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SHIPLIFT FACILITY SAFETY CASE

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**NUCLEAR SITE SAFETY
JUSTIFICATION**

**Shiplift
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Facility Safety Case

ISSUE 3 AMDT 1

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AMENDMENT RECORD

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AMENDMENT HISTORY

Amendment Status	Reason for Issue	Issue Date
Issue 1 Original	New NSSJ approved FSC	November 1999
Issue 1 Amdt 1	Incorporation of FSS into FSC, as per CNSC Instructions	April 2000
Issue 1 Amdt 2	Incorporation of Live Files entries. Update of operational procedures due to reorganisation.	January 2001
Issue 2	Internal, IPR and Regulatory review. New Issue	May 2002
Issue 2 Amdt 1	Incorporation of 12 to 10 day docking duration	July 2005
Issue 2 Amdt 2	Incorporation of Docking with TWS Embarked	July 2005
Issue 2 Amdt 3	Removal of requirement to fit PMLF on V Class Vessels whilst docked within the Shiplift	July 2005
Issue 3 Draft A	Complete up issue (FSC2005) Submitted to NNC Review.	July 2004
Issue 3 Draft A1	Complete up issue (FSC2005) Submitted to IPR Activity.	July 2004
Issue 3 Draft A2	FSC2005 Submitted for Base due process	September 2004
Issue 3 Draft B	FSC 2005 Submitted for NSSSC Review	September 2004
Issue 3 Draft C	FSC 2005 Issued for CNSC review incorporating NSSSC comments	October 2004
Issue 3 Final	Endorsed at Category 1/A by CNSC on 16 November 2004	November 2004
Issue 3	CNNRP Agreed (12Berth)	May 2005
Issue 3	CCNRP Agreed (Shiplift)	July 2005
Issue 3 Amdt 1	Minor editorial amendments to reflect Management changes	January 2010

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EXECUTIVE SUMMARY

INTRODUCTION

This document presents the Facility Safety Case for the Shiplift Facility which is comprised of the Shiplift building and 12 Berth. The Shiplift building houses the equipment and services necessary to lift from the water and support all current classes of British nuclear submarines and certain Royal Navy surface vessels to allow maintenance and defect repair work to be undertaken. 12 Berth provides equipment and services to allow any Royal Navy or Foreign vessel to be berthed whilst maintenance and defect repair work is undertaken.

This issue of the Facility Safety Case articulates the current status of the safety substantiation for the Facility.

SCOPE OF THE SHIPLIFT FACILITY SAFETY CASE

This document covers the activities to be carried out at the Shiplift Facility relevant to nuclear and/or radiological safety. These activities include operation, maintenance and repair activities scoped in the Shiplift and 12 Berth Hazop studies, to be carried out for the following vessels:

- Swiftsure Class Ship Submersible Nuclear.
- Trafalgar Class Ship Submersible Nuclear.
- Vanguard Class Ship Submersible Ballistic Nuclear.
- Certain Royal Navy Surface Vessels or equipment.
- Foreign Surface Vessels or Submarines (12 Berth only).

Safety Justification has now been developed for the berthing and docking of Astute Class vessels in the Facility. This safety justification has not yet been incorporated into the FSC pending operational proving.

With respect to the docking capability, the scope of this issue of the Facility Safety Case is as follows:

- Dockings per year
- Maximum docking duration days. Noting that safety justification is being developed for extended dockings up to days duration
- Indicative days per year docked
- Crane lift maximum potential dropped load energy over a Swiftsure or Trafalgar Class vessel not to exceed 0.3MJ, or 0.5MJ over a Vanguard Class vessel, or 2MJ over the Shiplift platform (crash mat protected main section). Lifts of up to 36 tonne are permitted over the platform rudder section without crash mat protection (Crane has 47.8 tonne lift capacity). During dockings no connection will exist between the main platform and the rudder section

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- Decay Heat limit [REDACTED] (for S-Class SSNs)
- Permanent Magnetic Locking Feature fitted to Swiftsure and Trafalgar Class vessels
- No intrusive Nuclear Repairs
- Docking with Strategic Weapons embarked (Combined limit of [REDACTED] days for all SSBN)
- Docking with Tactical Weapons embarked.

In respect of the 12 Berth capabilities the scope of this issue of the Facility Safety Case is as follows:

- Average of [REDACTED] days per year of SSBN/SSN alongside.
- Maximum 12 Berth crane lift over SSBN/SSN of 0.3MJ equivalent energy (Crane has 20 tonne lift capacity).
- Release of nuclear safety related equipment on submarine for defect repair or maintenance controlled by the Procedures Authorisation Group taking decay heat levels into account.
- Berthing with Strategic Weapons embarked.
- Berthing with Tactical Weapons embarked.

PURPOSE OF THE SHIPLIFT FSC

This issue of the Facility Safety Case justifies continued regulatory approval for Shiplift operation from 29 January 2010, for the above scope of activities and to continue Shiplift operation thereafter, by demonstrating that they are tolerable and ALARP until the next Periodic Review of safety, subject to Regulatory agreement and in accordance with the appropriate HMNB Clyde safety management arrangements and reviews.

This issue of the Safety Case has been produced, in compliance with Her Majesty's Naval Base Clyde management system, to meet an agreed interpretation of the Ministry of Defence Safety Principles and Safety Criteria as set out in JSP 518 Issue 2. This interpretation, embodied in the Her Majesty's Naval Base Clyde Shiplift Safety Principles Paper, recognises the Facility as an Existing Facility. Further clarification of these Safety Principles has been prepared in the form of Development and Assessment Guidelines. Evidence of compliance with these requirements is provided by reference to Site and Facility documentation, and by a systematic and comprehensive safety assessment process, the results of which are presented within this document.

FACILITY SAFETY CASE CATEGORISATION

The Facility Safety Case has been categorised as Category 1, in accordance with the nuclear safety significance of the operations carried out at the Facility, as defined in Joint Services Publication 518.



MANAGEMENT AND OPERATION OF THE FACILITY

Whilst a submarine is present at the Facility the Commanding Officer is responsible for the management of nuclear safety to the Facility Operator, who is responsible for the overall nuclear safety of the Facility to the Site Authorisee. The scope of operations covered by this safety case is strictly governed by predefined written local orders within a documented Facility safety management system that is controlled and approved in accordance with Her Majesty's Naval Base Clyde Management System. The documentation which governs the operation of the Facility includes identified Conditions and Limits of Safe Operation as defined in the Facility Safety Report.

PERIODIC SAFETY REVIEW AND INDEPENDENT NUCLEAR SAFETY ASSESSMENT

A Regulatory review of the Shiplift Facility Safety Case was carried out following the further development of the FSC under the last Periodic Safety Review (2001) and the subsequent Staged Improvement Programme (2002-2005). The Independent Nuclear Safety Assessment identified a number of comments. Issues which remain outstanding have been identified in this report. These issues will be addressed following the development of the following work items:

- The Shut-Down Safety Case will allow an integrated assessment of the risk of operations at the Facility, including vessel maintenance
- The next Periodic Safety Review is now in progress. This will assess the FSC against safety case modern standards requirements and better inform a robust ALARP assessment.

SUMMARY OF FSC SAFETY ASSESSMENT

The safety assessment presented in this Facility Safety Case develops the quantitative safety case, on the basis of a substantial body of previously reported detailed analysis, through summarisation of the following principal elements.

- An assessment of the radiological safety of normal operations, and review of As Low As Reasonably Practicable.
- Hazard identification processes for: environmental and man-made hazards, Facility and Submarine accident hazards, and systems failures that could impinge on nuclear plant safety.
- A Hazard Log identifying operational and engineered safeguards against each hazard.
- A deterministic assessment of the capability of the Facility's equipment and structures to perform the required duties when subject to the defined foreseeable events.
- A probabilistic assessment of the risk to individuals associated with the potential radiological consequences of fault conditions at the Facility, be they, submarine crew, site workers, or members of the public.

The findings of the deterministic and probabilistic assessments are as follows.



FINDINGS OF THE DETERMINISTIC ASSESSMENT

Using the method of assessment for an Existing Facility as set out in the Shiplift Safety Principles Paper all the nuclear significant structures have been shown to be code compliant for all foreseeable events. The cut-off frequency for foreseeable events has been set at 10^{-4} per year. From this it can be concluded that the Shiplift Facility is compliant with the MOD Safety Principles 9 and 20 which relate to the integrity of structures to withstand their predicted loadings associated with the scope of the Facility.

The quantitative deterministic assessment does not take benefit from a number of features of the Shiplift design:

- Redundancy and diversity of the structural elements.
- Yield characteristics of cradles.

Cognisance of these features within the safety case enhance confidence in the robustness of the case.

FINDINGS OF THE PROBABILISTIC RISK ASSESSMENT

The Facility utilisation assumptions adopted for the purposes of the current probabilistic risk assessment reflect the experience of operations in recent years with regard to the occupancy of the different classes of submarine. The Shiplift building and platform utilisation assumed is:

- [REDACTED] Shiplift docking and undocking cycles per year. This is assumed to consist of [REDACTED] Vanguard Class and [REDACTED] Swiftsure and Trafalgar Class dockings with the corresponding assumed occupancy of [REDACTED] days and [REDACTED] days respectively.
- A maximum of [REDACTED] days on pins (mechanically locked at its maintenance level when bearing a nuclear vessel) on any occasion.
- A 12 Berth annual nuclear utilisation of [REDACTED] with [REDACTED] attributed to Vanguard Class and [REDACTED] to Swiftsure and Trafalgar Classes.

On the basis of this utilisation, the initiating event frequencies developed for the Facility Safety Case, and the Nuclear Steam Raising Plant Design Authority's Probabilistic Safety Assessments for the plant, the assessed risk to individuals in each of the three population groups defined in Joint Services Publication 518 Issue 2.

	Risk		
	Criteria (y^{-1})		Assessed Risk (y^{-1})
	Basic Safety Objective	Basic Safety Limit	Risk to an Individual
General Public	10^{-6}	10^{-3}	6.0×10^{-6}
Site Personnel	10^{-6}	10^{-4}	3.7×10^{-5}
Crew	10^{-6}	10^{-4}	3.6×10^{-5}



From the above table it can be seen that the risk associated with the Facility is 6% of the public BSL. The risk is 37% of the BSL for site personnel and crew. The risk associated with Facility operations has been shown to be tolerable and falls within the As Low As Reasonably Practicable (ALARP) region by a reasonable margin. On this basis, continued Shiplift Facility operations are considered acceptable. However, the Facility risk remains above the Site Basic Safety Objective level, such that there is an imperative to pursue reasonable and practical means to provide an improved demonstration that the Facility design and its operations are consistent with the As Low As Reasonably Practicable principle. It is expected that the further work in progress will reinforce the current assessment that the risk associated with operations at the Shiplift Facility is tolerable and ALARP.

The assessment identifies that the available Reactor Plant Design Authority Probabilistic Safety Assessment information does not fully reflect the requirements of the Shiplift Facility Safety Case in that all activities on 12 Berth are not fully scoped. A number of shortfalls in the detailed risk assessments are identified in the supporting technical documentation, which may influence the risk contributions identified to arise from individual hazards, however the uncertainties associated with these contributions are small in comparison with the total risk and would not affect the qualitative conclusions of the safety case. It is expected that the development of the Shut Down Safety Case will better inform the NRP risk and the significance of the external (Facility) hazards with respect to the NRP. This will enable improvements to be made in the probabilistic assessment for the Facility as identified in the SJP.

Nevertheless the assessment has identified that most of the current data is conservative and on balance concludes that there is considerable confidence in the overall risk assessment result.

The principal contributors to risk are submarine internal events (67% of the risk to the public) and crane collapse (31%). The NRP and submarines are provided with a number of safeguards inherent to their design to reduce risk, particularly in respect of the largest contributors to the assessed risk, which are internal flood and LOCA. The risk of crane collapse arises from postulated hook-up/hang-up faults, and is predominantly driven by human error. Possible additional safeguards have been considered in the context of ALARP and a Forward Action Plan for appropriate action has been added to the Shiplift Facility SJP.

OUTSTANDING ISSUES

In developing the safety case in response to the specific threats and challenges of the identified hazards a large number of issues have been addressed and closed out within this issue of the Facility Safety Case, however, a number of issues remain. The following are examples with the full details contained in the FAPs:

- The current safety justification does not include a comprehensive Fault Schedule for the Facility. Discrepancies exist between the CLOSO report and the FSC, FSRs, DSRs and TRs.
- The current CLOSO report does not identify the limits and margins that exist between the Normal Operating Zone, the Safe Operating Zone and the Ultimate Design Limit for the relevant plant and structures.
- The nuclear safety requirements and the activities that need to be undertaken to provide/ensure a safe environment is provided for the Strategic Weapons Systems should be defined.
- The current FSC does not consider either the internal or external radiological consequences of events and /or accidents within the submarine.

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- A fully integrated probabilistic risk assessment is required which will include risks associated with all NRP maintenance/repair, Weapons storage including all hazards that could affect SWS.
- The current platform Reliability calculations do not take account of the contributions from Design Capability events. This means that the contribution of platform failure to the Excessive Boat Attitude (EBA) risk may be under-estimated.
- The detailed analysis of the EOT Cranes cannot address the previously identified concerns, as it has departed from the previously agreed methodology.
- The effect of blast on the building
- The lack of withstand of the EOT crane trolley rail clips under earthquake loading
- Withstand capability of the on board systems.

The effect of all of these shortfalls has been assessed in the safety case and in all cases the risk has been shown to be acceptable or mitigating arguments have been identified that show that the submarine's safety is not compromised. The issues relating to further development of the safety justification will be addressed following development of the Shut Down Safety Case.

FUTURE FACILITY SAFETY CASE DEVELOPMENT

Future work will address shortfalls in the safety case against modern standards and will review where benefits have been suggested. This work is reflected in the Facility Safety Case Safety Justification Plan (SJP) and the proposed resolutions presented in the Forward Action Plans contained in the SJP.

The current FSC continues to be assessed against JSP 518 Issue 2 and the included SPSCs. It is recognised that further development of the FSC will include assessment against JSP 518 Issue 3 and thereby the recently issued Naval Nuclear Safety Principles.

CONCLUSION

This document has demonstrated that the Facility is compliant with the Safety Principles and Safety Criteria as interpreted by the Safety Principles Paper. All structures have been shown to be compliant with the relevant design code presenting a robust deterministic demonstration. The assessment of the public risk from all the hazards both external and internal to the submarine has shown that this is only a small percentage of the BSL. An ALARP study has not identified the need for any major improvements. Therefore it has been concluded that the Facility Safety Case has shown that the Shiplift Facility meets all its safety requirements and its acceptability has been demonstrated.

PART 1

Introduction





PART 1

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Introduction





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INTRODUCTION

BACKGROUND

- 1001 The Shiplift Facility at Her Majesty's Naval Base (HMNB) Clyde is an existing Facility provided in support of the nuclear submarine flotilla. This Facility Safety Case (FSC) is intended to present a robust and reasoned demonstration that the nuclear risks associated with the Facility and operations conducted at the Facility are tolerable and As Low As Reasonably Practicable (ALARP), and also demonstrate compliance with the Ministry of Defence (MoD) Safety Principles and Safety Criteria (SPSCs) as contained in Joint Services Publication JSP518 (Ref. ¹). For the purposes of applying the SPSCs to the Shiplift Facility as an Existing Facility the SPSCs were interpreted in the light of the Safety Principles Paper (SPP) (Ref. ²), as agreed by the Regulator (CofN/CNNRP/501/6/2/2/542/2001 dated 19th March 2001 (Ref. ³)).
- 1002 Between December 1999 and 2004 a Staged Improvement Programme (SIP) (Ref. ⁴) and (Ref. ⁵) was carried out for the Shiplift FSC. A Periodic Safety Review (PSR) (Ref. ⁶) and (Ref. ⁷) was part of SIP Phase 2 that commenced in April 2000 and completed in March 2001. The PSR did not identify any significant new issues, and the subsequent SIP Phase 3 programme was a continuation of the Safety Case development that had been undertaken in the Medium Term Programme (MTP) (Ref. ⁸). The outstanding issues identified were closed out within the SIP Phase 3 and are reflected within this FSC.
- 1003 It is noted that JSP 518 Issue 2 (Ref. 1) has been subsequently superseded by Issue 3. This has prompted a number of changes in the structure of the Regulatory arrangements and Authorisee compliance. The principal changes are:
- a. The Naval Nuclear Programme (NNP) is now regulated by the Defence Nuclear Safety Regulator (DNSR)
 - b. Regulatory judgement against the permissioning of activities will be informed by the Safety Assessment Principles (SAPs) (Ref. ⁹)
 - c. The Naval Reactor Plant Authorisee (NRPA) safety management arrangements now include a set of Naval Nuclear Safety Principles (NNSPs) (Ref. ¹⁰). The NNSPs provide a comprehensive set of design and assessment principles, including criteria, and provide both deterministic and probabilistic standards against which safety cases associated with design and operation can be developed and assessed.
- 1004 The next Periodic Safety Review (PSR) is currently in progress on the Shiplift Facility. The PSR will identify the safety case developments necessary to align the Shiplift safety case with modern standards and to comply with Issue 3 of JSP 518. Pending the completion of the PSR this issue of the FSC continues to demonstrate compliance with the MOD Safety Principles as defined in JSP 518 Issue 2 (Ref. 1) and the current issue of the Site Safety Case (Ref. ¹¹). All subsequent references in this document to compliance requirements will be to JSP 518 Issue 2 (Ref. 1) and the MOD SPSCs. However it is the intention subsequent to the Periodic Safety Review that future issues of the Shiplift safety case will demonstrate compliance with Issue 3 of JSP 518 and the NNSPs (Ref. 10).

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- 1005 Since April 2000 nuclear submarine dockings have received appropriate approval from the Authorisee. The Clyde Nuclear Safety Committee (CNSC) has monitored progress on safety case development, and found this to have been satisfactory.
- 1006 This issue of the FSC articulates the current status of the safety substantiation (in accordance with Process Map NSSJ-MGMT-PM-001 (Ref. ¹²)) and provides the required demonstration that the Facility is safe for continuing operations. It is recognised that the current PSR will identify outstanding issues and the requirement for continued progress in the development of HMNB Clyde Safety Cases to meet modern standards.
- 1007 This FSC is supported by Facility Safety Reports (FSRs) and Design Safety Reports (DSRs) identified at paras 1034 and 1036.

THE FACILITY SAFETY CASE

Scope of the FSC

- 1008 This document covers the activities to be carried out at the Shiplift Facility for the following vessels:
- a. Swiftsure class.
 - b. Trafalgar class.
 - c. Vanguard class.
 - d. Certain Royal Navy (RN) surface vessels or equipment.
 - e. Foreign surface vessels or submarines (12 Berth only).
- 1009 Safety justification for Astute class activities within the Facility is now being developed. This is currently in two parts:
- a. Safety justification in accordance with Authorisation Condition 22 for Astute class arrival at Berth 12. Astute class activities at Berth 12 have been justified for the first ████ weeks operating cycle. The safety justification has been accepted as satisfactory by DNSR (Ref. ¹³) subject to required improvements to the safety case. Astute operations at Berth 12 have been Permissioned following the release of the Astute Operational Readiness Hold Point.
 - b. Safety justification in accordance with Authorisation Condition 22 for Astute class berthing and docking in the Shiplift docking facility. The safety justification has been accepted as satisfactory by DNSR subject to the resolution of outstanding issues (Ref. ¹⁴). Permissioning of berthing and docking in the Shiplift is subject to release of the Astute Operational Readiness Hold Point and operating proving trials which are expected to take place in 2010. The AC22 currently forms a proposed Live File amendment to the Shiplift FSC and will be incorporated into the FSC following authorisation of Astute operations at Berth 12

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- 1010 The activities within the scope of this FSC are those covering hazards external to Current Class submarines. Each of these identified hazards has been subject to a suitable and sufficient risk assessment process in accordance with extant Safety Management arrangements. Hazards internal to the submarines are intended to be considered in SUB IPT's safety cases for Current Class vessels. The Facility Probabilistic Risk Assessment (Ref. ¹⁵) provides an integrated view of the residual risks of internal and external submarine hazards. Comprehensive listings covering the full scope of activities considered in the development of this FSC are presented in the HAZOP reports for the Shiplift (Ref. ¹⁶), and the 12 Berth, (Ref. ¹⁷). These HAZOP reports have been used, together with the accumulated hazard identification information compiled in previous issues of the FSC, in the compilation of a comprehensive hazard log presented in the Hazard Assessment FSR, Ref 21.
- 1011 The scope of the operations permitted within the Facility is governed by this FSC. However, the scope may be amended by the Authorisees approval letter written, on an individual docking basis, on the recommendation of the CNSC, which will include any additional safeguards that may be required.
- 1012 The scope of this FSC is limited with regard to the handling of heavy loads that could impact a submarine hull or the platform which is based on a maximum impact energy. A restriction of 2MJ is placed on the loads lifted over the area of the platform protected by crash mats and 0.1MJ for unprotected areas of the platform. For an impact directly onto the submarine a confidence statement issued by Naval Reactor Plant Authorisee (NRPA) (Ref. ¹⁸) indicates that a 3MJ hull impact withstand for Vanguard and Astute Classes is expected to be approved by March 2010. This could be reduced to 1 MJ in the absence of simple protection over (open) casing hatches above bulkhead 64 (A Class) and 106 (V Class). Hull impacts for S&T Class is currently limited to 0.3MJ. The lifting of heavy loads with the capability of producing more energetic impacts will not be undertaken in the normal course of Shiplift operations. Special lift procedures will be developed for heavier lifts.
- 1013 The basic Facility utilisation assumptions adopted for this issue of the FSC reflects the experience of operations in recent years. The Shiplift building and platform utilisation assumed is [redacted] Shiplift docking and undocking cycles per year, comprised of [redacted] Vanguard (V) Class and [redacted] Swiftsure and Trafalgar (S&T) Class dockings, with a maximum of [redacted] days 'docked' on any one occasion. It is also assumed that the Shiplift Platform will be available for [redacted] days per year and of the annual 12 Berth availability, [redacted] is attributed entirely to Vanguard class usage, with [redacted] for Trafalgar/Swiftsure Class. Note: Surface vessels and foreign submarine will occasionally use 12 Berth, however they are not factored in the utilisation assumptions. Foreign nuclear submarines would berth under a standard agreement, such that no information on risk would be made available and UK submarine data would require to be used anyway.
- 1014 All dockings occur with decay heats less than [redacted] ([redacted] for S Class) and with Permanent Magnetic Locking Feature (PMLF) fitted to all S and T Classes.
- 1015 There is expected to be significant changes to the future operating criteria. These are principally:
- a. Berthing and Docking of Astute at the Facility. Astute Class will dock with decay heats less than [redacted] and will be fitted with control rod drive latches.

- b. Maximum docking period extended from [redacted] to [redacted] days. Safety justification for extending the docking period is currently under development.

The availability of the Shiplift Platform will remain at [redacted] days.

- 1016 The safety cases for Tactical and Strategic Weapons lie with the relevant IPTs and the Base will comply with the requirements of these authorities for berthing or docking submarines with weapons embarked.
- 1017 In the event that a docking was proposed, where hull deformation or significant tile loss was suspected, inspections and surveys would be undertaken by divers to identify the extent of the deformation and enable a judgement to be made as to whether a docking was feasible within the scope of the FSC. If the judgement were favourable the docking would be undertaken. If, in the view of the docking officer the 1m/2m above grounding load profile indicated a good fit the docking would continue. The load profile would be judged against the established acceptable Cradle Docking Load Profile and the margins against safety limits considered by the DNSAG. If the fit was not good, appropriate investigations would be undertaken by divers to inform the way ahead. This would be carried out in accordance with established Safety Management Arrangements. (Note: A good fit may be interpreted as a load profile above grounding that, based on experience, will in the opinion of the docking officer lead to a satisfactory docking).

Period of Validity of the FSC

- 1018 This issue of the FSC is in support of continued Shiplift Facility Operations and will remain valid from approval until the next planned Periodic Review. The FSC is subject to Periodic Review and update in accordance with HMNB Clyde Policy. If the activities change, the FSC will require review.

Basis of the Safety Case

- 1019 The activities within the scope of Shiplift Operations have the potential to lead to event sequences which result in significant radiological releases. The Shiplift FSC has therefore been categorised Category 1 in accordance with the requirements of JSP518 (Ref. 1).
- 1020 The basis of the safety case presented in this issue of the FSC is that:
- Hazards to safe operation of the Shiplift Facility have been identified and assessed with the Safety Functional Requirements (SFR) set down against which the acceptance will be judged.
 - Appropriate engineered and administrative safeguards have been established, and are maintained consistent with the appropriate control or mitigation of the hazards presented.
 - The potential radiological risks to crew, site workers and members of the public have been assessed and demonstrated compliant with the JSP518 (Ref. 1) requirements. In some instances the assessed risks are marginally greater than the basic safety objective levels for particular accident conditions.



- d. Adequate margins of safety have been demonstrated with regard to the capability of safety related structures, equipment and systems for all foreseeable events as defined in the SPP. A small number of outstanding issues are identified, none of which undermines the safety case. (Their planned resolution is presented in the FAs contained within the SJP Ref. ¹⁹)
 - e. The Facility's design and operations are shown to be consistent with the ALARP principle.
- 1021 This issue of the Shiplift FSC presents a case that is fully compliant with all the MOD Safety Principles and Safety Criteria (SPSCs) provided in JSP518 (Ref.1) and interpreted in the SPP (Ref. 2). This includes the justification by deterministic and probabilistic safety analysis of the Shiplift Facility.
- 1022 The results of the Probabilistic Risk Assessment (PRA) (Ref.15) presented in this document draw upon information provided in the Reactor Plant Safety Justification (RPSJ) and the Nuclear Reactor Plant (NRP) Design Authority Risk Models (Ref. ²⁰), and the Design Substantiation Safety Case (DSSC) documentation for the Facility. The development of these risk models reflects those risks associated with the Shiplift Facility and the improved substantiation produced during SIP3.

THE FACILITY

Location and Brief Description of the Facilities Provided

- 1023 The Shiplift Facility provides berthing, docking and defect rectification facilities for nuclear submarines and certain surface vessels. The Facility is comprised of 12 Berth and the Shiplift.
- 1024 The location of the Shiplift Facility and its relationship to neighbouring Facilities is shown in Figure 1.1. The detail of the interfaces with other Facilities is fully defined in the Design Safety Reports (DSRs) and potential future interfaces are discussed in the SJP.
- 1025 The Shiplift and 12 Berth are both X Berths as defined by JSP518 (Ref. 1).
- 1026 The facilities at 12 Berth provide for all current classes of British nuclear submarines, certain RN surface vessels and equipment, and foreign surface vessels and submarines in accordance with HMNB Clyde requirements and the Standard Statement for the berthing of Visiting Foreign Nuclear Powered Warships. All of the necessary support systems and services (including overside services and craneage) to enable maintenance and repair work to be undertaken in accordance with statutory and MoD requirements for nuclear and industrial safety, and environmental protection, are provided.
- 1027 The Shiplift provides a covered docking facility for current classes of British nuclear submarines (and certain RN surface vessels or equipment). The docking process at the Shiplift involves lifting the vessel from the water using docking cradles supported by an articulated platform. The platform is carried by beams, each beam being raised and lowered by a pair of synchronous hoists. A section of the platform can be decoupled and lowered independently of the main platform to allow removal of a submarine rudder, tailshaft or propulsor. An independent road bridge at the seaward end of the main platform is operated by further hoists. Electrical and control and protection systems are provided to ensure safe and controlled operation.



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- 1028 At the landward end there is a Cradle Marshalling Area (CMA) and Transfer Pit in which docking cradles to support nuclear submarines are assembled and transferred to and from the platform as required.
- 1029 The Shiplift structure consists of a reinforced concrete deck on two levels and forming two quays (North and South), interconnected and monolithic with a deck at the landward end (see Figure 1.1). This structure is supported by a system of vertical and raking tubular steel piles where the raking piles are socketed into bedrock. The platform hoists are mounted on the two quays with the platform beams suspended between them.
- 1030 The decks are covered by a steel framed superstructure, the South side of which provides accommodation for the platform controls, electrical equipment, personnel and other purposes. The South Quay is widened along its length to form 12 Berth and is connected to land by the South Access Jetty. A 20 tonne (t) jetty crane runs on rails which are embedded in the 12 Berth jetty.
- 1031 Two 55/2t Electric Overhead Travelling (EOT) Cranes are provided in the Shiplift. Both cranes run on a common set of rails mounted in the structure of the Shiplift. The two cranes are of identical design, each having a 55t main hoist, a 2t auxiliary hoist and an anti-collision system.

Facility Boundary

- 1032 The Shiplift Facility consists of the following areas and structures, HMNB Clyde identification numbers are given in parentheses:
- a. The Cradle Marshalling Area (CMA) (1429) and the Cradle Transfer Pit (1428).
 - b. The Block/Cappers/Sheaves Workshop and Store (1413).
 - c. The Blocks and Cappers Stowage (1433).
 - d. The Mechanical Handling Equipment Storage Building (1451).
 - e. 12 Berth (1402).
 - f. The Shiplift Apron including the Access Road (1401).
 - g. The structure and supports of Building 1401 and all systems, structures and equipment therein with the exception of Northern Utilities Building (NUB) (1407) distribution systems and Communications (which all form part of the Northern Utilities Building (NUB)).
- 1033 The boundary of that part of the Shiplift Facility, which is an element of the Authorised Site is shown as the cross-hatched area in Figure 1.1. The part of the Shiplift Facility which is not an element of the Authorised Site consists of the CMA, and workshops and stores in 'b', 'c' and 'd' above. These extend beyond the Authorised Site.

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SAFETY DOCUMENTATION INTERFACES

1034 A documentation map showing the links to the HMNB Clyde Site Safety Case (SSC) (Ref. 11), other FSCs and the relationships between the FSC and its supporting documentation are provided in Figure 1.2. The FSC is supported by five Facility Safety Reports (FSR) written to capture the detail covering the following areas:

- Hazard Assessment (HA) (Ref. ²¹)
- Safety Functional Requirements (SFR) (Ref. ²²)
- Probabilistic Risk Assessment (PRA) (Ref. ¹⁵)
- Conditions and Limits of Safe Operation (CLOSO) (Ref. ²³)
- Fault Recovery Guidance (FRG) (Ref. ²⁴)

Note: The FRG document was passed to the DNSAG Chairman on the advice of the CNSC for further development.

1035 This FSC is also substantiated by a suite of DSRs which cover Shiplift specific issues (such as structural safety) and generic issues (such as site wide services relevant to the Facility). The relationship between the FSC, its FSRs, DSRs and other elements of the Safety Case is shown in Figure 1.3.

1036 The following Shiplift specific DSRs substantiate the FSC:

- a. Shiplift Cooling Water Supplies. (Ref. ²⁵)
- b. Shiplift Electric Overhead Travelling Cranes. (Ref. ²⁶)
- c. Shiplift Platform. (Ref. ²⁷)
- d. Shiplift Fire Protection. (Ref. ²⁸)
- e. Shiplift Miscellaneous Services. (Ref. ²⁹)
- f. Northern Jetties Catamarans. (Ref. ³⁰)
- g. Shiplift 12 Berth 20t Crane. (Ref. ³¹)
- h. Shiplift Civil Structure. (Ref. ³²)
- i. Shiplift Berthing Equipment (Design report) (Ref. ³³)

1037 The following generic DSRs interface with, and support the FSC:

- a. Northern Utilities Building. (Ref. ³⁴)
- b. Faslane Communications Systems. (Ref. ³⁵)
- c. Nuclear Alarm. (Ref. ³⁶)
- d. Faslane Northern Area Dockside Installed Reactor Accident Monitoring System (DIRAMS). (Ref. ³⁷)

1038 This issue of the FSC interfaces with the demonstrations of safety for the existing classes of nuclear submarines under the auspices of the Submarine Support Integrated Project Team (IPT), tactical weapons under the auspices of the Underwater Warfare Systems IPT, and for strategic weapons under the auspices of the Strategic Systems IPT. The justifications for the safety of those systems is contained within the appropriate documentation, including explosive licensing, and is not repeated within this document.

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- 1039 The nuclear safety significant interfaces between the Shiplift Facility and current class Ship Submersible Ballistic Nuclear (SSBN)/ Ship Submersible Nuclear (SSNs) consist of the engineered overside services and Shiplift platform's arrangements for the stable support of submarine hulls, as identified and discussed, particularly in Part 3 (Description) and Part 5 (Safety Assessment) of this FSC. The relevant nuclear safety requirements that these systems are required to fulfil are detailed, and systems safety justified, in the appropriate DRSs defined above (notably Cooling Water DSR (Ref. 25), NUB DSR (Ref. 34) and Shiplift Platform DSR (Ref. 27)). This FSC also interfaces with the current class Reactor Plant Safety Justification's Probabilistic Safety Assessment (PSA) which provide input data to the Facilities risk assessment. Through this interface the risks associated with the reactor plant accident hazards are incorporated into the assessments made as identified in Part 5 of this FSC.
- 1040 Within the structure shown in Figure 1.3, two elements have particular significance for the forward development of the Shiplift FSC, namely this issue of the FSC and the FAs, which arise from the supporting SJP (Ref.19).

Structure of the Shiplift Facility FSC Document

- 1041 This issue of the FSC document has been structured in accordance with the requirements of Process Map NSSJ-MGMT-PM-001 (Ref.12), and the guidance in JSP518 (Ref.1).
- 1042 Part 2 of this document summarises the safety function requirements as identified in the FSR (Ref. 22) and sets out the principles and criteria this safety case is required to address in order to demonstrate the acceptability of the Facility. It has been agreed with the Regulator that the Safety Principles shall be interpreted in accordance with the HMNB Clyde Shiplift Facility Safety Principles Paper (Ref. 2), with particular regard to the deterministic demonstration of Design Capability, especially of safety related structures.
- 1043 Parts 3 and 4 set the context which enables the reader to interpret the subsequent Parts, that summarise the outcomes of the safety assessments and technical analyses performed in support of the safety case. Part 3 describes the Facility, its operations, and safety equipment. Part 4 sets out the management systems important to the achievement of safety. Part 4 provides an outline of the Conditions and Limits of Safe Operation and refers to the CLOSO report (Ref. 23) in which the Conditions and Limits of Safe Operation are scheduled.
- 1044 Part 5 presents the overall assessment of safety, following a summary of the radiological safety implications of normal operations, and the outcomes from both the deterministic Design Basis Assessment (DBA) and the PRA (Ref.15) analyses performed in support of continued Facility operations.



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- 1045 The safety of the Facility is dependent on the capability of the engineered structures and systems, and operating personnel, to deliver the duties necessary to maintain the safety of visiting submarines. It is recognised within this issue of the FSC that, when a visiting submarine is berthed at the Facility, the Nuclear Defence in Depth principle vested in the design of the reactor plant and the submarine as a whole becomes extended to encompass the Facility's design and operations. The submarine provides Defence in Depth through the provision of primary and secondary levels of containment against the release of fission products from the reactor fuel. Within this issue of the FSC it is demonstrated that the design, as described in Part 3 and operation of the Facility provides adequate protection for those barriers, and means to safeguard against their disruption in the event of accident hazards. The Facility's engineered structures and systems are operated and maintained, within the safety management system set out in Part 4, to ensure that the totality of the Facility's systems and personnel work together in contributing to Defence in Depth and the control of risk.
- 1046 For this Facility, which is an existing Facility, it has been agreed with the Regulator (Ref. 3) that the DBA shall be approached through the demonstration of Design Capability for all foreseeable events as described within the SPP (Ref. 2). The principles of this approach are used to extend its scope to cover some lower frequency fault conditions, and provide further information to assist the judgement as to whether the facility design may be deemed to be consistent with the ALARP principle.
- 1047 The PRA (Ref. 15) for the Facility, as summarised in Part 5, draws on the PRAs developed for V class and T class submarines and combines the salient results from these assessments with the initiating event frequencies, and Facility utilisation information, appropriate to this safety case. From this data the assessed risks for Facility workers, other persons on site, and members of the public are derived.
- 1048 Part 6 presents a review of Facility operations which outlines the operating experience base and the administrative processes under which critical reviews of the Facility and its equipment are undertaken.
- 1049 Part 7 sets out the case for the acceptability of current operations and includes the findings of a review of the safety case against the relevant principles and criteria. The principles and criteria of particular note are the MoD Safety Principles and Basic Safety Objective (BSO)/Basic Safety Limit (BSL) criteria expressed in JSP 518 (Ref.1). Part 7 also presents the outstanding issues to be addressed in the development of the safety case.
- 1050 Part 8 provides a list of acronyms and a glossary of the principal definitions used in this FSC.

Forward Actions

- 1051 This issue of the FSC and the associated programme of FAs arising from the SJP has been developed with the aim of permissioning of continued use of the Shiplift and 12 Berth to conduct dockings until the next planned Periodic Review. The SJP includes the planned work to close the outstanding issues identified in Part 7 of this FSC.

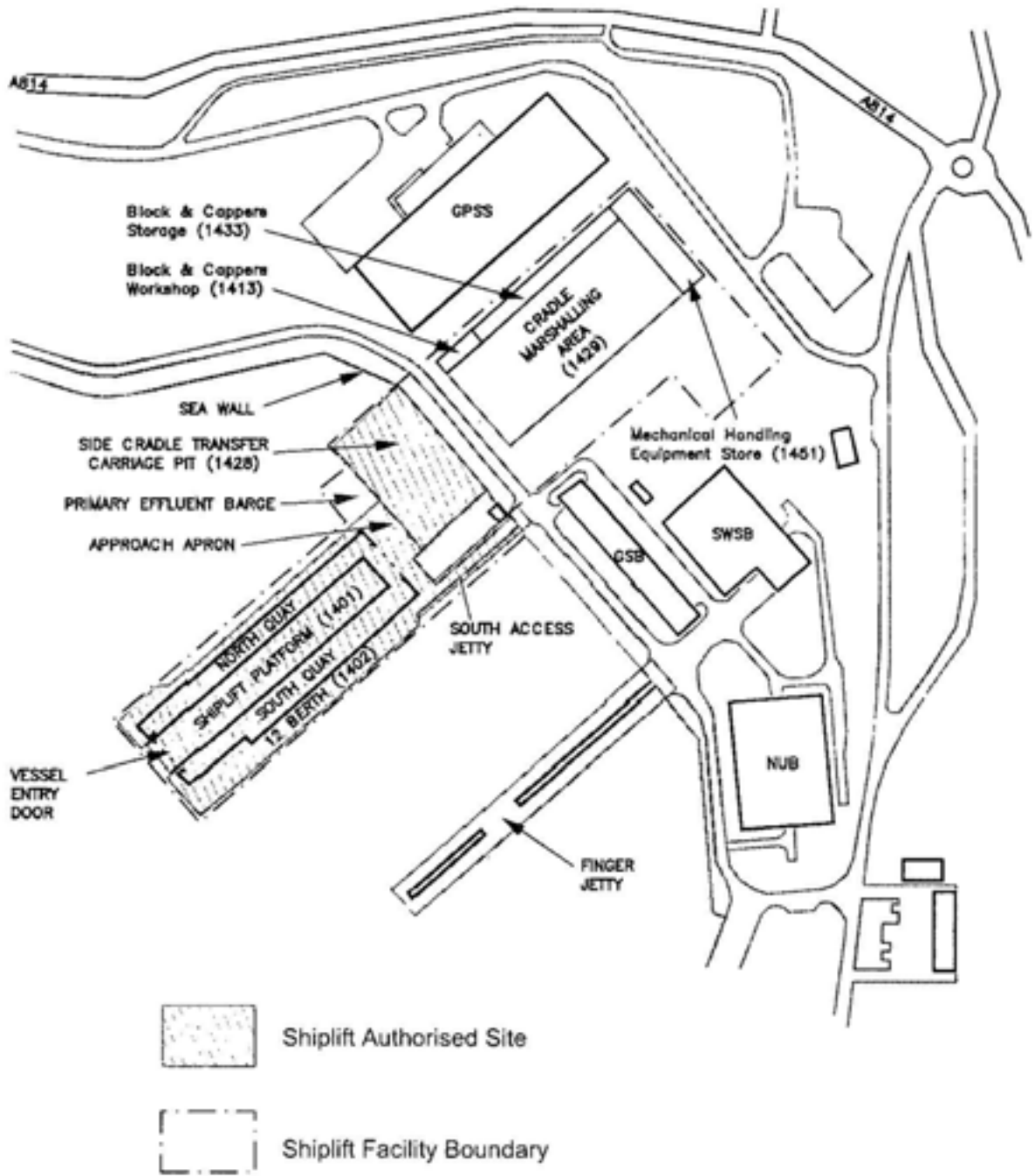


Figure I.1 Location of the Shiplift and 12 Berth

Nuclear Site Safety Justification

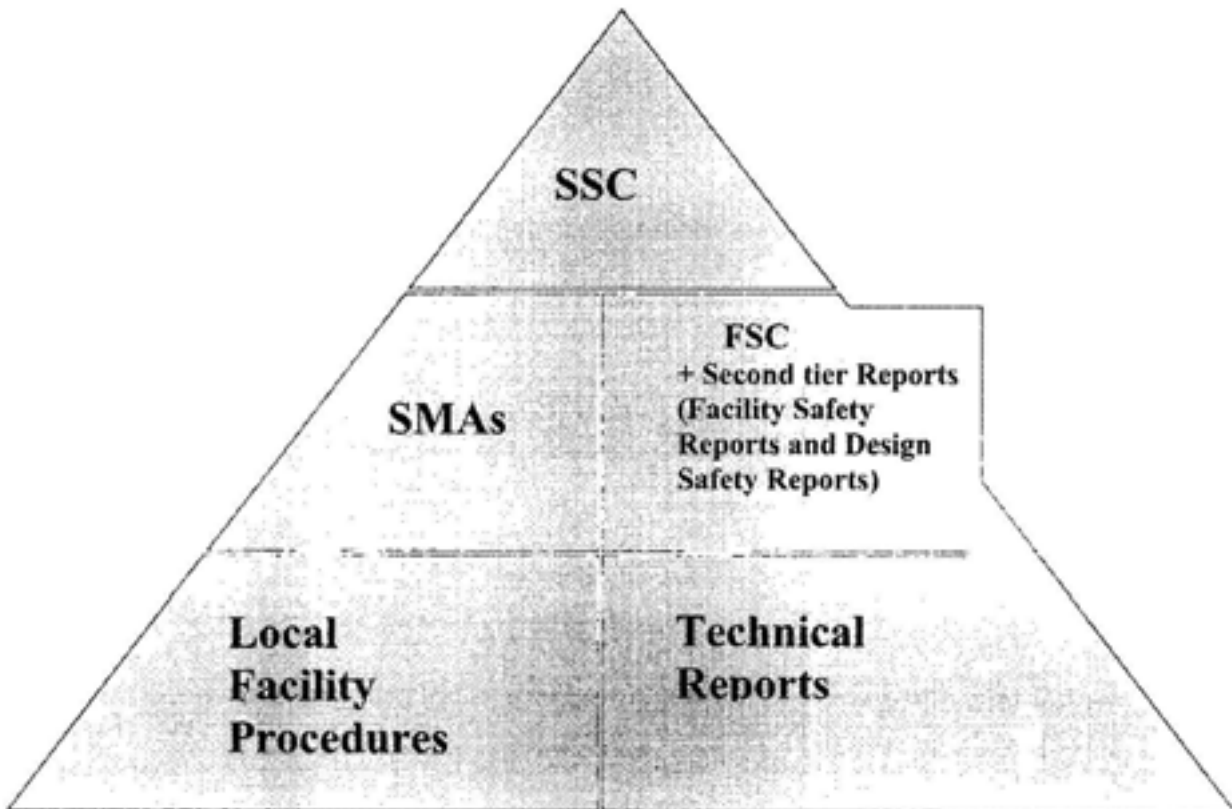


Figure 1.2 Safety Documentation Map

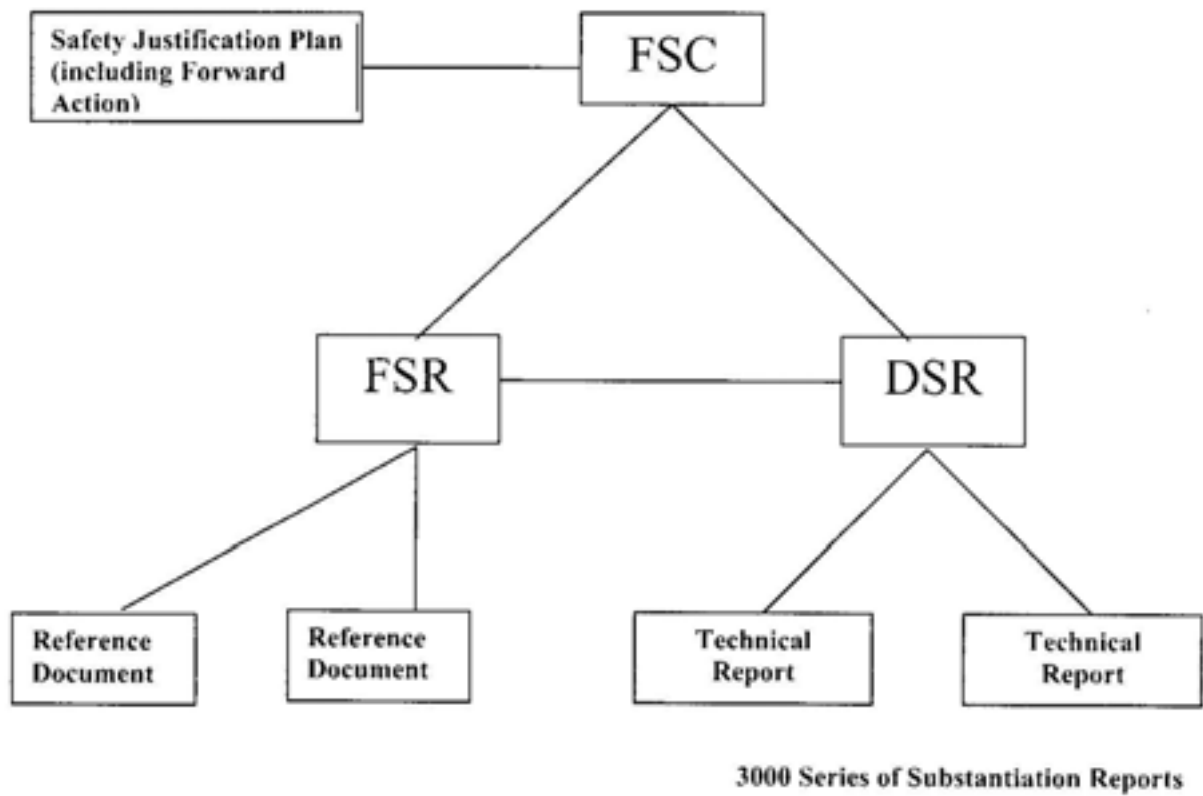


Figure 1.3 FSC Documentation Structure

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REFERENCES

- | | |
|---|---|
| ¹ JSP518 | Regulation of the Naval Nuclear Propulsion Programme Issue 2 |
| ² SSCPMT-TR-522 | HMNB Clyde Shiplift Facility Safety Principles Paper. Issue 6 |
| ³ CoN/CNNRP/501/6/2/2/542/2001 | Regulator Letter, dated 19 th March 2001 |
| ⁴ SSCPMT/GEN/592 | SIP Phase 2 report, March 2001 |
| ⁵ SSCPMT/GEN/593 | SIP Phase 2 Additional Studies report, March 2001 |
| ⁶ SSCPMT/PSRR/567 | Periodic Safety Review report, Volume 1 – Main report, March 2001 |
| ⁷ SSCPMT/PSRR/567 | Periodic Safety Review report, Volume 2 Part 1 – Annexe 1 – 21 Works lists, commentary, March 2001 |
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| ⁹ SAPs | Safety Assessment Principles for Nuclear Facilities. 2006 Edition. Revision 1. (HSE) |
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| ¹¹ N.2522.49 | HMNB Clyde. Site Safety Case, Issue 3 |
| ¹² NSSJ-MGMT-PM-001 | Process Map. Production, Control and Administration of Safety Justification and Nuclear Site Justification. Revision 3 |
| ¹³ DNSR/15/8/11 | DNSR 20/08(R). Astute Operations AC22 Submission and Key Points from Astute Level 4 RIF held at HMNB Clyde on 20 May 08. 13 June 08. |
| ¹⁴ DNSR/15/8/3 | DNSR 16/09(R). Safety Justification of Astute Dockings in the Shiplift. 9 Jun 09 |
| ¹⁵ N.2522.52/2 | Shiplift Facility, Facility Safety Report - Probabilistic Risk Assessment - Issue 2 |
| ¹⁶ SA/RSMS/RD03460001-SL | Shiplift HAZOP Report Issue 1 |
| ¹⁷ RSMS/RD03041001 | 12 Berth HAZOP Report Issue 1 |
| ¹⁸ NRPA Letter | NP/606/07/12 [3678/09]. PWR 2 Vanguard and Astute Classes. Confidence Statement on Shutdown Safety Case Hull Impact Withstand. 11 Nov 2009 |
| ¹⁹ SJP DJD252/6/1 | Shiplift Safety Justification Plan Issue 9 |
| ²⁰ RRMP23065 | Shiplift Facility Probabilistic Risk Assessment Supporting Report - Summary of Risk Data Vanguard, Trafalgar and Swiftsure Classes - Issue 1. |
| ²¹ N.2522.190 | Shiplift Facility, Facility Safety Report – Facility Hazard Assessment - Issue 1 |

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²² N.2522.189	Shiplift Facility, Facility Safety Report – Safety Functional Requirements - Issue 1
²³ N.2522.52/3	Shiplift Facility, Facility Safety Report - Conditions and Limits of Safe Operation – Issue 1
²⁴ N.2522.52/4	Shiplift Facility, Facility Safety Report – Fault Recovery Guidance - Issue 1
²⁵ N.2522.77	Shiplift Cooling Water Supplies Design Safety Report – Issue 2
²⁶ N.2522.75	Shiplift EOT Cranes Design Safety Report Issue 2
²⁷ N.2522.79	Shiplift Platform Design Safety Report – Issue 2
²⁸ N.2522.81	Shiplift Fire Protection Design Safety Report – Issue 2
²⁹ N.2522.83	Shiplift Miscellaneous Services, DSR - Issue 2
³⁰ N.2522.84	Northern Jetties Catamarans Design Safety Report Issue 1
³¹ N.2522.76	Shiplift 12 Berth 20t Crane Design Safety Report Issue 2
³² N.2522.78	Shiplift Civil Structure Design Safety Report – Issue 2
³³ TR 3560	Shiplift Berthing Equipment Design Report
³⁴ N.2522.60	Northern Utilities Building Design Safety Report – Issue 1
³⁵ N.2522.61	Faslane Communications Systems Design Safety Report – Issue 1
³⁶ N.2522.66	Faslane Nuclear Alarms Design Safety Report – Issue 1
³⁷ N.2522.62	Faslane Northern Area DIRAMS Design Safety Report Issue 1