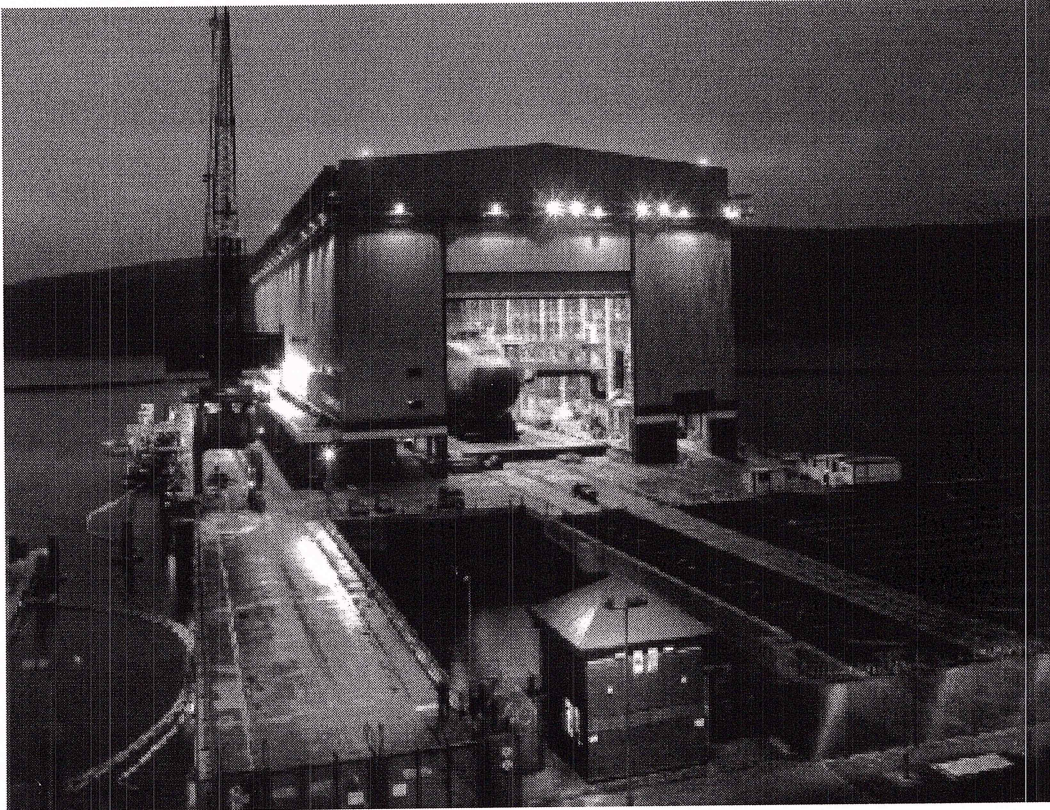


PERIODIC REVIEW OF THE SAFETY CASE FOR THE SHIPLIFT AT HM NAVAL BASE CLYDE

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Summary

The Shiplift Facility at HM Naval Base Clyde is used to provide a docking facility for nuclear submarines. It was recently the subject of the first ever Periodic Safety Review for a Ministry of Defence Nuclear Facility, completing in March this year. The Review Report has been accepted by HMNB Clyde and is currently with the Naval Nuclear Regulator for agreement. HMNB Clyde is currently closing out the resulting Work Package.

The Shiplift Facility Safety Case document suite comprises over two hundred documents. Seven enabling contractors supported the Periodic Safety Review, with the process taking twelve months. This paper presents the process undertaken by the Mott MacDonald Team that managed and reported on the PSR, and the logic used in arriving at that method. The paper examines the main difficulties encountered, foreseen and unforeseen, and the lessons learned for future Periodic Safety Reviews.

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INTRODUCTION

1. The Shiplift Facility at HM Naval Base Clyde was commissioned in 1993. It provides a covered docking facility for British nuclear submarines and certain surface vessels or equipment. The Shiplift Facility Safety Case (FSC) forms part of the Nuclear Site Safety Justification (NSSJ) at HMNB Clyde. It is mainly supported by fifteen Design Safety Reports (DSRs), which are in turn supported by Technical Reports (TRs).
2. Authorisation Condition 15 of BR 3018(2), requires that Periodic Safety Reviews be carried out to ensure continued conformance of Facility Safety Cases to BR 3018(2), including the Safety Principles and Criteria specified therein.
3. This paper presents the process used to manage and report on the Periodic Safety Review (PSR) of the Shiplift, this being the first ever PSR for a Ministry of Defence Nuclear Facility. The PSR commenced in April 2000 and completed in March this year.
4. The Periodic Safety Review was carried out as part of a much larger programme of work, termed the Shiplift Staged Improvement Programme (SIP). This is due to complete in 2005, and staff at HMNB Clyde are currently closing out the PSR findings as part of SIP Phase 3.

SCOPE OF PERIODIC SAFETY REVIEW

BOUNDARIES OF THE FACILITY UNDER REVIEW

5. The physical boundaries of the Shiplift Facility under review were defined by the FSC documentation. Points of interface with other facilities and utilities and their safety cases were confirmed as part of the review.

DOCUMENTARY SCOPE

6. The documents reviewed under the PSR process were those comprising the current safety case. In the first instance they were identified by the audit trail of references emanating from the current regulatory approval letter. The review addressed the Shiplift Facility Safety Case documentation down to Technical Report (TR) level, totalling over two hundred documents. To include a further tier of documents in the review would have enlarged the scope of the Review considerably, and was considered unnecessary since the principles of the safety case are all reported at TR level or above. Other supporting documents were available to Reviewers but were treated as reference documents, available to allow the reviewers to explore areas of detail at their discretion if this was considered necessary.
7. The review also covered the Nuclear Safety Management System for the Shiplift Facility.

REVIEWS OF INTERFACES WITH THE FACILITY SAFETY CASE

8. Reviews of Interfacing Facilities relied upon were conducted down to Design Safety Report level (one tier below the Shiplift FSC document) unless additional depth of review was justified. This limitation was based on the assumption that the Interfacing Facilities will have their own Periodic Safety Review at suitable intervals.

9. The review also considered the interface with the Nuclear Steam Raising Plant, Strategic Weapons Systems, Tactical Weapons, other jetties and the Nuclear Site Safety Justification.

THE PSR TIME HORIZON

10. The time period covered by the PSR extended from inception of the safety case out to the anticipated completion of the Works List arising from the next PSR. Contingency assumptions based on the date for completion of the SIP led to a time horizon of 2011.

MANAGEMENT ARRANGEMENTS

11. Acknowledging the Facility Operator as owner of the safety case, overall direction of the PSR was the responsibility of the Shiplift Safety Case Project Management Team, headed by the Naval Base Design Director and formed of five SIP project staff plus the Mott MacDonald Support to Project Team Leader. The MoD staff on the management team provided knowledge of the Facility and safety case, and access to the organisations responsible for their maintenance.

THE SUPPORT TO PROJECT (STP) TEAM

12. In view of the volume of work involved, a StP team was employed to manage the Periodic Safety Review. The StP team used MoD-contracted specialists to conduct the review. To maintain the "intelligent customer" concept the StP team managed the PSR whilst enabling effective overall control remain with MoD. The StP team comprised up to four Mott MacDonald staff, and one member of Sage Safety Limited under subcontract to Mott MacDonald.

13. The main functions of the StP team were to:

- identify and collate the FSC and all supporting documentation;
- develop the requirements for the PSR into a detailed, robust and auditable process comprised of specific and unambiguously defined tasks that covered all of the necessary facets;
- identify and instruct appropriate contractors to undertake each task;
- progress each task to programme;
- review the task products and recommend acceptance;
- produce the PSR report and its associated Works List, derived from the task products, and take the PSR report through the independent reviews devised for it.

DEVELOPMENT OF THE PSR PROCESS

14. Prior to commencing the PSR, the StP produced an approved Management Plan that described in detail how the PSR would be undertaken. The plan set out the detailed procedures, methodology and guidelines for the conduct of StP's management of the PSR.

15. The StP Management Plan provided the means of breaking down and inter-relating the PSR tasks through the use of:
- an overall flow chart of the PSR process;
 - a more detailed PSR "Route Map", depicting which documents (viz. FSC, DSR or TR) were to be subject to which Parts of the review. It also showed the necessary transmittal of Review Points between review elements, to provide a review of safety case cohesion;
 - a PSR Task Requirements Schedule derived from the Route Map and the PSR requirements. It gave a highly prescriptive set of requirements for undertaking and reporting each review task. These sets of requirements ensured that the various parts of the PSR, as broken down through the logic of the management plan, continued to fit together as a complete and cohesive Periodic Safety Review. This would result in the production of a robust PSR report supporting a comprehensive Work List of items requiring corrective action to be taken.
16. The above tools also provided the audit trail for the development of the PSR requirements, which are described below.

CONDUCT OF THE PSR ON A DOCUMENT BASIS

17. With over 200 documents in the Facility Safety Case, conduct of the PSR on a Hazard basis was rejected, mainly on the basis of logistics. The FSC documents are organised largely on the basis of plant and structures, and there is no Hazard Log cross-referencing the hazards, the affected plant and the documents in which the hazards are addressed. The conduct of the PSR on this basis therefore carried the programme risk that the hazard justification trail might branch out unpredictably, requiring the supply of large numbers of documents at short notice.
18. On the other hand, having identified the documents comprising the Safety Case, the documents associated with a particular DSR could be readily determined in advance and provided to the reviewers. The decision was therefore taken to conduct the PSR on a documentary (largely plant and structures) basis determined by the structure of the DSRs supporting the Facility Safety Case and the systems that they covered. Even so, the production of the documentation for the various reviewers under the enabling contracts remained a considerable (albeit predictable) task in its own right.

USE OF ENABLING CONTRACTORS

19. Prior to the commencement of any task, a clarification meeting was held with the relevant contractor. This meeting was to clarify and agree the precise scope and timing of the work prior to the submission of his Statement of Work, programme and price. The StP team tracked progress and reviewed the product of each task to ensure that it complied fully with prescribed requirements, hence maintaining the integrity of the PSR. Particular attention was paid to ensuring that the reports were clear and consistent.

USE OF SUITABLY QUALIFIED AND EXPERIENCED REVIEWERS

20. The PSR is itself a review and it was therefore not considered cost-effective to conduct a full Independent Peer Review of every aspect of the PSR. To do so would have been to conduct a "review of a review" at a detailed level. A decision was made

at the outset, therefore, to ensure that only persons with suitable qualifications and experience were to be used by the contractors carrying out the work.

ASSUMPTIONS

21. The PSR covered over two hundred documents ranging over a considerable number of physical elements of the facility and its interface with the external environment. Several hundred more documents are referenced by these core documents. In order to clearly bound the task and carry it out effectively, a number of explicit assumptions were made and justified in advance. Some are implicit elsewhere in this paper. Some others were:

PERIODIC SAFETY REVIEW OF INTERFACING FACILITIES

22. That Interfacing Facilities as defined earlier will all be the subject of their own Periodic Safety Reviews during the next five years or such other period as will be acceptable to the Authorisee and the Regulator.

REVIEW OF EFFECT OF SHIPLIFT AGEING ON INTERFACING FACILITIES

23. Where Shiplift Facility ageing affects Interfacing Facilities, this will be addressed by the PSRs of those Facilities, by review of the ageing review reports from the Shiplift PSR. This provides a cost-effective means of identifying what are expected to be minor changes to the external hazard assessment of these Interfacing Facilities.

COMPLETENESS OF THE WORK LIST

24. All work required by nuclear safety considerations and identified by the PSR must be unambiguously identified in the Work List, even if that work is in hand. Hence closure of the Work List implies closure of all extant outstanding issues.

ASSESSMENT OF PLANT CONDITION

25. Part of the Ageing Review would include a projection of the anticipated condition of the plant to the next review in 2011. It was assumed that this assessment should be based on visual inspection and engineering judgement. It was further assumed that current maintenance and trends in plant deterioration would continue unchanged. Where site visual inspection was insufficient to allay the concerns of a PSR Reviewer, a Work List Item was raised to ensure that appropriate inspection would be conducted.

TREATMENT OF UTILITY ENHANCEMENTS WHEN ASSESSING FUTURE CHANGES TO THE FABRIC AND OPERATIONS OF THE FACILITY

26. That, when any utility enhancements currently under consideration are introduced, the due process requirements for those changes will be address all appropriate nuclear safety issues once the selected options are chosen. The logic of this assumption was readily apparent when considering some utility targets that were examined but will almost certainly not proceed.

THE PSR PROCESS

27. PSR comprised a number of connected facets, namely:

- a review of the status and validity of the Facility Safety Case documentation;
- a review of the effects of facility ageing and changes to design and safety assessment methods and standards;
- a review of the impact of revisions to the safety criteria and standards;
- a review of changes to the external environment and hazards arising from it;
- a review of the impact of potential changes to operations;
- a review of the effectiveness of the Shiplift Facility Safety Management System.

28. These facets were addressed by the review elements described below.

STATUS REVIEW

29. As a simple precursor to the examination of the safety case all safety case and supporting documentation was identified and located, and its approval status checked. Documents that could not be located were identified, and added to the Work List to ensure that they were either legitimately removed from being referenced by safety case documents, or located and stored in the NBDA Registry. Any document that had not been through the appropriate due process was identified and recorded as a Work List item. None of these documents were found to be of significance.

30. All outstanding issues against the Shiplift Facility Safety Case were identified and drawn together, ranging from the high level CNNRP Caveats on acceptance of the FSC to minor design concessions from past years that had not been fully closed out. All outstanding items were added to the Work List, either individually, or as single "bulk items", each referring to an unambiguously stated scope of work defined elsewhere.

REVIEW OF TOP TIER FACILITY SAFETY CASE DOCUMENTS

31. The Review was carried out on the top tier safety case documents, as follows:

- The physical site conditions and configuration were checked against the FSC. (A more detailed inspection at Design Safety Report level was carried out under the Ageing Review below).
- Present facility operations were checked against the FSC.
- Interface claims were checked with the Site Safety Case and other Facility Safety Cases.
- Compliance with MoD Safety Principles and guidance on the contents of a Facility Safety Case was reviewed. In addition, a review was carried out against BR 3018(2) Annex C, which states the requirement for production and assessment of safety documentation to justify safety during all phases of the Facility life cycle.
- Claims against lower tier documents were listed for verification in reviews of lower tier documents, as a consistency check up and down the

document hierarchy. References were checked to ensure cohesion of the safety case and adequacy of documentation capture for the PSR.

AGEING REVIEW

32. The "Ageing Review" was carried out at DSR level and below. It included other aspects of the PSR and comprised the tasks described below:

- A review by visual inspection against current conditions and layout of plant, known ageing mechanisms and projection of condition to next Periodic Safety Review. Where a visual inspection was inadequate and the safety case presented insufficient mitigation, recommendations to inspect, test, or otherwise establish the effects of ageing were presented;
- A review of validity of existing safety analysis methods, taking account of any adverse observations from the visual inspection;
- A review as to whether any changes to methods and technology would give rise to worthwhile safety improvements or to through-life cost benefits;
- A pragmatic but effective review for areas of the safety case eroded by actual performance data;
- A review as to whether findings from Operational Experience Feedback had been applied. Where there was found to be no system for processing failures, near misses and the like into "lessons learned" or Operational Experience Feedback, this was recorded as a finding;
- A review of interfaces with other facilities, again, to ensure consistency and cohesion of the safety case;
- A review against the current requirements of the HMNB Clyde Corporate Administrative Instruction on Preparation, Review, Approval and Amendment of Design Safety Reports;
- Verification of all claims made against the DSRs, using the Schedules of Review Points raised during review of the top tier FSC documents. Claims made in DSRs against TRs or other lower tier documents were also verified, allowing an audit trail to be established showing consistency and cohesion of claims made up and down the safety case;
- A review of all document references, for consistency and cohesion, and to ensure complete capture of safety documentation by the PSR.

REVIEW OF OTHER PSRS

33. The Safety Case was reviewed to determine the degree to which it satisfied any relevant recommendations arising from the PSRs performed on similar facilities. This review had been intended to comprise the review of the safety case against the recommendations from other relevant PSRs, to establish any lessons learned that should be applied to the Shiplift. However, this was the first PSR to be conducted by the MoD. Hence the review was expanded to include a justified selection from other (PSR-equivalent) reviews of Safety Cases, including Civil nuclear facilities and the Barrow-in-Furness Shiplift facility.

CHANGES TO STANDARDS AND CRITERIA

34. This review had in part been addressed by the review of the top tier documents against SPSCs and the subsequent roll down of review points for lower tier documents. However, SPSCs extant at the inception of the FSC were compared with subsequent issues incorporated into BR3018(2). Advice was also sought from the NNRP on changes anticipated in the future, to provide a basis for the review.

REVIEW FOR CHANGES TO THE SHIPLIFT EXTERNAL ENVIRONMENT

35. This task identified changes to the Shiplift external environment that had occurred since inception of the Safety Case or could occur in the period up to the next review. The changes relevant here are those that may have an effect on external hazards to the Shiplift and the submarine therein or may produce new ones. Examples might be increased surface ship traffic or increased traffic to local airports.

REVIEW OF FUTURE CHANGES TO THE FACILITY FABRIC AND OPERATIONS

36. This part of the PSR comprised the review of the Safety Case to determine any modifications warranted due to changes in the mode of operation, duty or fabric of the Shiplift Facility or Interfacing Facilities, either currently in progress or planned before the next Periodic Safety Review.

SAFETY MANAGEMENT SYSTEM (SMS) REVIEW

37. The SMS review examined the current Safety Management System for completeness and effectiveness insofar as it applied to the Shiplift Facility, against:

- the Safety Management requirements of BR3018(2);
- the Key Review Points identified by review of the FSC; and
- the principles and working practices set out in JSP430 *Ship Safety Management System Handbook* (Ref.32) and DEF STAN 00-56 *Safety Management Requirements for Defence Systems*.

38. A detailed plan was produced for the SMS review, and this was reviewed by two independent reviewers: One ensured that the requirements of BR3018 would be addressed, and a similar review ensured that best practice from the field of Ship Safety Management would be incorporated.

39. The safety management system for the Shiplift Facility was then reviewed against best practice and BR3018, in accordance with the approved plan, to establish that an effective safety management system was in place, was complete, and was observed. Appropriate feedback from other parts of the PSR was provided to the reviewers, to add to the basis for their own investigations.

WORK LIST

ASSEMBLY OF REVIEW SCHEDULES INTO THE WORK LIST

40. The results of the various reviews comprising the PSR were reported in a series of schedules, each arising from a combination of:
- a separate facet of the PSR and
 - either the top tier documents or a different element of the Shiplift fabric.
41. The schedules identified deficiencies in the safety case and gave justified recommendations for corrective action. They were merged electronically into a Work List in one common format. This was advantageous in sorting and presentation of the Work List, both for the PSR Report production and for subsequent handling and closeout of the Work List Items. Data transfer and audit procedures were developed to address configuration control and integrity of data transfer from reviewers' reports.
42. The Work List was then "cleaned". Duplication of obviously identical items was removed, and some Work List items were transferred between parts of the Work List to ensure representation against the correct part of the PSR. An ALARP review (see below) of each of the Work List item followed, with an editorial review to improve clarity. On completion, a quality review reported on correct electronic transcription of material into the Work List, accounting for the few items removed or transferred.

ALARP JUDGEMENT BY REVIEWERS

43. At the time of deriving the original Schedules of Findings, the reviewers had been asked to allocate an adjudged Safety Category to each Item raised in their Schedules. These categorisations were retained for reference purposes in the Works List.

ALARP FILTRATION

44. The Work List was subjected to a provisional filtration process for tolerability and ALARP to ensure that only cost effective items were carried out.
45. The tolerability aspect of the review identified those items deemed necessary to establish the tolerability of the Safety Case in the area in question. The ALARP aspect of the review covered those items where tolerability had been clearly established and the implementation of the item might improve safety. Any reduction in risk is balanced against the cost of implementing the item.
46. Much of the data to do this work rigorously was not available, and the ALARP procedure had yet to be agreed with other industry members and with the Regulator. In the meantime, conservative assumptions were made and the output regarded as provisional until the data is confirmed.
47. Each item on the Work Lists was categorised as follows:
- Category A, which addresses shortfalls in the Safety Case and prevents Tolerability from being claimed;
 - Category B, either having a minor role in a dominant hazard, or associated with a lesser hazard where the risk contribution is small;
 - Category C, which is not safety related;

- Category E, which recommends modification to the safety case documentation that requires no further assessment work. The modification could be made by a knowledgeable editor without significant further work.
48. Category A and B recommendations will be addressed during Phase 3 of the SIP and the Editorial modifications will be considered during the re-write of the relevant documents. Category C recommendations will not be pursued but will remain on the Work List for information and to record the close-out of each finding raised during the PSR.
49. The Tolerability and ALARP process was initially undertaken within the StP team by Sage Safety, and the results reviewed and adjusted as appropriate by a Local Expert Group with collective suitable qualifications and experience to review the results.

PRIORITISATION OF WORK LIST ITEMS

50. The items on the Work Lists were accorded a priority based on lead-time and urgency to allow the Regulator to consider and agree to the implementation of urgent items in advance of giving his full agreement to the report and Work List. This allows optimisation of implementation work during Phase 3 of the SIP Project.

WORK LIST FORMAT

51. The Work List states all Findings and Recommendations for the entire PSR in a common format. Many of the columns or fields in the Work List are presented to allow sorting of Items as needed at a later date. The following were considered important:
- Complete and comprehensible details of each finding, its justification and corrective action;
 - Unique identification of each Item, and a complete audit trail back to the full review report and the original finding identified therein, for context and for further information;
 - Information to allow data manipulation and sorting, e.g. relevant plant or structure, relevant hazard, ALARP and other categorisations.

RESULTS

52. The PSR report (with approximately forty supporting documents) was issued on time in March 2001, and was accepted by the Clyde Nuclear Safety Committee.
53. A total of some 2000 individual Work List Items were identified, albeit these contained a small number of Items referencing other work packages. Following Tolerability and ALARP assessment, very few were accorded category A or C. One fifth of the findings were accorded category B, and approximately three quarters Category E.
54. Whilst a number of new findings against the Facility Safety case documentation have been identified, none of them, either individually or collectively, are considered to be of sufficient magnitude to require Facility operations to cease.
55. The PSR considered that the Facility will remain fit for operation until the completion of the next PSR, up to 2011, subject to:
- the currently planned work programme being completed; and

- the Work List items at Categories A, B and E being closed-out; and
- the implementation of any unforeseeable Safety Standards and Criteria required for an existing facility; and
- the continuous availability of an approved Facility Safety Case;

LESSONS LEARNED

56. As stated above, this Shiplift Periodic Safety Review was the first to be carried out on a MoD nuclear facility. During the review, the management team gained useful experience that will be of use for the conduct of subsequent PSRs.
57. In particular, it was considered that the issue of clear and detailed instructions to the individual reviewers backed up by meetings to clarify and confirm the requirements of the review and ongoing liaison with the reviewers had been essential in achieving a uniform standard of review, presentation and reporting.
58. The use of standard schedules of Findings and Recommendations for the different parts of the review greatly assisted this uniformity of reporting and facilitated the management of the large volume of information that was processed into the Work Lists.
59. Notwithstanding the above, improvements can be made based on the experience, to improve the efficiency of the process and to help reviewers to get it right first time.
60. The performance of some reviewers was exemplary. However, despite the measures taken to ensure that each reviewer had a full understanding of the requirement, it was evident, on reviewing the reports, that some of the reviewers had failed to assimilate this. Several iterations of some review reports resulted, with considerable loss of programme time, which the PSR team had to recoup. Often, those who attended the clarification meetings transpired not to be the actual reviewers, and it was evident that some reviewers did not check their own work against what was specified. Measures need to be taken to minimise this and/or allow for the effects.
61. The PSR examined the Facility Safety Case in considerable depth. However, the level, spread and nature of the findings would certainly indicate that no element of this review was unnecessary. Notwithstanding this, it is highly desirable that a more economical means of achieving a suitably robust Review be found. For the Shiplift, it is very likely that implementation of the Work List will result in a much smoother review next time. For a mature and robust safety case on a less complex facility, the effort expended would be considerably reduced. Furthermore, for a hazard-based safety case, better targeting of review effort may be appropriate and some areas might attract reduced attention on ALARP grounds.
62. To provide continuity of management of the Work List Items, suitable MoD personnel should form a greater part of the review team. Consideration should be given to improving "soft" processes, particularly in the safety management area. These might, for example, entail allowing appropriate MoD staff to suggest corrections to findings as and when they are raised.
63. Seminars were held to inform affected management personnel, but nonetheless there appeared to be a certain lack of understanding in many quarters regarding the role of the PSR team and the reviewers, and their involvement with other Base personnel.

More seminars and/or increased audiences would be beneficial, particularly with the increased experience of the management team in conducting PSRs.

CONCLUSIONS

64. The PSR was successful, completed on time and accepted, despite programme delays and despite this being the first Periodic Safety Review of a MoD nuclear Facility.
65. Success was assured by:
- developing a clear and logical scope and bounding this with clear, logical and justified assumptions specific to the task at hand; and
 - giving attention to detail and developing a demonstrably cohesive set of prescriptive requirements to ensure a robust but pragmatic review.
66. The Review covered all of the aspects through which the passage of time might erode, or might have eroded, the validity of the Shiplift Facility Safety Case.
67. A full audit trail from each Work List item to the reviewers' reports was maintained to justify the inclusion of the item on the Work List and facilitate access to full substantiating detail of any finding.
68. Several elements of the approach were found to be essential to the success of the Review. In addition, several lessons have been learned that have the potential to ensure more widespread ownership, smoother running and better cost effectiveness of future PSRs.

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