Reports are contained in Reference 1, which includes the following which are appropriate to Site operations:

a. Execution of any work, test or trial in a manner not covered by Atomic books, ship's Operating procedures, and Authorised Nuclear procedure or Test Document.

b. Repeat loss of shore services following a failure reported in an Incident report.

c. Events that in other circumstances could have led to an Incident, although there was no actual nuclear safety significance.

d. Failure of standby shore electrical or reactor cooling water supplies following the loss of the primary or alternative supply.

e. Any event where shore support services to the NRP were at risk.

Notes:

1. Where the integrity of the Shiplift or shore based services is suspect, a signalled notification of the incident is to be sent by the relevant Facility Operator/Utility Manager to DNSR and NRPA iaw BR3018 and JSP 392.

2. Where there is doubt as to whether a signalled notification is required then advice shall be sought form the Assurance Department (AD).

3. If the incident relates to Nuclear Reactor Safety or Repair Authority actions then the submarine/Repair Authority/NRPA are to be consulted as appropriate.

Radiological Incidents

33. An Incident Report for Radiological Safety Incidents is to be raised iaw JSP 392[10] for any of the following circumstances:

a. Any suspected overexposure of radiation.

b Any suspected inhalation or ingestion of radioactive material.

c Any release of radioactive material not approved by SEPA

d Any case of fixed skin contamination.

e Any contaminated wound.

f Any occurrence having the potential for individual overexposure or widespread exposure.

g Any occurrence considered appropriate by a Health Physics Officer.

h. Any occurrence likely to generate press or media interest

Notes:

1. If a Signal Notification of the incident is required, it is to be raised iaw JSP 392 and should include location, time and cause of incident, the estimated amount of activity released, the number of persons contaminated, details of subsequent decontamination and the results of the post incident survey and sample of water alongside if affected by the release.

2. The investigation shall be conducted under the direction of BRSO advised by BRPA. Site Radiological Incident Reports should be forwarded to BRPA for comment prior to NSAM assessment.

3. If required, the HSE/SEPA is to be notified by BRPA iaw IRR99 or RSA 93.

34 Radiological Incidents concerning the NNPP are also to be reported to the NRPA iaw Reference 1.

35. The Site Incident Report is to be forwarded to the Assurance Department (AD) within 3 weeks of the incident for assessment. A Site Incident Report Assessment (SIRA) will be produced by DSA and forwarded to DNSR (copy to NRPA) within 3 months of the incident. If this timescale cannot be met, DNSR is to be informed in writing, giving brief details of the incident and the reasons for the delay in the assessment.

Findings

36. Findings affecting the Base will be captured by the NSER system and appropriate actions agreed between the Facility/Section manager and the AD. Where appropriate, corrective actions may be aligned to specific Forward Action Plans, which are subject to review by Hold Point Control methodology. Corrective actions are to be recorded in the CMS Corrective/Preventive action data base. NSERs are to remain open, for tracking purposes until corrective actions have benn implemented or are embedded in appropriate process.

37. Facility Managers are to monitor the progress of event reports and findings raised within his/her facility. Should any trends or patterns be detected, then a fresh investigation to cover them collectively should be instigated, keeping AD informed.

38. A target date of 6 months is to be set for the completion of all recommendations and corrective actions resulting from the investigation. Where this timescale is not achievable a SQEP review is to decide on the appropriateness of extending the deadline, the application of greater resource or regulatory censure.

Operational Experience and Feedback

39. Lessons Learnt summaries and Site Incident Report Assessments are to be distributed to the principal Output Directors and their key managers for Line dissemination. CAPFASFLOT is to be included for all Events concerning submarines.

40. Where judged appropriate, Lessons Learnt summaries are to be copied to MOD OELG members (HMNBDevonport, DML, BAE, VULCAN, NRPA and NPOS SM) and the National OELG.

Reports and Trend Analysis

41. Completed NSERs are to be returned to the Reportee and copied to other Base departments involved in the event.

42. NSERs are to be reported routinely to the Nuclear Safety Committee and to the Defence Nuclear Safety Regulator at the Site (Level 3) Regulatory Interface Meetings. Arrangements are to be in place to notify DNSR immediately for serious incidents, in accordance with the requirements of references 2,5,11 & 12.

43. In administering the NSER system, the AD is to monitor for local trends that may require urgent corrective actions and provide appropriate warning/advice. NSERs are to be reviewed on a quarterly basis and trends reported to the CNSC in an annual report.

Records.

44. A record of all events and a database of corrective actions is to be maintained. A bring-up system is to be operated to monitor the progress of investigations and corrective actions.

45. All NSERs are to be allocated a unique NSER reference number and cross-referenced to any Incident Report number.

46. Records are to be archived for 30 years (50 years if they pertain to radiation events) unless otherwise stated.

Paterson, Kevin

From:]
Sent: 19 September 2008 13:36
To: Watson, Isabelle;
Cc:
Subject: Clyde BPM Study and Action Grid

Attachments: BPM Issue 2 (Edited).doc; BPM Recommendations Action Grid.xls; future facility URD Issue 1.doc

BPM Issue 2 (Edited).doc   BPM nmendations Action   future facility URD Issue 1.do...

As discussed, please find attached the BPM Assessment Report and the Action Grid which captures Clyde's response to each of the report's recommendations. I understand these documents will be discussed at your meeting on 24 Sep 08. I would appreciate early visibility on any thoughts you may have on our intended approach.

I have also attached the User Requirements Document for the Future Radioactive Waste Management Capability. Hopefully this document will provide some confidence that the Base is actively engaged in developing the waste management capability to replace the current facilities (REDF and APF).

You will receive these documents formally in due course.

Regards

Base Radiation Protection Adviser
Ext:

<<BPM Issue 2 (Edited).doc>> <<BPM Recommendations Action Grid.xls>> <<future facility URD Issue 1.doc>>

HM NAVAL BASE CLYDE

Assessment of Arrangements to Comply with Best Practicable Means for the Handling, Movement, Processing, Storage and Disposal of Radioactive Waste at HMNB Clyde, Faslane

ISSUE 02
Sept 2008

Revision Status

Issue	Reason for Issue/Amendment	Date
Draft A	For Internal Review by JE	19 March 2008
Draft B	For Internal Review by BM/MoD Stakeholders	25 March 2008
Draft C	Stakeholder Review (Incomplete Version)	13 May 2008
Draft D	For Final Review before Due Process	3 July 2008
Issue 1	Submission to CNSC for Noting	5 August 08
Issue 2	Incorporation of CNSC Comments	17 September 08

Authorisation

(For the last issue shown on Revision History)

	Signature	Print Name	Position	Date
Author			Jacobs	
Verifier			REDF SCE	
Sponsor			Facility Manager	
Informed Customer		/	Workstream Leader	

Executive Summary

In order to satisfy the conditions of the Letters of Agreement regulated by the Scottish Environment Protection Agency (SEPA), HMNB Clyde must demonstrate that within any particular waste management stream, Best Practicable Means (BPM) are used to minimise the amount of radioactive waste produced (in terms of activity and volume) and released to the environment.

Following postponement of the proposed integrated Radioactive Processing Facility (RPF), SEPA have requested that HMNB Clyde submit a demonstration of BPM for current and future waste handling arrangements. This report represents an assessment of the arrangements at Clyde, recommending where appropriate actions that need to be taken to allow the arrangements to be considered as BPM.

The report followed the guidance produced by Scotland & Northern Ireland Forum for Environmental Research (SNIFFER).

- The scope of activities carried out at HMNB Clyde can be summarised as:
- The generation of radioactive waste at source.
- The movement of (liquid and solid) radioactive waste around HMNB Clyde to the Active Processing Facility (APF) or the Radioactive Effluent Disposal Facility (REDF) as applicable.
- The treatment and holding of liquid radioactive waste.
- Sampling and analysis of all wastes.
- Discharge of liquid waste to the environment.
- The receipt, segregation and processing of solid waste at the APF.
- Disposal of solid waste to Low Level Waste Repository, Drigg
- Gaseous radioactive waste generated as a result of radioactive effluent movement, processing and disposal.
- Gaseous radioactive waste generated as a result of solid waste handling and disposal.

A series of recommendations were identified that would greatly enhance the demonstration of BPM at HMNB Clyde.

The key issues are:

- The management systems in place for management of radiological protection and radioactive waste can be improved and a review is under way to look at the most appropriate qualifications and experience of the Facility Manager post to ensure it meets the needs of the future radioactive waste management activities and radiological protection requirements. The organisation in place requires to be cross trained as originally planned without the reliance on supervisors. Much of the knowledge is invested in a few supervisors, indicating that should there be a significant change of personnel, it would further erode confidence in the ability to deliver the required operations in accordance with BPM.
- At the point of generation, limited waste prevention or minimisation takes place. This is because training of workers lacks specific content on environmental

implications of radioactive waste management operations. Recommendations cover these issues.

- Addressing the recommendations arising from the PEB incident in February 2008 is fundamental to making a demonstrable argument that the arrangements for managing liquid radioactive waste are BPM. Actions include:

    - Maintain a critical item list and ensure it has an adequate maintenance schedule.

    - Review all procedures relating to the transfer of effluent from submarines considering any improvements, ensuring that appropriate SQEP are involved.

    - The environmental awareness of all staff involved in the discharging, handling, processing and disposal of liquid effluent, should be improved to ensure that where applicable it is part of the core competencies of staff.

- The pipework external to the facility requires the implementation of an appropriate maintenance regime, to reflect its importance in transferring effluent and where the opportunity exists, the implementation of modern standard connections and material specifications. Recommendations cover these issues. Should the recommendations be too onerous, it may be more cost effective to replace the existing pipework, thereby ensuring it is the equivalent standard to the internal process plant. The liquid effluent process requires modification in order to meet the ongoing demands of reducing discharges to the environment. A refurbishment design is already in hand that will make key improvements to reduce discharges and improve leak detection systems in the process plant.

- The solid waste stream has little segregation; however, some relatively simple processes are recommended to improve segregation and reduce the volumes being designated as LLW. This is in advance of the intended introduction of a sorting table. Recommendations cover these issues.

- With the introduction of new waste management systems (improved segregation and ISO-skips), their success should be reviewed after a period of time to ensure that their implementation is effective.

The report summarises that whilst HMNB Clyde are actively taking steps to improve the management of radioactive waste at HMNB Clyde, it is not demonstrably BPM in all aspects of waste generation, handling, processing and disposal.

Contents

1. Introduction

1.1. Background

The radioactive waste handling and disposal arrangements within HMNB Clyde (Faslane) are undertaken in accordance with Letters of Agreement [ref [1]] covering the disposal of liquid and solid waste via the Active Processing Facility (APF) and Radioactive Effluent Disposal Facility (REDF). Compliance with the Letters of Agreement is regulated by the Scottish Environment Protection Agency (SEPA).

Under the Letters of Agreement, there is a requirement is to ensure that all radioactive waste handling and disposal activities undertaken at HMNB Clyde utilise Best Practicable Means (BPM). Now that the proposed Radioactive Processing Facility (RPF) is delayed, it will be replaced by a refurbishment to the existing process plant utilising key aspects of the RPF design, SEPA have requested that evidence be provided [ref [2]] demonstrating that activities can and will continue to satisfy the requirements for BPM.

The layout of Faslane in relation to the waste handling facilities is shown in figure 1.

1.2. Purpose

The purpose of this document is to demonstrate how different potential options for processes, operations and management systems to reduce discharges were identified and compared and how the implementation of any recommendations will optimise radioactive waste management.

In this context the components of BPM are:

Best: the most effective option in preventing the release of radioactive material from a process and/or minimising or rendering less harmful those that cannot be prevented. There may be more than one set of options all of which achieve the same degree of effectiveness. The "best" in this context is the one that properly takes account of the overall benefits and detriments.

Practicable: an option that is technically possible and could be used by the operator without costs or other detriment being incurred that are unreasonable in relation to the benefits gained.

Means: the way in which a task is carried out, or an objective is fulfilled. It includes the provision maintenance and manner of operation of any plant, machinery or equipment and supervision of any operation.

1.3. Scope

The scope of this report covers all aspects of radioactive waste activities from the point of generation of liquid, solid and gaseous waste to final disposal. The report covers the arrangements to support the APF and REDF until the end of their design lives; it does not consider the arrangements associated with the proposed replacement facility.

The scope refers only to a review of waste handling activities at Faslane. Waste handling activities at RNAD (Coulport) are undertaken under separate HMIP Letters of Agreement (regulated by SEPA).

The scope of activities to be considered for liquid, solid and gaseous waste is therefore as follows:

Liquid radioactive waste management activities:

a. Generation of radioactive liquid effluent on board the nuclear submarines

b. Discharge of radioactive liquid effluent to a PET or PEB

c. Movement of radioactive liquid effluent to REDF from submarines via PET or PEB

d. Receipt of the radioactive effluent from the PET and the PEB including the discharge lines into REDF

e. Transfer of liquid waste around HMNB Clyde:

- Transfer of liquid from M11
- Transfer of liquid from the APF to the APF Lab Tanks
- Transfer of Liquid waste from the Radiochemistry Laboratory to APF Lab Tanks
- Transfer of the APF Lab Tanks direct to Gareloch

f. Holding of the liquid effluent prior to treatment

g. Transfer of effluent through the treatment process

h. Holding of the treated effluent

i. Sampling of effluent

j. Disposal of treated radioactive liquid effluent including the discharge pipeline

k. Discharge point of the treated effluent

Solid radioactive waste management activities:

a. Solid waste generated from reactor plant maintenance activities on nuclear submarines

b. The movement of the radioactive waste from the submarines to the APF for processing.

c. The receipt and segregation of solid waste at the APF

d. The shredding and compacting of solid waste at the APF

e. Disposal of the Radioactive Waste

Gaseous Radioactive Waste Management Arrangements

Trace gaseous radioactive waste generated as a result of radioactive effluent transfer, processing and disposal.

Trace gaseous radioactive waste generated as a result of solid waste handling and disposal.

2. BPM Assessment Methodology

2.1. Legislative Requirements

The Letters of Agreement issued under the Radioactive Substances Act 1993 [ref 1] require that MoD (Navy) use best practicable means for reducing the quantity of radioactive waste. In determining whether any particular process is BPM, it is incumbent upon the operator at regular intervals to consider the level of management and engineering control that minimises, as far as reasonable practicable the release of radioactivity to the environment whilst taking account of a wide range of factors, including cost effectiveness, technological status operational safety, social and environmental factors.

In determining whether a particular aspect of a process represents the BPM, there is no expectation that expenditure will be incurred, whether in time, money or trouble, which is grossly disproportionate to the benefits likely to be derived. Where it is demonstrated that the BPM has been applied, doses or risks may be regarded as As Low As Reasonably Practicable (ALARP).

2.2. Methodology

This assessment of BPM is written utilising the advice provided by the Agencies for assessment of an operator's application of BPM under RSA93, prepared by the Scotland & Northern Ireland Forum for Environmental Research (SNIFFER) [ref 3]. SEPA requires operators to apply BPM so as to minimise the volumes and activities of radioactive wastes that are generated and have to be discharged to the environment and to reduce the impacts of waste management on people and the environment. Furthermore, the report states that a BPM assessment is essentially a consideration of whether an adequate argument has been made that further measures to reduce risk (or implement more control measures) are not needed because these measures cannot be implemented at a reasonable cost given the economic and social factors taken into consideration.

A Statement of Requirements was raised and agreed internally within HMNB Clyde, which sets out the following methodology to be followed in this report. For the existing arrangements, BPM will be assessed by considering what means are currently in place to control radioactivity acknowledging any improvements already planned:

The stages of the review methodology therefore are:

- Description of waste producing processes
- Assessment of individual activities by:
  - How the creation of waste is prevented or minimised
  - Options for improvements including alternative arrangements, taking due note of
    - Consideration of risk and exposure
    - Environmental concerns – including leakage and escape, and how close the levels for disposal are to the authorised limits.
    - Technology considerations, novelty, complexity, operability.

- Any health and safety considerations
- Cost effectiveness
- Design, operability and maintenance issues
- Existing HMNB Clyde constraints

Many aspects of waste management arrangements at Clyde are interrelated so in a number of cases it has not been necessary for this report to use this methodology explicitly where duplication would result.

The concept of proportionality is central to the application of BPM. SEPA's policy is not to require operators to incur expenditure whether in money, time or trouble that would be disproportionate to the resulting benefits.

2.3. Report Structure

The report is structured as follows:

- Section 3 presents the waste inventory for disposal, and the management processes for waste minimisation and sentencing currently in place at HMNB Clyde.
- Section 4 sets out the BPM assessment of the arrangements for generating all forms of radioactive waste.
- Section 5 sets out the BPM assessment for the liquid radioactive waste management activities
- Section 6 sets out the BPM assessment for the solid radioactive waste management activities
- Section 7 sets of the BPM assessment for the gaseous radioactive waste activities
- Section 8 summarises the review and provides an overall statement of HMNB Clyde's compliance with the principles of BPM.
- Section 9 presents the conclusions and recommendations for further work identified in sections 4-7.

3. Overview of Waste Handling Activities at HMNB Clyde

3.1. Introduction

This section describes the management organisation in place and the radioactive waste generation and processing activities at HMNB Clyde, including information on current disposal limits and their utilisation. It is not intended to be anything more than a generalised description of the waste arisings at HMNB Clyde.

The principal sources of radioactivity at HMNB Clyde are generated as a result of Naval PWR operations. These are:

- Tritium (H3) which is contained predominantly within the primary coolant
- Cobalt-60 (Co-60), an activation product formed on the steel surfaces of the primary system pipework and components and released during operation and maintenance activities within the submarine.
- Other activation products include Nickel-63 and Iron-55
- Small amounts of other gaseous waste products, principally Argon 41 from reactor plant operations.

3.2. Management Organisation

The current REDF Facility Manager (FM) organisation is shown at Figure 2.

The FM as the key post is currently under review to determine the validity of the current responsibilities, qualifications and competencies detailed in JSP 518 [ref 4]. In order to properly manage the totality of the facilities and interfaces, the post would benefit from specific knowledge and experience in radioactive waste management and radiological protection. This review also provides the opportunity to ensure that FM and his key supervisors (Radioactive Process Engineer (RPE) and Senior Health Physics Controller (SHPC)) are environmentally aware of the operations they are managing and being better equipped to appreciate the significance of the issues at hand. This is particularly relevant given the nuclear safety events in the last few months associated with the lab tanks, pipework and PEB. These issues are covered specifically in section 5, the BPM assessment for the liquid waste management activities.

Up until the end of 2007, each facility (REDF and APF) was operated by a separate group of four trained operators; neither group of four was trained to operate the other facility. The current business model for Babcock Marine requires a more flexible approach to operations, increasing utilisation whilst not undermining safety. A decision was taken to reduce the total number of staff from eight to six, but to ensure that all staff were cross-trained for all operations across both facilities, including PET and PEB operations. In reviewing the operating arrangements, the most demanding operations, requiring the greatest resource, is the PEB discharge operations which require 3 staff. The PEB is currently out of service (as will be discussed in section 5) and with the intention that there should be 6 fully trained staff available, all other operations can be effectively managed.

The training of all REDF and APF staff is undertaken in accordance with HMNB Clyde's formal nuclear training arrangements [ref 5]. In addition to the FM, the key supervisors, RPE and SHPC together with the FSC author must meet, as a minimum, the requirements of JSP 518 [ref 4]. The competence of all staff is assessed against their use of REDF/APF equipment as applicable and local records maintained at a local level. Only those deemed competent and having successfully completed the training can undertake operations in either facility.

The planned cross training has not progressed as quickly as had necessarily been envisaged; therefore, in order to continue to support continued PET operations, supervisors have been supporting the extant procedures (see recommendation 4).

Recommendation 1: Progress with the intended review of the Facility Manager post training and experience to develop a suitable post profile with improved qualifications and competencies specifically in radioactive waste management and radiological protection.

3.3. Liquid Radioactive Waste Management Activities

3.3.1. Sources of Liquid Radioactive Waste

The majority of the liquid radioactive waste consists of primary circuit water from the nuclear reactors that are used to power the different classes of nuclear submarines at HMNB Clyde. The primary circuit water is discharged during reactor plant warm up for current classes of SSNs or during maintenance tasks of the TSSBNs. It can be discharged either to a PET or the PEB for transfer to the REDF [ref 6].

The annual throughput (both in volume and inventory terms) will reduce over time given the improvements introduced in the new PWR2 plant and also the reduction in size of the nuclear submarine fleet.

Small volumes of radioactive waste are also generated as a result of a variety of operations within the shore based support facilities; comprising liquids discharged from the active drains systems in the Nuclear Engineering and Welding Section (NE&WS), the APF and the radiochemistry laboratory. Effluent from the NE&WS is collected in, and transferred from, the NE&WS Drain Tank (M11); effluent from the APF and the radiochemistry laboratory is drained directly to the APF Lab Tanks.

Figure 3 indicates the routes between the support facilities and the REDF.

3.3.2. Disposal Limits

The figures detailed in Table 3.1 provide an indication of the current liquid waste disposal limits together with information on previous disposals.

Radioactivity	Discharge Limit (GBq)	Discharges (GBq)				
		2003	2004	2005	2006	2007
Beta	0.5	0.015	0.006	0.013	0.006	0.013
Co-60	0.5	0.008	0.007	0.003	0.003	0.003
H-3	1000	110.960	47.94	115.141	120.888	66.406
Alpha	0.2	0.003	0.002	0.002	0.001	0.001

Table 3.1 Disposal Limits and Liquid Radioactive Waste Disposal Information

3.4. **Solid Radioactive Waste Management Activities**

3.4.1. Sources of Solid Radioactive Waste

Solid radioactive waste is generated during routine maintenance of nuclear submarines at HMNB Clyde both on board the submarines and within the shore based support facilities, particularly Nuclear Repair (NE&WS) and the APF and REDF. The vast majority of solid waste that is removed from radiologically controlled areas can be disposed to local landfill. All waste which has a specific activity of 0.4 Bq/g or less is disposed of as domestic waste in accordance with the Radioactive Substances Act (substances of low activity) Exemption Order [ref. 7]. Only waste that after assessment for compliance with the Conditions for Acceptance (CFA) for the Low Level Waste Repository (LLWR) and has a specific activity greater than 0.4 Bq/g is considered suitable from onward transporting to the WAMAC facility for super compaction and additional shredding before being grouted in a Half Height ISO container (HHISO) for disposal at LLWR Drigg [ref. 8].

The waste is defined in two separate Waste Characterisation Documents [ref.9] and [ref. 10].

Non-Metallic This consists predominantly of combustible, compactable, dry, low-level operational waste from submarine reactor compartments (RC); or from other radiologically controlled areas within H.M. Naval Base Clyde. It includes such items as filters, clothing, paper, polythene, lagging and other barrier or change-room wastes. Other items that may be present are hoses, wood, cleaning and monitoring wastes such as swabs and filter papers.

Metallic This consists predominantly of non-combustible contaminated and/or activated metal components from the RC. This waste stream is considered to be unsuitable for low-force compaction. Consignments will be separated into waste suitable for WAMAC HFC and waste unsuitable. The majority of the items within this waste stream are contaminated on surfaces which cannot be readily accessed to allow thorough decontamination.

This waste is moved into the APF building by dedicated transport following collection at the point of generation on the Base.

The HMNB Clyde Quality Assurance Plan (QAP) 05 [ref 11] Management and Control of Solid Low Level Waste for Disposal at BNFL describes the arrangements and responsibilities for the collection, monitoring, segregation, compaction, packaging, labelling and preparation for transport and safe transportation of solid low level waste to the British Nuclear Group (BNG).

Solid waste is double bagged and transferred using dedicated transport to the APF. Solid waste will contain mixed beta-gamma emitting radionuclides; there is no known source of alpha emitting radionuclides. Much of this waste will have very low levels of radioactivity and, following measurement and sentencing, can be disposed of via the normal domestic waste route using the Substances of Low Activity (SOLA) Exemption Order [ref 7].

The processing of solid waste in the APF also leads to the production of small volumes of water containing low levels of radioactivity. This liquid radioactive waste arises through washing / decontamination of items, either for re-use or to remove the surface contamination levels prior to disposal.

The layout of the APF is shown in Figure 4.

3.4.2. Disposal Limits

There are no prescribed limits on the volume or specific activity that the APF can accept or store. The only limits placed on the APF are governed by the physical size of the Facility but through operational experience there has never been an occasion where the Facility has not been able to handle the volume of materials receipted at any one time.

The figures detailed in Table 3.2 provide an indication of the current solid waste disposal limits together with information on previous disposals. Table 3.3 sets out the 2007 desiccant disposals.

	Limit (rolling 12 months)	*2004 Values*	*2006 Values*	2007 Values
Total Volume	40 m^3	26.8 m^3	29.5 m^3	7.6 m^3
Co-60	4000 MBq	40 MBq	1365 MBq	766 MBq
H-3	10000 MBq	4 MBq	20 MBq	3 MBq
Gross Beta	3000 MBq	115 MBq	1251MBq	497 MBq
Gross Alpha	30 MBq	0 MBq	0 MBq	0 MBq

Table 3.2 Disposal of Solid Radioactive Waste

Note: There were no solid waste disposals in 2005

	Limit (Rolling 12 months)	2007 Values
Total Volume	$2m^3$	$1.8\ m^3$
H-3	20 MBq	2 MBq

Table 3.3 Disposal of Solid Radioactive Waste (Desiccant) from RNAD Coulport

(This was the first consignment made in December 2007 that had been made by HMNB Clyde)

3.5. Gaseous Waste as a Result of Radioactive Waste Movement, Handling Processing and Disposal

3.5.1. Sources of Gaseous Radioactive Waste

Gaseous radioactive waste may be generated as a result of a variety of operations involving the handling and processing of liquid and solid radioactive waste, in addition to maintenance activities on board the nuclear submarines. It can comprise:

- Particulates from the nuclear workshop, APF and on board maintenance activities such as cutting or grinding radioactive pipework or other components of submarine equipment.
- Liquid i.e. tritiated water vapour and potentially gases from reactor operations in the transfer of effluent.
- Trace amounts of Ar-41 from the transfer of effluent and purging of the reactor compartment post power operations.
- Trace amounts of Carbon 14 as a by product of reactor operations by the activation of O-17 in the water

The handling and processing of liquid radioactive waste in the REDF generates gaseous radioactive waste from three routes:

- During transfer of effluent from the PET/PEB to the buffer tank (generation of airborne contamination / vapour due to splashing, evaporation)
- During transfer of effluent from the effluent process system to the discharge tank (generation of airborne contamination / vapour due to splashing, evaporation and agitation of liquid radioactive waste).
- Generation of vapours through evaporation of liquids whilst held within the Buffer or Hold Tanks.

Processes carried out within the APF that lead to the production of gaseous radioactive waste include;

- Segregation of solid waste
- Shredding / compacting of solid waste (the majority of gaseous arisings)
- Solidification of liquid waste / ion exchange media
- Decontamination of equipment

3.5.2. Disposal Limits

Due to the very small amounts of radioactivity associated with these gaseous discharges, SEPA has not sought to implement any numerical disposal limits.

3.6. Recording of Radioactive Waste Inventories and Disposal

One of the issues that arose in undertaking this review was looking at the record keeping system to identify the fairly basic level of information contained in this section. Whilst it is not a major issue, if arrangements are being reviewed, it is worth considering standardising record keeping. There is already an outstanding audit finding regarding the recording of compliance with AC 32 on maintaining of inventories, therefore in clearing this incident [ref 12] it provides an opportunity to reconsider how all this data is kept.

Recommendation 2: Review the record keeping system to ensure it is standardised and in accord with the relevant MoD and Statutory requirements.

4. BPM Assessment of the Generation of Waste

4.1. Current Arrangements

Generation of radioactive waste at HMNB Clyde can be broadly divided into two types:

- Primary arisings from the PWR operations on board the nuclear submarines, borne from operational necessity. The Procedure Authorisation Group (PAG) is responsible for the authorisation, monitoring and controlling of all operating, maintenance, repair, testing and commissioning documentation for all Nuclear Implicated Work on board the submarines, and which by implication give rise to radiological waste. PAG membership includes Health Physics representation.

- Secondary arisings from operations within the shore based facilities are similarly controlled via the Nuclear Services Authorisation Group (NSAG). As with the PAG, NSAG membership includes Health Physics representation.

4.2. Option Analysis

There is explicit mention of the requirement to ensure radiation exposures to operators ALARP and whilst the procedures are clear on how waste and other arisings should be managed to prevent the spread of contamination, there is no stated requirement on waste minimisation. It therefore follows that the requirement to consider the environment in all aspect of operations needs to be made more robust and transparent if there is to be confidence that waste is prevented or at best minimised at source. Health Physicists are a part of the PAG/NSAG system and with their knowledge in this area can ensure that good practice for waste prevention and minimisation is built into the procedures. The goal, however, should be that this requirement is automatically factored into all planning.

Base Health Physics Staff and Ships Staff at radiologically controlled area barriers would benefit from explicit training on how waste should be properly packaged such that receipt by APF staff (see section 6) would be a formality. Anecdotal evidence suggests that items often have to be repacked to meet the criteria in RPSOs [ref 13] suggesting that the training of those working in the controlled areas is lacking in this particular area.

There are no operational reasons that would preclude waste prevention and miminisation being considered and where practicable, achieved both during consideration in the PAG/NSAG and actually during the progress of the procedure.

4.3. Summary

By virtue of the arrangements already in place, only waste processes that are required to be undertaken as an operational necessity are undertaken and the procedural arrangements in place control waste arisings with the potential for contamination (surface, liquid or gaseous) being minimised at source by the appropriate use of containment. This gives confidence that the operations undertaken are justified and optimised.

Whilst these controls in place give confidence that the waste is properly controlled and managed as it arises, the local arrangements do not specifically make any reference to waste prevention and minimisation and nor is it included in any detail within any training. Inclusion of this detail would ensure that all those carrying out the work had an appreciation of the requirement for prevention and/or minimisation and its practical implementation.

Until such time as the education of the work force including ships staff undertaking the work is addressed and specific requirements set out within procedures, BPM will be difficult to demonstrate. It is understood that there is an intention to combine the Health Physics and APF monitors into one pool and train them accordingly. This has the benefit of ensuring that the tunnel monitor is appropriately trained in the receipt and proper packaging of radioactive waste.

The following recommendations are therefore made and should be actively pursued by HMNB Clyde management to ensure that they are followed through and that issues of waste minimisation become common place in the way work is undertaken. The aim should be to train all radiation workers including Health Physics staff to segregate and prepare waste for transit properly which will in turn reduce the possibility of leakage and escape and the quantity of waste to manage and will therefore have benefits throughout the solid waste stream.

Recommendation 3: The PAG and NSAG, supported by Health Physics professionals should critically review all proposed work packages and associated procedures to ensure radioactive waste generation is optimised if it cannot be prevented.

Recommendation 4: Training for all relevant Base employees and ships' staff responsible for the generation of the waste should be reviewed and updated to ensure that it adequately addresses best practice in waste prevention and minimisation techniques; an appropriate level of environmental awareness should be adopted by all workers.

5. BPM Assessment of Liquid Radioactive Waste Management Activities

This section considers the various stages of effluent transfer and processing from the point of generation to the point of disposal in Gareloch. The utilisation of the agreed SEPA limits [ref 1] is very low; however the continuing pressure to reduce discharges to zero is reflected in the assessment regarding the additional work required.

5.1. Discharge of Radioactive Liquid to a PET or PEB from Submarines

5.1.1. Current Discharge Arrangements to a PET

Radioactive Liquid Effluent is discharged to a PET located on the submarine casing. The PET is supplied by REDF under the control of PAG approved procedures specific to a particular submarine.

Figure 5 shows a PET and its connections.

- The requirements for supply of a PET are:
    - Ensure the PET is empty and a spill pack available throughout
    - The carboys used to drain the discharge hose on disconnection are confirmed as empty and sufficient to drain the discharge hose.
    - Pressure testing the discharge hose to confirm "nil leakage."
    - Ensure discharge hose is blanked and doubled bagged to prevent leakage during transit.
    - Undertake a radiation survey and ensure Ships Staff are informed accordingly.

All equipment including the flat bed lorry upon which the PET is transferred is fully maintained/checked to ensure they are within the appropriate test date for use.

A transfer route is specified for the PET and an alternative provided.

Once received by the Submarine:

- A controlled area is set up and monitored as required by Ships Staff (HP).
- A catchment is set up under the connection point to capture any spill during the connection phase
- The system is leak tested to ensure adequate connection. "Nil Leakage" is required.

During the discharge, requirements are set up to stop if pressure or temperature within the system exceeds the specified levels or any effluent leakage occurs.

Disconnection of the PET:

- On completion of the final discharge the system is flushed with demineralised water

- A radiation and contamination survey carried out.

- The flanged connections are disconnected over a catchment, and the hose is drained to carboys. These are then transported to the APF for analysis. The procedure makes it absolutely clear that no draining can occur direct to the Gareloch.

- A record is taken of the contents of the PET and the temperature of the effluent.

The reverse precautions for the supply of a PET are then enacted including a full radiation and contamination survey.

Operational necessity dictates the use of the PET although the procedures do allow for frost conditions and make provision for certain actions in the event of low temperatures which might hazard the safe transfer of effluent to the PET. No other allowance is made for environmental conditions.

5.1.2. Option Analysis

Alternative options have been identified to replace the use of a PET. These were considered in the course of the design evolution of the new jetty at which the new class Astute will be berthed [ref 14]. This was also reviewed as part of an options review following the postponement of the proposed RPF [ref 15].

Option 1: Retain Current Arrangements Using the Existing PET.

Description of Option

This option retains the current arrangements with the placement of a PET on to the casing of the submarine for discharge operations then lifting it onto transport for transit to REDF.

Risk and Environmental Considerations

Controls that are in place to manage the PETs and the routine maintenance and operations are approved through NSAG or PAG as applicable, carried out by SQEP operators, giving a level of confidence on the adequacy of the arrangements. However ultimately the timing of discharges and movements of PETs is dictated by operational needs and carried out in the open air taking no account of the environmental conditions prevailing at the time. It is therefore important to refer back to recommendations 3 and 4 which advises a critical review of all procedures to consider the importance of the waste prevention and minimisation, and to ensure that all workers including ships staff are suitably trained in environmental issues to assess the conditions in which the waste is generated.

Technological Considerations

There were none identified in retaining the existing arrangements

General Health and Safety Issues

There are health and safety considerations when transferring a PET onto and off the casing particularly if operational necessity dictates that the move occurs in inclement weather although controls are in place that prevent crane movements under certain conditions.

Cost Effectiveness

The retention of the existing PET arrangement does not involve additional cost and is a proven technique given the size of this site.

Design, Operability and Maintainability

Detailed procedures cover the connection and disconnection of a PET and are carried out by SQEP staff. The PET itself is specifically designed for the movement of liquid effluent and the design life of the current tanks expires in 2022. A detailed maintenance routine is carried out at 3 monthly intervals as well as statutory testing of all lifting lugs and pressure systems, and the NDT conducted every 5 years on the tank welds was considered adequate. No outstanding issues on maintenance were identified including missed maintenance or failure to comply with any statutory tests or NAS3 requirements. Given the Examination Maintenance Inspection and Testing (EMIT) schedule they are subjected to, so long as compliance is maintained with these requirements, it is the opinion of Clyde Design Authority that they will remain fit for purpose throughout the remaining design life [ref 16].

The reliance on carboys is a weak point of the design. The inherent risks this introduces can be resolved by draining the effluent back into the reactor plant as is done at HMNB Devonport. This would be a relatively simple procedural change to implement without introducing a potentially expensive design change to the PET. Whilst option 4 below details a superior design for the PET, however, one aspect of it could be implemented relatively easily and at low cost: the introduction of self-seal hose couplings to ensure leak tightness.

A recent incident [ref 17] however highlighted that if procedures and correct line ups are not followed, then an unauthorised discharge can occur. In this case, during a pressure test following a PET connection, it was noted that the pressure was not building up as required – this was due to an incorrect line up on the active waste tank that allowed potentially contaminated effluent to flow out into the Gareloch. Anecdotally, adherence to procedures has tended to be a recurring theme, a cultural issue that HMNB Clyde need to find a way to address.

Existing Constraints

Whilst the current arrangement is proven for the existing berths. During review of proposed arrangements for the transfer of effluent at the new jetty [ref 14] design issues were identified in respect of the limited volume available of only 2.3m^3. This limits flexibility of a major plant evolution such as a loop drain if required; however, these are infrequent events so it is not considered a major issue in respect of the practicalities of continued use of PET tanks.

Given the issues set out above, some improvements have been identified:

There is no extant safety justification for the placement of a PET on a jetty, the adoption of which would negate the requirement for lifting onto the submarine and therefore the risk of spills and dropped loads. The new Valiant Jetty is a floating jetty and the Value Engineering study [ref 14] recognised that to meet the conflicting demands of the submarine and the jetty, both subject to tidal movements, the length of hose was prohibitively long. This was thought to prohibit safe transfer of effluent and would hinder crane tracks etc depending upon where the PET could be placed and increase the risk of spills/leakage and damage to the hoses.

However an alternative has already been identified which seeks to place an empty PET on the casing and then transfer the contents to a road mounted PET/Bowser. This removes the risks from lifting a full PET and also removes the concern over a jetty placed PET. Although it does introduce double handling of the effluent, on balance, the risk is considered to be justified when considered against the risks associated with jetty placed PET.

Option 2: Local tanks on berths or other locations.

This option requires involves pipework installation on the Berths with local tanks installed at suitable locations. These tanks could then be emptied into a PET and the effluent then transferred to the REDF. It would be cheaper than a fully piped system (discussed below) but would still be expensive and would require disruption to the berths etc. The effluent would still require to be transferred by PETs and would therefore in effect be double handling and the risks of spills and leakages would increase.

This option is discounted as it has the potential to introduce additional risk of spills and leaks, at not inconsiderable expense and disruption, without a tangible benefit.

Option 3: Fully Piped System

This system would require fixed pipes at each berth leading back to the REDF. A fully piped system was not considered cost effective [ref 15]. There were concerns raised over the control of access to the pipe runs and on the provision of leak detection. This option may become a better option if the REDF and the nuclear berths were located in the same area as this would reduce the length of the pipe runs and therefore reduce the installation costs, the access control & the disruption to the Base. The principles of fixed pipes are discussed in section 5.4 below as they relate to the transfer of effluent to and from the REDF. However, currently the existing constraints at HMNB Clyde preclude such a major development.

This option is therefore discounted on the grounds of practicality.

Option 4: Replacement of PETs by Improved Design.

Description of Option

This option replaces the PETs with an enhanced design but carrying out principally the same function. A typical design could be similar to the Super Transportable Effluent Tanks (Super TETs), currently in use at Devonport Royal Dockyard for transfer of effluent from submarines. The design features of a Super TET are used here for illustrative purposes.

Risk and Environmental Considerations

These two items are considered together as they are inter-related. The risks of utilising this item as opposed to a PET are reduced due to the inherent design features when compared to the PET, although the issues in respect of the need for a safety justification to place the tank on the jetty remain, and the risks associated with the lengths of hoses and the potential fouling of crane tracks on the jetties leading to potential leakages remain and are undiminished.

The following enhanced design features are included:

- Fail close valves in the event of a failure preventing leakage.
- Self seal hose couplings to ensure leak tightness
- High/Low level controls, alarms and trips
- Tank overpressure alarm and trip
- Bund sump alarm and trip
- Interlocks to prevent unauthorised operations
- Two levels of containment are provided. The primary containment is the tank itself with isolation valves within a secondary containment iso-container capable of containing all the tank contents in the event of catastrophic failure.
- Any airborne activity within the secondary containment as a result of a fault is contained via HEPA filtration.

This would represent a superior design and would resolve many of the issues in using a PET with a far reduced risk of effluent leakage during a discharge or whilst in storage or transit. However the fundamental issue of placement on a jetty remains as previously described.

Technological Considerations

No specific considerations were identified as the design, whilst not familiar to HMNB Clyde, nevertheless has some commonality in C&I, so provided that an adequate maintenance schedule is in place and operatives are trained, an alternative design could be used.

General Health and Safety issues

No specific H&S issues were identified. Those relating to the placement of the hose of the jetty remain.

Cost Effectiveness

It can be readily seen that the design described above offers advanced protection but it is anticipated that in development and build, each item would cost well in excess of £100K therefore the replacement of the existing PETs with an advanced design is a disproportionate response .

Design Operability and Maintainability

The new design would require greater maintenance to take account of the additional design features incorporated and would require training in its use.

Existing Constraints

The existing constraint of the need for a safety justification for discharges to a tank on the jetty remains, and until such time as this issue is resolved, this option cannot be considered.

5.1.3. Summary

The PETs are an available proven method of transferring effluent with a good safety record. However in order to better demonstrate BPM, improvements can be made to the containment of effluent to reduce the risks of leaks and spills. Furthermore, the self seal hose couplings in the enhanced design (option 4) should also be considered as they are cheap and easy to implement with the benefit of improved leak tightness. The incident on HMS Superb reported above was due to a procedure not being followed correctly. This is a cultural issue that HMNB Clyde need to find a way to address if these sorts of incidents are to be prevented in the future. In the next section, details are provided on a recent incident concerning the PEB [ref 18]. It is important that the issues regarding maintenance and procedural control are followed through and read across to the discharge of radioactive liquid effluent to a PET.

The PETs design life expires in 2022 before which point consideration will need to be given to an adequate replacement which could include some of the enhanced containment features detailed in option 4 above.

5.1.4. Discharge Arrangements to a PEB

The arrangements for the PEB are as for the PET.

Figure 6 is a schematic of the PEB system.

The current PEB is out of service following the incident referred to above [ref 18], during which there was an unauthorised discharge to Gareloch. The investigation identified a series of shortfalls relating to the inadequate functioning and maintenance of the working tank level indication therefore allowing operators to misinterpret the contents of the tank. A higher level of confidence exists with the PET as there is a sight glass on the side allowing a direct sight of the level contents. Nevertheless recommendations made in that report should be read across to the PET to ensure that the circumstances leading to the incident cannot be replicated. This is discussed further below.

The PEB is tied alongside E-berth. The berth has been subject to a mechanical and electrical survey on its suitability to continue receiving the barge [ref 19]. Remedial action to prolong its life has been identified and agreed for implementation.

5.1.5. Option Analysis

Option 1: Continue with the Current Arrangements

The investigation [ref 18] into the PEB incident highlighted a series of issues relating to training, maintenance, procedural control and interfaces between REDF and Ships Staff. Remedial action in the form of an action plan has now been agreed and forwarded to SEPA [ref 20]. Completion of the action plan following the PEB incident in February 2008 is key to making a demonstrable argument that the arrangements for discharging effluent from submarines to PETs or PEB (or equivalent) is BPM. Actions can be summarised thus:

- Maintain a critical item list and ensure it has an adequate maintenance schedule
- Review all procedures relating to the transfer of effluent from submarines considering any improvements, ensuring the appropriate SQEP are involved.
- The environmental awareness of all staff involved in the discharging, handling, processing and disposal of liquid effluent should be improved to ensure that where applicable it is part of the core competencies of staff.

Unless these issues are satisfactorily addressed, it will be very difficult for HMNB Clyde management to sanction the use of the PEB and demonstrate BPM.

Option 2: Continue with Current Arrangements but with a New Barge

Description of Option

The requirement here would be that a new barge was designed to a modern standard that included:

a) A level of secondary containment should be in built minimising the risk of overflows/ spills and leakages, which should include the connection, disconnection and transfer process actually occurring under cover.

b) Alarm panels and level indicators in an ergonomic designed control suite

c) Tank agitation to ensure that effluent settling over time can not occur giving a long term radioactive waste disposal issue. It should be noted however that this has not been an issue with the current barge and whilst it may not have been seen as a necessary requirement, agitation systems are a part of modern effluent receipt systems and should not automatically be excluded.

Risk and Environmental Considerations

So long as the requirements of a-c above are addressed together with the issues detailed in the action plan [ref 20] the risks to the environment from the use of a barge will be minimised.

Technological Considerations

The principle of a Barge remains at odds with modern facilities although if the conditions of containment and design are maintained, a "dumb" barge may be considered BPM in the absence of a more practicable land based solution.

General Health and Safety Issues

There are none.

Cost Effectiveness

A new barge has been estimated to incur costs in excess of £200K and therefore may not be the most cost effective option.

Design, Operability and Maintainability

The development of a new barge in accordance with the Authorisation Conditions would ensure that the operability and maintainability were fully assessed and demonstrated before the item was brought into service

Existing Constraints

In looking at a new PEB the arrangements should also be reviewed including the conditions for discharge given that the transfer is open to the elements if (a) above can't be achieved. Any barge will be subject to MCA checks and its movements managed by QHM staff , giving confidence that a barge can remain in a safe seaworthy state either in transit or whilst alongside.

This is an expensive option but provides the benefit of being readily used at the new jetty which has been designed to receive a barge.

In addition to this, there is also the matter of E-berth itself as remaining suitable to berth a new barge. It has been subject to structural inspection [ref 19] and recommendations made. These are in hand and need to be progressed to ensure confidence that E Berth is structurally sound to berth a PEB, but also form the support to the discharge pipeline (see 5.6 below) out in the Gareloch and effluent receipt from the PEB to REDF.

Option 3: Delete the Requirement of the Barge

This option examines the implications of HMNB Clyde discontinuing with the use of an effluent barge. This option therefore deletes the requirement for a barge completely. The ability to implement this option is predicated on two facts:

a) That a suitable safety justification can be made for a PET (or suitable alternative) on the new valiant jetty (or elsewhere) demonstrating that the risks from leaks and spills was acceptably low.

b) That no discharges take place as a routine from Astute class submarines but full use is made of their MUD tank, which are part of the new reactor plant design to minimise the requirement for routine shore discharges from Astute and Vanguard class submarines.

Consideration to alternative methods of effluent transfer will be required if Clyde decide not to use an effluent barge. An assessment of additional risks due to any increased manual handling must be included in any assessment undertaken. However, this must be assessed in light of the much lower volumes involved with Astute and Vanguard class submarines liquid effluent discharges.

Option 4: A Lorry Mounted Tank/Barge Mounted Tank.

Description of Option

This option removes the need for a PEB and replaces it with a lorry mounted tank that can move from berth to berth as the requirement exists. An alternative would be a barge mounted tank but the same principles apply.

Risk and Environmental Considerations

Such an option represents an accumulation of radioactive material but negates the risks from dropped loads. As a tank for radioactive effluent it will need to fulfil some basic criteria:

- Fail close valves in the event of a failure preventing leakage.
- Self seal hose couplings to ensure leak tightness during transfers
- High/Low level controls, alarms and trips
- Tank overpressure alarm and trip
- Bund sump alarm and trip
- Interlocks to prevent unauthorised operations

Technological Considerations

There may be an issue regarding the ability of the submarine to pump effluent to a road mounted tanker if the vehicle was not able to get sufficiently close to the submarine. A long effluent hose may prohibit effective transit of effluent.

General Health and Safety Issues

This adds a significant weight to a jetty loading which would require to be substantiated.

Cost Effectiveness

The barge mounted tank may be a cost effective option but the relative cost differences between a road tanker and a new barge are not readily identifiable given that the requirements for transfer of effluent remain the same. A road tanker would not offer any great financial advantage over a barge but perhaps be more in keeping with practice elsewhere in industry.

Design, Operability and Maintainability

This is effectively a large PET that removes the operational concern over limited capacity (2.3m3) raised at [ref 14] but on a road/barge. It has several advantages in that a large discharge would be in one single operation and it would already be part of a vehicle/barge, removing the need for craning operations therefore removing the risks of dropped loads. There would be an interconnecting flexible hose to the submarine capable of operating at tidal jetties.

Existing Constraints

The barge option is the favoured option for the HMNB Clyde as it offers the greatest flexibility for the new jetty whereas with the distances between jetties currently involved, more than one bowser would be required, possible incurring significant costs. Parking positions may also be an issue if the hoses cross crane rails.

5.1.6. Summary

The current PEB cannot be used in its current configuration. A new PEB designed to the standards appropriate for receipt of effluent will cost in excess of £250K but may represent BPM in the absence of a practicable alternative for the new class of submarines. A barge or lorry mounted SuperTET or equivalent may present a more cost effective option if a justification can be made for SuperTETs to receive effluent direct from the submarine.

5.1.7. Summary of Discharges from a Submarine

This assessment came to two conclusions:

- That the use of a PET (in appropriate conditions) is the optimum solution and BPM and no other cost effective solution was identified for the duration of the lifetime of REDF.
- The use of a PEB, is not viewed as the optimum solution and further work is required to identify whether there is a practicable alternative.

In order to underpin this assessment and better demonstrate BPM, the following recommendations are made:

Recommendation 5: Steps should be taken to ensure that lessons are learned from the Torbay / PEB event and that appropriate corrective actions have been identified. [ref 20]

Recommendation 6: The arrangements for the leak protection during a discharge to a PET can be improved by draining the overflow effluent back into the reactor plant instead of a carboy as carried out at BM (Devonport) and introducing self seal hose couplings to ensure leak tightness.

Recommendation 7: HMNB Clyde should resolve the maintenance issues associated with liquid radioactive waste systems to ensure that the appropriate maintenance is carried out on all systems. This extends to setting up a maintenance schedule entirely of environmentally sensitive plant and equipment to ensure they are maintained to a standard commensurate to their importance.

Recommendation 8: The PAG should critically review the precautions and requirements for discharges in conjunction with the submarine staff to ensure that the conditions within which the discharge takes place are conducive to an operation involving transferring of radioactive effluent. This links back to recommendations 3, 4. and 6.

Recommendation 9: The requirement for a safety justification for a PET placed on a jetty to receive a submarine discharge should be assessed taking into account the risks of leaks and spills resulting from the use of flexible couplings and potentially long lengths of hose.

Recommendation 10: The requirement for a new PEB or equivalent barge mounted tank should be considered before steps are taken to procure a new design, which by implication will need to be designed in accordance with standards expected of an effluent tank and address the actions identified and agreed following the PEB incident [ref 20].

Recommendation 11: Follow through the recommendations made by the E Berth Structural report [ref 19] such that it can be confirmed as sound for the duration of the lifetime of the REDF (5 to 7 years).

5.2. Movement of Effluent in a PET/PEB to the REDF

5.2.1. Current Arrangements

The current arrangements for transfer are as follows:

For the PET: Under procedural control on a specified route utilising the controls detailed in section 5.1.2 above. The PET remains on the lorry whilst the transfer of effluent takes place. This negates the requirement for additional lifts into the REDF compound.

For the PEB: Towed round to E- Berth by QHM under PAG control and prepared for discharge.

5.2.2. Option Analysis

No alternative arrangements for the transfer of a PET to REDF were identified. The arrangements are well identified under procedural control.

5.2.3. Summary

The current arrangement for the transfer of PET to the REDF is BPM.

5.3. Receipt of Effluent from PET at REDF

5.3.1. Current Arrangements

Transfer of effluent from the PET to REDF takes place under cover at the PET discharge area under NSAG control. The PET remains in situ on the low loader removing the risk of dropped loads.

The system is subject to routine maintenance and no issues have been identified. A recent inspection did not identify any issues [ref 21].

The PET is connected to the PET discharge point on the east side of the Treatment Plant. This is by means of a flexible hose, which is pressure tested to confirm the integrity of the system. The REDF is lined up to receive the discharge from the PET. The contents of the PET are discharged into Buffer Tank B under nitrogen pressure. Throughout the discharge process, the level of the Buffer Tank is monitored in the Control Room, whilst the pressure and level in the PET is monitored locally at the PET. On completion of the discharge, the flexible hose between the PET and the Treatment Plant connection point is flushed with demineralised water from the Plant into the PET. The PET is then re-pressurised and the water discharged into the REDF Treatment Plant. The hose is isolated, disconnected and drained into a carboy.

All procedures are under NSAG control [ref 22]

5.3.2. Option Analysis

In light of the conclusion that the use of the PETs is in keeping with the principle of BPM with the current arrangements, no other options were identified. With the procedural control and EMIT regime in place and if exercised properly, adequate arrangements are in place to minimise the risk of effluent leakage during effluent receipt at REDF from a PET.

However improvements can be made for the effluent transfer process by improving the level of containment on the PET. The receipt of effluent is under cover in the Wendy House and this has been demonstrated as sound. However on the PET itself there is little containment.

5.3.3. Summary

Whilst adequate arrangements are in place to minimise the risk of effluent leakage from the PET to the REDF consideration should be given to additional containment on or about the PET during the transfer into the REDF. Therefore, BPM will be better demonstrated if the following recommendation is followed through.

Recommendation 12: Give consideration to improved containment arrangements for effluent transfers between a PET and REDF to minimise the risk of escape to the environment if a leak were to occur.

5.4. Transfer of Effluent to REDF by Installed Pipework

Section 5.4 considers the totality of the existing installed pipework as the issues for their utilisation and maintenance are similar. It is therefore set out as follows:

- A description of the installed pipework that is in use at Faslane
- A discussion on the requirements the discharge pipe lines and their integrity
- An option analysis for the various pipelines
- Summary of the BPM argument for their continued use.

5.4.1. Installed Pipework Routes

The following radioactive effluent pipework routes are installed.

- **APF to APF Lab Tanks** - The interconnecting effluent pipework between the APF and APF Lab tanks is a mixture of 2", 3", 4" & 6" Nominal Bore (NB) UPVC pipe. The pipework is protected by its location within the APF or within a concrete duct and was installed mid1980s.
- **M11 to APF Lab Tanks** - The interconnecting effluent pipework between the M11 and APF Lab tanks is 2" NB Medium Density Polyethylene (MDPE). The pipework is protected within a concrete duct and was installed in the early 1990's.
- **Radiochemistry Pipeline to APF Lab Tanks** - The interconnecting effluent pipework between the radiochemistry tank and the APF Lab Tanks is 3" NB UPVC. The pipework is protected by its location within the APF underground is located within a concrete duct to the APF Lab Tank manifold.
- **APF Lab Tanks to REDF** The interconnecting effluent pipework between the APF Lab Tanks and the REDF is 2" NB MDPE. The pipework is protected within a buried cast iron pipe between inspection pits and was installed in the late 1960s.
- **APF Lab Tank Discharge Pipe from Wendy House to Demag** - The APF Lab Tank pipe that runs from the 'wendy house' to the demag store is 2" NB schedule 40 stainless steel. The pipework is protected by lagging. Various sections of this pipe have undergone NDE inspection.
- **PEB to REDF Discharge Pipe** - The PEB to REDF discharge pipe is 2" NB consisting of schedule 10 and 40 stainless steel. The pipework is protected by lagging and located within a concrete duct. Various sections of this pipe have undergone NDE inspection.
- **REDF to Gareloch Discharge Pipe** - The REDF to Gareloch discharge pipe is 2" NB consisting of schedule 10 and 40 stainless steel. The pipework is protected by lagging. Various sections of this pipe have undergone NDE inspection.

These pipelines have been subject to surveys [ref 23] which will be discussed in section 5.4.3. It should be noted however, that currently the pipe lines connecting APF to APF Lab tanks have been taken out of service following the discovery of levels of contamination in and around the tank connections. At the time of publication of this report the origin of the contamination had not been determined.

5.4.2. Current Arrangements

This section sets out the current arrangements for the pipes and their utilisation.

5.4.2.1. Generation and Transfer of liquid effluent from the APF to the APF Lab Tanks

Effluent arising from the various activities within the APF is piped to the Lab Tanks. Sources include from the wash hand basins, decontamination area and showers. The volumes are indicated in the table below:

Year	No. of discharges	Amount (m^3)
2007	9	41
2006	2	12
2005	12	30
2004	5	21
2003	12	57.5
2002	14	61
2001	18	77.5

Table 5.1 APF Lab Tank Discharges to Gareloch

It should be noted that, as discussed later is this section, the APF Lab Tank area allows ingress of rain water that is pumped into the tanks for discharge. Therefore these volumes contain a level of rainwater that is difficult to accurately quantify.

All operations are under NSAG approved documentation [ref 24]

5.4.2.2. Generation and Transfer of liquid waste from M11 Tank to the APF

Waste was captured in the M11 tank and pumped into the APF lab tanks on an infrequent basis. The tank is located underground outside the North East corner of the NE&WS. It contains an Effluent Discharge pump, a level sensor and vent filter, discharge valves, pressure switch and pump isolation valve. Access to the tank is via gattick covers controlled by the REDF. When effluent reaches a pre-determined level it is discharged to the Lab Tanks.

The tank area sits in a sump which can be pumped to the APF Lab Tanks. All M11 operations are governed by NSAG approved documentation [ref 24]. Arrangements are already in place to ensure that liquid radioactive waste (i.e. primary coolant) is drained from the test rigs/pipework before leaving submarine, thereby reducing quantity to be drained at NEWS workshop. The table below illustrates the small volumes being transferred in comparison to the total volume being discharged from the APF Lab Tanks on an annual basis.

Tank levels are monitored locally in the NE&WS, with a repeater alarms in a manned area of ES(HP). Typical annual arisings of liquid radioactive waste from the NE&WS are up to 0.5 m^3.

At the time of this review, effluent was being drained to M11 tank but the interconnecting pipework to the APF Lab tanks has been subject to an investigation to determine levels of contamination in and around the APF Lab tank connections.

Figure 7 is a schematic of the APF Lab Tank system including M11.

5.4.2.3. Liquid Waste from the Radiochemistry Laboratory to APF Lab Tanks

The Radiochemistry laboratory is sited on the first floor of the Cochrane Building. [ref 25] Sources contained within the laboratory consist of the following:

- One litre samples of radioactive liquid effluent from REDF/Lab Tanks
- Primary coolant samples
- Liquid Calibration Sources

Liquid samples can be stored for up to 3 months but are double bagged with sufficient absorbent material which is in keeping with the requirements of RPSOs [ref 13].

Routine surveys are carried out and contamination levels above background are not normally detected giving high confidence that the handling and processing of liquid effluent samples is sound. All potentially contaminated liquid arisings generated in the Radiochemistry Laboratory are to be drained to the Laboratory Tanks. Drip trays are to be flushed clean with demin water after use.

Any solid waste is to be double poly-bagged, labelled appropriately and transferred to the APF as detailed in RPSOs [ref 13].

5.4.2.4. Transfer of Effluent from the APF Lab Tanks via REDF to Gareloch

There are two APF Lab Tanks, taking the very low level radioactive effluent from M11, APF and the radiochemistry laboratory which facilitate sampling and radiochemical analysis, before it's discharged directly to the Gareloch. The system incorporates two discharge pumps which are situated in the area adjacent to the Lab Tank room. The pumps can take effluent from either tank or the sump and discharge the effluent to the Hold Tanks or to the Gareloch, or allow re-circulation of liquid effluent to either of the ES(HP) Lab Tanks for sampling. The discharge line incorporates a pressure gauge and a sampling point. To prevent unwanted discharge to the Gareloch, the final discharge valve is situated in the REDF compound, where it is double locked and controlled by the REDF.

Figure 7 refers.

Tank levels are monitored locally within the lab tank control room with repeater alarms in a manned area of ES(HP).

Historically, the radioactive contents of the Lab tanks has never been high enough to require circulation via the REDF process Plant.

The tanks have no agitation and historically there is no evidence of radioactive build up suggesting that agitation would not be required.

No volume or flow check is done to confirm all the effluent has transferred. A full maintenance schedule is in place approved by NSAG.

The facility exists to sample either Lab Tank via a dedicated sample point.

The operation and discharge of these tanks is controlled by NSAG documentation [ref 24].

5.4.2.5. **Discharge Pipe from PEB to REDF**

Once the PEB is secured at E Berth, preliminary volume, temperature and pressure checks are carried out on the demineralised water tanks, nitrogen bottles and the liquid effluent. Portable radios are used to establish a communications link between the REDF, PEB and E Berth. The PEB is connected to the pipework at E Berth valve house by the flexible discharge hose, which is pressure tested to confirm the integrity of the system. The contents of the heavily contaminated tank in the PEB are discharged to the REDF (usually Buffer Tank B), using the effluent discharge pumping system on board the PEB, through the interconnecting pipework within a surface concrete duct. If necessary, the Flank Tanks are emptied in the same way; these tanks are pumped out together to prevent listing of the Barge during discharge. Once emptied of radioactive liquid effluent, the PEB interconnecting pipework and the flexible hose is flushed with demineralised water, and drained back into the Barge Effluent Tanks. The REDF is informed that there will be no further discharges. The hose is then disconnected and the PEB is prepared for re-use in accordance with the approved arrangements.

The surface concrete duct in which the PEB-REDF pipe sits was not specifically designed for effluent pipework, rather for shielding the now redundant resin discharge pipes and providing some degree of protection from external hazards. The duct has no in built leak detection system, and is not lined therefore allowing any leak from the pipe to escape into the environment.

All discharges are controlled by approved NSAG procedures [ref 26].

5.4.2.6. **Discharge Pipe from REDF to Gareloch**

The arrangements for discharge of the treated effluent to Gareloch are discussed in section 5.6 following the section on the process plant, in keeping with the principle of the document that it follows the route of the waste from generation to disposal. This sub-section therefore only looks at the pipeline.

The pipeline extends through the demag store into a concrete duct for a short distance (3m) then exits through the security fence over water until it rejoins E-berth and descends down into Gareloch.

5.4.3. **Integrity of the Pipework**

The pipework described above has been subject to survey [ref 23], the results of which are:

- Plastic Pipework: NBDD investigations and surveys confirmed that the plastic pipes are protected from external influences which can cause degradation by virtue of their location within underground ducts, buildings or protected by a cast iron pipe and inspection pits. The pipework has not been subject to extreme pressure or temperature variations and the effluent that passes down the pipes is benign in nature therefore it is likely that the pipework remains in a condition similar to its initial condition with little or no deterioration.

- Discharge Pipework inspections and surveys have been hindered particularly for the discharge to Gareloch line because of the particular route as described above, presents some health and safety challenges which in the long term may not be acceptable. The survey indicated a weld failure resulting in a release of radioactive effluent over an unidentified period of time. This has now been repaired allowing discharges to recommence.

- APF Lab tanks Wendy House to Demag Store – The pipe that runs from the wendy house to the demag store has a degree of support from the REDF compound fence and is lagged.

- The APF Lab Tank sump allows ingress of rain water which is pumped back into the tanks and disposed of to Gareloch with the other low activity effluent.

- Ducts: the ducts are not lined in anyway therefore there is no barrier to prevent any seepage straight to the environment. The structure of the ducts themselves is of sound quality and unlikely to degrade to any degree over the next 5 to 7 years.

- During May and June 2008 a radiological assessment was undertaken on sections of the REDF radioactive effluent pipeline as described above. The assessment involved taking liquid samples of Lab Tank pits and sump and smears of pipework especially around flange joints and other accessible connections. The liquid samples were subject to gamma spectroscopy and liquid scintillation. The smears were subjected to gross beta counting and liquid scintillation. Solid material waste that was removed from the Lab Tank pipe inlet area during an initial clean up was assessed using shielded plastic scintillation.

The results of the analysis show that levels of contamination was detected in 4 keys areas:-

- Discharge flange at E Berth

- surface contamination was found on smears of inlet and outlet Lab Tank flange area

- Lab Tank sump effluent positive liquid scintillation result for Tritium of sump liquid

- First Lab Tank discharge pipe inspection pit (No4) positive liquid scintillation result for Tritium

As a result of these surveys, the pipelines into and leaving the APF Lab Tank area have been taken out of service. An investigation is underway to establish the root cause of the positive results of the Lab tanks pipework, sumps and No 4 pit is underway which will include an engineering assessment of the pipework. Until that work has finished and is reported, an argument cannot be made for the continued use of this pipework.

These findings do give some degree of confidence that the pipes themselves are not in any immediate state of dis-repair but the connections and joints may require more detailed examination. There is no maintenance regime (in the form of visual inspections or NDE) to provide the necessary ongoing confidence of their integrity. Furthermore in order to inform that maintenance regime, there are no detailed drawings or specifications which provide the Operator with a detailed understanding of how the pipelines were constructed, laid (i.e. routed) or their specification.

The requirements for managing pipelines of this nature are now discussed in the next section and a series of recommendations made to ensure that the continued use of pipe could be considered as BPM over the remaining life. Alternative options are then discussed in the subsequent section.

5.4.4. Discussion and Recommendations for Further Work

It is clear that several aspects of the pipework do not conform to modern practice. The continued use of this pipeline requires careful consideration. These are discussed below:

- The level of information held regarding these pipes is not of sufficient detail to provide the necessary level of confidence in the system for an extended period. Comprehensive "As Built" drawing information does not exist and information which is available can be misleading. For example record drawing information exists showing inspection hatches to view expansion joints but the revision status does not confirm the modification was installed. In relation to the use of the plastic pipework, there is no detailed information on the material selection particularly for its use for the radiochemistry drain. Whilst the pipeline is in good condition and the liquid passing down the pipeline has very mild chemical content, confirmation should be sought that the plastic used is still appropriate.

- Flange joints provide the potential for seepage and are to be avoided in systems which cannot be inspected. Without accurate drawing information it is difficult to identify whether this is an issue and there are hidden joints. If an underground system contained in a duct or culvert cannot be inspected by removal of a cover or grating panel, fully welded joints provides the most reliable jointing method in underground pipe line installations .The joints within the underground installation can be strength tested prior to start up .

- Cracks in the external surface of old existing insulation provide an opportunity for water ingress and therefore a corrosion mechanism. However the survey work and inspections indicated that the pipework was in very good condition despite a potentially corrosive marine environment for exposed areas of Stainless Steel.

- The available inspection ducts and sumps are not sealed from the environment in so far as rain water /debris builds up therefore its not possible to make a routine visual inspection without operational support to pump out these out in advance.

- A weld repair has been completed of a flange on the discharge pipeline at E Berth and a verification process has established that this section of the pipeline is free of leaks. However as stated above until the engineering assessment/investigation has reported back, the other pipelines into and out of the APF lab Tanks cannot be brought back into service and an argument made for their ongoing integrity.

These points lead on to the following series of recommendations applicable to all the pipes described in section 5.4.1:

Recommendation 13: No drawings exist illustrating clearly where connections are, and in order to ensure an adequate EMIT schedule is in place, "as built" drawings should be produced indicating any areas of concern where an inspection should be targeted and other specifications as deemed necessary. Areas of concern include:

- Direct Wall penetration (No Sleeve)
- Support points
- Dead legs
- Material interfaces, for example from carbon steel to stainless steel, or from stainless steel to plastic
- Joints including any expansion joints
- Material selection including insulation types.

In order to facilitate these drawings, a survey package to confirm the routes of the pipelines which have not been inspected to their position should be implemented.

Recommendation 14: Implement an adequate EMIT regime consisting principally of:

- Scheduled visual inspections to confirm whether any deterioration has occurred and in comparison with previous inspection record changes.
- Routine NDE , particularly ultrasonic testing of wall thickness
- Focus NDE on areas of concern particularly at any joints and welds to confirm integrity
- Regular radiological analysis to confirm no leakage

The confidence of the maintenance schedule can only be made if the recommendation 13 above has been fulfilled and a full specification has been set out.

Building on the implementation of the EMIT regime recommended above, the state of the pipelines and their integrity must be tracked to build up a data base of information regarding the pipework to provide continuing confidence of their integrity as the reference design.

Recommendation 15: Despite the low levels of leachable chloride in insulation materials pitting and stress corrosion can take place in insulated stainless steel. The presence of moisture can concentrate chlorides in localised areas and lead to corrosion at the stainless surface. The chloride levels may be enhanced from external sources such as rainwater .Therefore where insulation is being replaced a foil corrosion barrier shall be specified between the pipe and insulation .The external tin casing on the insulation shall be sealed to prevent the ingress of rain water.

Recommendation 16: Where stainless steel pipework is being replaced and carbon steel supports are used, consideration should be given to providing an isolating strip between the stainless steel and carbon steel to prevent an external reaction or corrosion mechanism.

Recommendation 17: Where the opportunity exists, implement a leak detection system using flange covers if a suitable type can be identified. They are used in the chemical industry and change colour when seepage is detected. This may not be appropriate for such benign liquid effluent nevertheless improvements can be made in the level of detection.

Recommendation 18: Ducts and sumps must be made leak tight to prevent the ingress of rainwater requiring in the case of the water in the APF Lab Tank sump to be treated as active and pumped back into the tank. Sumps should be lined with an appropriate material to ensure they prevent water ingress. Ducts should be modified to include some method of containment for any leak. This could be in the form of a stainless steel/aluminium tray underneath the pipe effectively lining the trench. The large concrete covers should be replaced by easily removal covers rather than the heavy concrete blocks which present a dropped load hazard to the underlying pipework, as well as a H&S hazard to the individual(s) tasked with their removal. However the ducts/inspection pits should remain covered to prevent rainwater ingress.

These recommendations are potentially quite far reaching and in demonstrating integrity over the long term implementing them may not provide the most cost effective solution. They should be considered as part of the engineering assessment referred to above.

Therefore the section below provides alternative options to the existing installed pipework.

5.4.5. Option Analysis

This section provides an analysis of the varying options to the movement of the effluent in the underground pipelines.

5.4.5.1. Option Analysis for Transfer of Liquid waste from M11 to APF Lab Tanks

Option 1: Maintain the Current Arrangement

This option requires the pipelines to be brought back into service and an adequate maintenance regime on the M11 tank and associated control panel instigated. Currently the level indicator is understood not to be on an asset register and therefore not maintained to a level that it should be. However action is in hand to resolve this with the introduction of an asset list of environmentally sensitive equipment that will include such items currently not included. This is an undertaking of the action plan reported at reference 20.

To achieve a level that could be considered best practice, the recommendations made in section 5.4.4 apply to M11 connected pipework. Furthermore the origin of the radioactive contamination needs to be identified and resolved before the pipelines can brought back into service.

Option 2: Drain the Effluent Direct to an Engineered Portable Container for Transfer to APF:

This will depend on volumes of liquid generated; however, recent history indicates that they are very low with none being discharged last year from the M11 tanks, thus suggesting this is a sustainable arrangement. This option would remove the requirement for tanks and pipework and hence reduce the potential production of radioactive waste and operator dose during maintenance. It effectively removes the risk of any potential leakage and escapes from buried systems. Costs for this engineered modification would be modest.