

PART 3

Demonstration of



Acceptability

PART 3

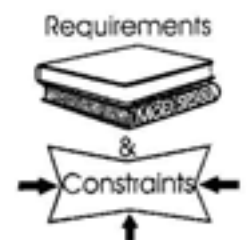
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DESCRIPTION OF THE FACILITY, SAFETY FEATURES AND OPERATIONS

INTRODUCTION

- 3001 A general description of the Facility is given in Part 1. The following sections describe the Shiplift Facility and the operations conducted therein:
- Description of the Facility. - Provides a brief description of the Facility and its location. This section also discusses the support services provided by the Facility to a docked or berthed submarine, and the support services required by the Facility.
 - Facility Safety Features. - Identifies and briefly describes the safety-mechanisms and safety-related equipment associated with the Shiplift Facility.
 - Facility Operations. - Provides a brief overview of operations conducted at the Shiplift Facility.
 - Radiological Inventory. - Discusses the type and amount of radioactive material held within the Shiplift Facility, and demonstrates that the amounts held are ALARP. This section also discusses other hazardous (non-radioactive) materials within the Shiplift Facility which have any potential to affect radiological safety.

DESCRIPTION OF THE FACILITY

General Characteristics

- 3002 The Shiplift and 12 Berth are both X Berths as defined by JSP 518 (Ref. ¹). The following figures have been included to aid the description the Shiplift Facility:
- Figure 3.1 Shiplift / 12 Berth Location Plan.
 - Figure 3.2 Sectional view of Shiplift with Vessel.
 - Figure 3.3 Elevation of Shiplift (Viewed from the Seaward end).
- 3003 The Shiplift Facility consists of the following major components:
- One Shiplift platform and associated equipment.
 - Two 55/2t EOT cranes.
 - Two quays (north and south) and associated berthing equipment.
 - Support systems for the docked nuclear submarine, including electrical and cooling water overside services.
 - Shiplift support services, including fire protection, ventilation, electrical services and communications.
 - One road-bridge at the seaward end of the Syncrolift platform.



- g. Four maintenance cranes are also provided for use during EOT Crane maintenance.

3004 12 Berth consists of the following major components:

- a. One 20t Portal Jib crane.
- b. Three Catamarans.
- c. Support systems for the berthed nuclear submarine, including electrical overside services.
- d. One quay.

Interfaces with Other Facilities

3005 The Shiplift Facility interfaces with other Facilities at HMNB Clyde, each of which has its own safety case within the NSSJ as follows.

- a. Nuclear Utilities Building (NUB) - the primary interface is the provision of electrical supplies to the Facility.
- b. Radioactive Effluent Disposal Facility (REDF) - receives radioactive effluent that is transferred from SSBN/SSNs at the Facility.
- c. Active Processing Facility (APF) - receives radioactive waste that is transferred from SSBN/SSNs at the Facility.
- d. HMNB Clyde Port (Port OMSR) - provides the port infrastructural arrangements that enables SSBN/SSN passage to/from the Facility's berthing facilities.

SAFETY FEATURES

3006 This section identifies and discusses the safety mechanisms and safety-related equipment within the Facility. A definition of the terms 'safety mechanism,' 'safety system' and 'nuclear safety implicated equipment' are provided within JSP 518 (Ref.1).

Safety Mechanisms and Systems

3007 All safety mechanisms within the Facility are administered in accordance with the requirements of Process Map NBDD-PM-032 (Ref.²) and are explicitly detailed within Part 5 of each supporting Design Safety Report. Examples of Facility system safety mechanisms, as identified in the relevant DSRs, is provided in Table 3.1.

3008 A safety mechanism, as defined in JSP 518 (Ref.1) Chapter 3 (AC27) is an engineered safeguard that is not invoked during normal operation which prevents the safety case being breached. The omission or failure of a safety mechanism would either lead to a significant increase in risk or fail to prevent the transgression of the design basis envelope.

Facility System	Safety Mechanisms
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Cooling Water and Firefighting Systems	No safety mechanisms identified within the DSR (Ref.3)
EOT Cranes	Main hoist emergency brakes, Radio controller's deadman's handle, Limit switches, overload protection and anti-collision system DSR (Ref. 6).
12 Berth Crane	Seismic switch, LT Limit switches, Hoist barrel limit switches and monitors, Drive trip DSR (Ref. 8).
Platform Mechanical and Electrical Systems	Crash mats (EOT crane dropped load protection) (DSR Ref. 9).
Civil Structure	Lightning protection system DSR (Ref 10).
Fire Protection System	Shiplift FE13/FM200 Gaseous Protection System DSR (Ref. 15).

Table 3.1 Shiplift Facility Systems Safety Mechanisms

Nuclear Safety Implicated Equipment and Systems

- 3009 The design life of facility structures, plant and systems are as identified in the supporting DSR and associated SJP documentation. This information is derived initially from the original design specification of the various structures, equipment etc and amended as necessary through life by means of Periodic Safety Reviews. Any significant 'life' issues identified within the appropriate Examination, Maintenance, Inspection and Testing (EMIT) schedules shall effectively update Part 6 of this FSC via the associated live file.
- 3010 The Nuclear Safety Implicated (NSI) equipment associated with the Shiplift Facility are:
- a. Cooling Water Systems.
 - b. Electrical overside services.
 - c. EOT cranes.
 - d. 12 Berth crane.
 - e. Civil engineering works including Impressed Current Cathodic Protection (ICCP).
 - f. Shiplift Platform Mechanical and Electrical systems.
 - g. Shiplift and Submarine communication systems.
 - h. Shiplift ventilation and air conditioning systems.
 - i. DIRAMS.
 - j. Berthing systems.
 - k. Fire protection systems.

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Defence in Depth

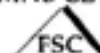
Submarine Features

- 3011 Defence in Depth is intrinsic in the design of the Reactor Plant.
- 3012 There are four physical barriers providing defence in depth against a Fission Product Release:
- a. Fuel Cladding.
 - b. Primary Coolant Boundary.
 - c. Primary Containment.
 - d. Secondary Containment.

Physical Barriers

- 3013 Fuel Cladding. - The first line of protection for preventing the release of fission products is the fuel plate cladding. To keep this intact it is necessary to provide a means of removing heat from the fuel plates to prevent the cladding thermal limits from being exceeded. The water in the submarine's primary circuit performs this cooling function. The submarine maintains two means of removing the heat from the primary coolant at all times. The Facility provides fresh water cooling and a seismically qualified seawater cooling system with redundancy in its performance, to provide the ultimate heat sink to remove the decay heat from the submarine.
- 3014 Primary Coolant Boundary. - The second means of protection for preventing a fission product release from the submarine is the primary circuit boundary itself. In the Shiplift this is kept intact at all times by not allowing intrusive repair on the primary systems.
- 3015 Intrusive repairs are permitted at 12 Berth. The limits on the Shiplift platform are as defined in the CLOSO FSR (Ref.22).
- 3016 All Barriers. - All the physical barriers are also provided with adequate protection from hazards that might be generated as a result of activities within the Facility and cause a direct or indirect impact on the physical barrier. The relevant dominant hazards are from loss of stable support (Excessive Boat Attitude (EBA)), dropped load (DL), a seismic event, EOT crane collapse and 12 Berth crane collapse. The main defence in depth features provided against these hazards within the Facility design basis are summarised below and described in this safety features section:
- a. Diversity and grading within the platform control and protection system which prevents against severe faults that may lead to loss of stable support.
 - b. EOT Crane Programmable Logic Controller (PLC) monitoring systems which back up the hard wired trips.
 - c. A slider mechanism to limit loads on the EOT cranes and rails in a seismic event.
 - d. Seismic triggers which put the platform and EOT and 12 Berth cranes in a safe state prior to a significant seismic event.

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- e. The articulated nature of the platform that allows safe re-distribution of load in the event of a single load path failure, retaining stable support for the docked submarine.
 - f. There is also structural redundancy in the pile support to the quays, providing further defence in depth within the load path.
- 3017 Shiplift Building. - It is not considered the Shiplift building provides a credible, additional, physical barrier for a nuclear submarine on the platform. It may however provide some limited mitigation in the event of a Fission Product Release.

Levels of Protection

- 3018 The Shiplift Facility offers five levels of protection providing Defence in Depth with respect to the prevention of accident sequences developing and, in the event that the prevention measures were not sufficiently effective, subsequently managing any sequence of events that could potentially lead to the worker/crew/public population groups being exposed to a Fission Product Release. The five levels are:
- a. Conservative Design.
 - b. Control of Operations.
 - c. Engineered Safeguards.
 - d. Accident Management.
 - e. Offsite Measures.
- 3019 It is the requirement of the Facility to protect and if practicable to enhance the physical barriers and to ensure the levels of protection are supported such that they can be maintained. This is primarily achieved through a sound design.
- 3020 Conservative Design. - The DSRs and their underlying Technical Reports (TRs) demonstrate the Facility to be of conservative design.
- 3021 Control of Operations. - This level of protection is supported primarily by the requirement to be in Plant State B as a normal operating envelope for the docking element of the Facility and being in Plant State B for some 90% of the time at 12 Berth. The maintenance of this plant state and its associated Loss of Heat Sink grace time provide significant margins in the protection of the fuel plates. Further in the docking element of the Facility, the decay heat removal capability is further supported by the requirement that intrusive primary plant repairs will not be undertaken ensuring the primary side of the process remains intact.
- 3022 The Facility operates to its own procedures, which recognise the normal, abnormal and emergency operating envelopes. Control of Operations is described later in this section.
- 3023 Engineered Safeguards. - The safety mechanisms and safety features, which comprise the engineered safeguards, are described within Part 4 of each supporting DSR referenced throughout Part 3 of this FSC.

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- 3024 Accident Management and Offsite Measures. - In respect of accident control and mitigation, the Facility and its staff are fully incorporated in the HMNB Clyde Nuclear Accident Response Organisation (NARO).

Cooling Water and Firefighting Systems

- 3025 The purpose of the cooling water and fire fighting systems is to provide supplies of cooling water to a submarine whilst docked on the Shiplift Platform. The cooling water systems provide system redundancy and diversity such that decay heat is safely and reliably removed from the reactor, and submarine machinery can continue to operate. The systems also provide water supplies for fire fighting. Three systems are provided:
- a. Sea Water Cooling (SWC) System. - Provides a sea water supply for all classes of submarines. SWC is provided from the SWC system through hoses and flooding bonnets to the intake ports of the submarines cooling systems enabling these systems to operate whilst the submarine is out of the water on the Shiplift platform.
 - b. FWFF System. - Provides a fresh water supply for High Pressure Decay Heat Removal (HPDHR) cooling for Vanguard Class submarines and Emergency Cooling (EC) for S&T Class submarines.
 - c. Sea Water Fire Fighting (SWFF) System. - Provides a sea water supply as a primary and alternative to the fresh water supply for HPDHR on Vanguard Class Submarines and EC on S&T Class submarines.
- 3026 Whilst afloat submarines retain the capacity to address any occurrence of fire using their own systems. Whilst docked in the Shiplift submarines capabilities could be vulnerable to exhaustion and suitable connection arrangements are made to avoid such a circumstance arising. These arrangements should be differentiated from the Facility's own capabilities to fight fire, which could also be used to back-up the boat specific arrangements both on the 12 Berth and when docked.
- 3027 The cooling water supply systems are fully described in the Shiplift Cooling Water DSR (Ref. ³).

Electrical Oversight Services

- 3028 Electrical oversight services are important in ensuring nuclear safety as they ensure the continuity of electrical supplies for reactor safety. They also allow equipment to be released for maintenance and repair.
- 3029 Oversight 440 Volt (V), 60 Hertz (Hz) supplies are provided to the submarine from two pairs of Shore Connection Boxes (SCBs) on the South Quay. The supplies are derived from the 6.6 kilovolts (kV) North Rings 1 and 2, and are transformed within the Facilities HV substations. Direct current (dc) supplies are also provided to three further SCBs. Details of electrical over-side services are fully described and illustrated within the NUB DSR (Ref. ⁴).
- 3030 Electrical shore supply cable formers are provided to support the electrical over-side services cables throughout the full range of submarine lifting. The formers are fully described in the DSR for the NUB (Ref. 4).



Description of Shiplift 55/2t EOT Cranes

- 3031 The purpose of the Shiplift EOT cranes is to perform nuclear and non-nuclear lifts as defined in JSP 518 (Ref. 1) in support of all vessels docked or berthed within the Shiplift Facility. The main function of the cranes being to manoeuvre loads utilising the cranes' main functions namely Main Hoist Raise/Lower, Aux Hoist Raise/Lower, Long Travel Landward/Seaward and Cross Travel North/South motions in a safe and controlled manner.
- 3032 Both cranes operate on a common set of long travel rails suspended above both quays supporting the crane structure.
- 3033 Both cranes are independently operated via the primary remote radio link or by a hard-wired pendant controller. The radio controller is the primary means of controlling the EOT cranes. For nuclear lifts the pendant controller is manned to provide a hard-wired emergency stop facility via the Pendant Emergency Stop Operator (PESO). All crane operations are undertaken in accordance with the requirements of SOP 943(N) (Ref. 3).
- 3034 The EOT crane travel and hoist motions are monitored by limit switches and other monitoring devices and by PLCs that can trip motion. Each device that can initiate a trip has one set of contacts hard wired into the associated drive to trigger the appropriate action and a second set of contacts wired into the associated monitoring PLC to provide back-up protection. Each PLC has its own internal watchdog, which upon detecting failure of the PLC will produce a system trip.
- 3035 Both EOT Cranes are of identical design and are fully described and adequately illustrated within the supporting DSR (Ref. 6).

Description of the 12 Berth Crane

- 3036 The 12 Berth jetty crane is provided to perform nuclear and non-nuclear lifts as defined in JSP 518 (Ref. 1) in support of vessels berthed alongside. The main function of the crane is to manoeuvre loads utilising the cranes main functions namely hoist raise/lower, luff in/out, long travel landward/seaward and slew left/right motions in a safe and controlled manner.
- 3037 Operation of the 12 Berth Crane as discussed later is fully described within SOP 760(N) (Ref. 7).
- 3038 12 Berth Crane is fully described and adequately illustrated within its DSR (Ref. 8).

Shiplift Platform Mechanical and Electrical Systems

- 3039 The purpose of the Shiplift Platform is to lift a vessel from the water, to safely support that vessel whilst maintenance, defect repair work and dock dependent work is performed and to lower the vessel back into the water.
- 3040 The Shiplift platform is simply an elevator for lifting nuclear submarines from the water to a level where work can be carried out in dry conditions on the platform. The Shiplift platform comprises an articulated timber decked steelwork platform, which together with a docking cradle is lowered beneath the water to a depth where the

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submarine can be floated into position above the cradle. The docking cradle is configured to support the submarines lower hull profile.

- 3041 Vessels are supported on a bespoke wheeled cradle train that can be assembled remotely and transferred to the Facility on a rail system which interfaces with rails clipped to the platform structure formed from longitudinal elements covered by the decking and attached to a series of main transverse beams supported by wire ropes.
- 3042 The loads imposed by a vessel are transferred through angled keel blocks, which interface with the vessel's hull through facings known as cappers. The keel blocks are attached to strongbacks that distribute the loads to the platform structure through wheeled bogies. The assembly of blocks, a strongback, and the bogies supporting the strongback constitute a cradle.
- 3043 There are three types of cradle - a standard cradle, a sliding strongback cradle and a nose block cradle. The standard cradles are supported on four-wheeled bogies, as is the nose block cradle, which supports a single keel block an offset forward from the bogie centreline that is only required when Vanguard Class vessels are docked. The sliding keel block cradle assemblies are equipped with auxiliary two-wheeled bogies which provide an outrigger support for the longer strongbacks necessary to enable the sliding action; these auxiliary bogies transfer little load.
- 3044 The platform is elevated by a number of synchronised, electrically powered mechanical hoists and wire ropes, which are supported at fixed evenly spaced positions on the North and South Quays along both sides of the platform. During routine vessel maintenance operations the platform, carrying the docking cradle and submarine, continues to elevate until it reaches the maintenance level, at which time a series of upper limit switches automatically stop further movement. The platform is then lowered onto a set of electro-mechanically actuated pins and the hoist loads are progressively shed to these pins.
- 3045 Platform lowering and raising, movements are controlled by an operator at the Operator Work Station (OWS) located in the Shiplift Control Room (SCR). This console includes the full complement of controls, indicator lights, alarms, load and platform position indicators necessary for the operator to safely and efficiently control all aspects of docking and the subsequent undocking of vessels.
- 3046 The function of the Shiplift platform is to support a vessel in a stable and defined manner during raising and lowering operations, including when the platform is temporarily stopped at any location during movements, and the period the platform is supported on pins at the maintenance position. The Control and Protection (C&P) systems are designed to control the raising and lowering of the platform, as well as to detect deviations from normal operating conditions and to protect against their potential consequences.
- 3047 The Shiplift Platform is fully described and adequately illustrated within the DSR for the Shiplift Platform (Ref. ⁹).
- 3048 Operation of the Shiplift Platform as discussed later is fully described within SOP 932(N) (Ref. ¹⁰).

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Civil Engineering Works Including ICCP

- 3049 The purpose of the civil engineering works is to safely support the Shiplift and 12 Berth, to provide sufficient integrity to ensure that damage to the structure as a result of internal and external hazards will not cause damage to nuclear related services, and to provide an interface with Shiplift EOT and 12 Berth cranes as described in the Shiplift Civil Structure DSR (Ref. ¹¹).
- 3050 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. This structure is supported by a system of vertical and raking tubular steel piles. The raking piles are socketed into bedrock and are designed to resist sway forces (including earthquake, wind and wave loads). The whole structure is described in the Shiplift Civil Structure DSR (Ref. 11).
- 3051 Syncrolift hoists are mounted under the two quays with the platform suspended between them. 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 the open 12 Berth and is connected to land by the South Access Jetty, both of these structures also being supported on piles. A gap bridged by a sliding plate provides seismic isolation at the sea wall.
- 3052 Corrosion of the piles is inhibited by paint on the exposed surfaces and by an Impressed Current Cathodic Protection (ICCP) system. While this system is necessary to the long-term integrity of the piles it must be switched off at all times when the Shiplift platform is in the water, and for twenty-four hours beforehand, to avoid the possibility of hydrogen embrittlement and accelerated corrosion of the hoist ropes and/or other components of the Syncrolift (the platform system itself is protected against corrosion by painting, greasing etc. but is not qualified for stray corrosion currents).
- 3053 Loads from the platform are applied to the structure either through hanger links or directly onto the hoist bedplate. These respectively react onto stub columns of reinforced concrete and thence onto reinforced concrete finger beams, or directly onto the finger beams at the hoist chamber floor level. Figure 3.2 provides a general view of the platform to civil structure load path. This is described in detail in the Platform DSR (Ref.9).
- 3054 North of the access jetty is the Side Transfer Carriage (STC) Pit for cradle marshalling. This consists of a reinforced concrete slab supported on reinforced concrete beams and steel piles. The STC pit is connected to the quays of the Shiplift building by a concrete Approach Apron.
- 3055 A Vessel Entry Door (VED) is provided at the seaward end of the Shiplift. The VED is constructed of a series of steel girders connected by chains and clad on both sides by fabric. Rollers at the ends of the girders run in vertical steel channels fixed to supporting box towers of reinforced concrete. The VED provides protection against the effects of extreme environmental hazards and blast. The VED is fully described in the Shiplift Civil Structure DSR (Ref. 11). The VED is operated and checks made in accordance with SOP 954(N) (Ref. ¹²) to ensure that it poses no threat to the nuclear submarine during berthing.

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- 3056 At the landward end of the Shiplift building is the Transfer Ashore Door (TAD). The door allows cradles to enter and leave the Facility and provides environmental protection for the Shiplift. The door is identical in design and operation to the VED described above.

Communications Systems

- 3057 Communications are provided in the Facility to:
- Assist personnel performing operations and evolutions.
 - Alert personnel in the event of an incident in the Facility.
 - Meet requirements of the Faslane Communication Systems DSR (Ref. 13).
- 3058 Shiplift Mobile Communications. - Mobile radio handsets are provided. These are the preferred communications for use by the docking group personnel during berthing and docking with the berthing system being utilised as the back-up system. There are sufficient handsets for allocation to all key personnel and berthing positions.
- 3059 General. - Various communications systems are provided at the Shiplift Facility. These are:
- Base Broadcast System.
 - Shiplift Broadcast System.
 - NUB Meridian System.
 - Base British Telecom (BT) System.
 - Shiplift Maintenance System.
 - Shiplift Berthing System.
- 3060 Broadcast Systems. - Although substantially common systems there are two methods of broadcasting messages within the Shiplift:
- Base Broadcast System. - This is described in the Faslane Communication Systems DSR (Ref. 13) and provides access within the Shiplift Facility to all Base broadcast messages.
 - Shiplift Broadcast System. - Uses the speaker system of the Base Broadcast System to provide a local broadcast system for the Shiplift. Broadcast messages arising from the Base Broadcast System override internal Shiplift broadcasts.
- 3061 Submarine/Shiplift/NUB Communications. - A dedicated communication system is available between the nuclear submarine manoeuvring room and the NUB Control Engineer at all times when the nuclear submarine is within the Shiplift Facility and receiving shore supplies. This is provided by the two main Base communication systems:
- The NUB MoD System (Meridian). - This is described in the Faslane Communication Systems DSR (Ref. 13) and provides a dedicated seismically qualified communications system between the NUB and the submarine manoeuvring room.

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- b. The Base BT System. - This is described in the Faslane Communication Systems DSR (Ref. 13) and is available at immediate notice.
- 3062 Shiplift Fixed Internal Communications. - Two local communications systems are provided within the Shiplift. Each of these systems is battery backed to provide a minimum of [REDACTED] use in the event of a power failure:
- a. The Maintenance System. - This system provides communications between a master communications panel in the SCR and the following outstations:
- Relay Room.
 - Roadbridge.
 - MCCs 1 to 6.
 - Sea Water Pump Room.
 - Headwinch Room.
- b. The Berthing System. - This system provides communications between the master communications panel at the Docking Officers Dais at the seaward end of the 13m level walkway (duplicated at the landward end) and the following stations:
- Capstans.
 - Sea Water Pump Rooms.
 - Headwinch Room.
 - SCR.

Shiplift Ventilation and Air Conditioning

- 3063 The purpose of the Shiplift ventilation and air conditioning system is to provide fresh air to compartments within the Shiplift, to remove fumes (including diesel exhaust) from the Shiplift and to cool essential Shiplift compartments and equipment. The system is comprised of the following elements.
- Ventilation and air conditioning is important to the RPR in order to maintain adequate operating temperature conditions for the panels. Excessive temperature could cause loss of the RP functions and PLMS. Temperature in the room is maintained by two 100% duty air conditioning units and monitored via a temperature high/low alarm provided in the SCR during platform operations.
 - The two SWC pump rooms are each provided with separate ventilation systems.
 - A boom-mounted system is provided to extract exhaust from the nuclear submarine diesels if run when the nuclear submarine is berthed. There are two separate extract arrangements for use according to nuclear submarine type. The diesel extraction system is removed before raising the platform beyond 1m (SSN) /2m (SSBN) and after electrical supplies are energised.

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Dockside Installed Reactor Accident Monitoring System

- 3064 The purpose of DIRAMS is to provide an indication and alarm in the event of a nuclear accident occurring at a berth.
- 3065 The Shiplift and 12 Berth are both equipped with DIRAMS, which is an automatic gamma radiation alarm. The Northern Area DIRAMS has readout facilities at the NUB Central Control Room, the Maritime Operations Centre and the Nuclear Accident Headquarters (NAHQ).
- 3066 The DIRAMS system is fully described/illustrated within the Faslane Northern Area DIRAMS DSR (Ref. ¹⁴).

Berthing Systems

- 3067 Berthing systems are provided to enable the nuclear submarine to safely enter and leave the Shiplift Facility. These systems include:
- a. A hydraulically driven head winch.
 - b. Four electrically driven capstans (two per quay).
 - c. Eight berthing trolleys (plus two spares), connected to the nuclear submarine in pairs to maintain it central to the Shiplift during entry/exit to the Facility.
 - d. Two wooden catamarans are positioned immediately inside the entrance of the Shiplift, one against each quay, to minimise the effect of any impact with the Shiplift structure.
- 3068 Berthing systems are fully described/illustrated within the Shiplift Berthing Equipment Design Report (Ref. ¹⁵).

Fire Protection

- 3069 Fire protection systems are provided to detect fires, to alert personnel once a fire has been detected and to provide systems which allow the fire to be fought. These systems are fully described/illustrated within the Shiplift Fire Protection DSR (Ref. ¹⁶).
- 3070 Nuclear safety defences are primarily based on segregation of redundant items and in some cases, fire resistant cabling. There are also important requirements to minimise fire risk by restriction of combustible materials and potential ignition sources. These are adequately reflected within Operation and Maintenance (O&M) procedures and local fire orders.
- 3071 The Shiplift fire alarm system includes analogue detectors, break-glass points and data signalling modules, with a main alarm panel located at the entrance stairwell No.1. It has interfaces with:
- a. The Supervisory Control and Data Acquisition (SCADA) system to activate common fire/fault signals via Police Post 4.
 - b. Air Handling/Ventilation plant system main power supply contactor units.
 - c. The Shiplift C&P Gaseous Panel Quench System.

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berthing or slipping from Berths 10, 11 or 12. Moves into the Shiplift are generally conducted using a total of three tugs.

- 3079 Berthing and movements at HMNB Clyde are described in detail in the Port OMSR (Ref. 18).

Planning and Preparation for Docking

- 3080 Planning. - a series of Pre Docking Planning Meetings are conducted. These are attended by representatives of the vessel, Planning Logistics Afloat (PLA). Shiplift staff and Clyde Design Authority. The purpose of the meetings is to agree and establish all aspects of the docking prior to the evolution. The main topics considered are:
- a. Documentation. - Operating and repair documentation including boat procedures.
 - b. Concessions. - Material state of the Facility.
 - c. Safety Case Issues. - Authorisation of the docking.
 - d. Vessel Requirements. - Cranage requirements, fitting of PMLF (S&T Class only), shore supplies, additional requirements for weapon retention, decay heat levels & domestics.
 - e. Shiplift Material preparations and defects.
 - f. Planning and Briefings. - (Un)Docking briefs, (un)berthing briefs and safety briefs.
- 3081 General. - Preparations for the Shiplift Facility to receive a nuclear submarine are undertaken against authorised procedures by the nominated O&M departments (SOP 920(N) (Ref. 21)). These ensure that all mandatory requirements prior to a nuclear submarine entering the Facility are achieved and that the Shiplift, its services, its personnel and the nuclear submarine meet the requirements of the DSSC. The requirement to start or continue a nuclear evolution with a degraded material state constitutes an abnormal condition requiring the DNSAG/NSAG and FO to fully assess the material state ensuring that nuclear safety shall not be compromised in accordance with committees' Terms of Reference as contained within the Clyde Management System (CMS).
- 3082 Environmental Conditions. - Prior to a nuclear submarine entering the Facility, the Shiplift environmental conditions are confirmed to be within the design envelope and the requirements outlined below must have been achieved. The Commanding Officer (CO), Docking Officer and Pilot must be satisfied that the evolution is safe in the prevailing conditions:
- a. Platform operation is not permitted (SOP 920(N) (Ref. 21)) if any of the following environmental conditions apply:
 - i. Wind speed greater than [REDACTED] knots.
 - ii. Wave height greater than [REDACTED] at the Shiplift.
 - iii. Electrical storms are forecast during platform operation.

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- iv. External ambient temperature lower than -11°C or higher than 31°C.
 - b. Limit switches are cleared of any icing.
 - c. Internal temperatures for Control rooms and LMS equipment are specified in the Platform DSR (Ref.9)
- 3083 The condition and limit of safe operation for environmental conditions are detailed in supporting FSR (Ref.22) All relevant conditions are explicit in the operating documentation.
- 3084 Shiplift Facility. - Prior to a nuclear submarine entering the Facility, the Shiplift will be in a fully operational state. Full details on the basis for judging that tolerability of risk is acceptable in the Faslane Shiplift are contained in Part 7 of this FSC. The Facility requirements outlined below will have been achieved:
- a. Maintenance. - All scheduled maintenance and calibration will be up to date in accordance with Process Map SHP-PM-015 (Ref. 23) and Clyde Management Systems. Where necessary a concession will be passed to the relevant authority in accordance with SOP 920(N) (Ref. 21) and NSAG-PM-003 (Ref. 24).
 - b. Load Path. - All load path items are reviewed, departures from specification are considered by the Facility Operator/NBDA. Where necessary a concession will be passed to the relevant authority in accordance with SOP 920(N) (Ref. 21). Maintenance Concessions for items with a periodicity of less than 3 months are controlled by NSAG-PM-003 (Ref. 24).
 - c. Shiplift Faults and Damage. - If, in the judgement of the Docking Officer, a potentially damaging event has occurred, the Shiplift is inspected and any damage found assessed by the DNSAG.
 - d. Control and Protection. - The Shiplift control and protection systems are fully operational. Checks on the control and protection systems are carried out as detailed in SOP 920(N) (Ref. 21).
 - e. Services. - Oversight services will be available as required and discussed at the pre docking planning meetings. Specific requirements are detailed in SOP 920(N) (Ref. 21).
 - f. Communications. - At least two communications systems are to be fully operational for the safe conduct of berthing and docking operations. Portable handsets are normally used for berthing/unberthing communications and are also available as back-up in the event of failure to any of the systems.
- 3085 Nuclear Submarine Conditions. - Prior to a nuclear submarine docking in the Facility, the nuclear submarine conditions are to be in accordance with PAG requirements, in Plant State B or lower with a decay heat rate of less than [REDACTED] (SSBN and SSN T class) [REDACTED] SSN (S class). The decay heat rate for Astute Class will be [REDACTED].

Pre-Operational Checks and Preparations

- 3086 Docking Cradle. - Prior to a nuclear submarine or surface vessel entering the Facility, the correct cradle is in place on the platform. The cradle specification is supplied by Facility Design Manager FDM 1 for nuclear vessels.

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- a. Cradle Survey. - The cradle is surveyed and approved fit for purpose in the CMA in accordance with SOP 959(N) (Ref. ²⁵) and on the platform levelled at the maintenance level. Checks include that the appropriate wheel chocking is in place, consistent with the requirements of the safety case as established in the DSR (Ref. 9).
 - b. Resilient Mount Compressions. - An initial set of block resilient mount compression readings are taken in accordance with SOP 962(N) (Ref. ²⁶) with the docking cradle unloaded.
 - c. PLMS Readings. - The docking cradle is lowered into the water to check for capper float off and raised again until the deck is at 1m above the water. A datum set of PLMS readings is taken at this point and attached to SOP 962(N) (Ref. 26) to assist with subsequent analysis of the Cradle Docking Load Profile (CDLP).
- 3087 Pre-Operational Checks. - Prior to a docking or undocking, physical checks known as Series A-D Pre-Ops confirm the operability and validate the assessed reliability of the control system and mechanical operability of the hoist system. These checks are a pre-requisite for all nuclear docking/ undocking activities SOP 920(N) (Ref. 21) and SOP 921(N) (Ref. ²⁷) respectively and must be undertaken within pre-defined timescales.
- 3088 The operating procedures are designed such that the docking operation will normally be completed well before expiry of the test period assumed within the Safety Case, which is an underlying assumption in the derivation of the system availability. This complies with the mean test intervals used in the reliability demonstration within the DSSC. If any of the test intervals are exceeded once the lifting stage of the docking has commenced, the DNSAG may authorise the docking to continue as an alternative to aborting the docking and moving the nuclear submarine to an alternative berth.
- 3089 Rising Tide. - For submarines with significant known hull defects or for the first docking after refit will be performed at low tide on a rising tide in order to ensure in the event of a platform hoist failure, an uncontrolled docking will not occur.
- 3090 Electromagnetic Compatibility (EMC)/Electromagnetic Interference (EMI) Restrictions. - Prior to a nuclear submarine entering the Facility, the following operating restrictions are to be implemented as safeguards against the hazard presented to platform operation by EMC/EMI as detailed by the DNSAG. These operating restrictions are a pre-requisite of SOP 920(N), (Ref. 21).

Berthing

- 3091 Reactor Plant State. - Decay heat and grace time will be calculated before the submarine enters the Shiplift. Plant State B or lower and the Containment State required by the PAG, will be maintained.
- 3092 General. - Upon completion of all pre-operational checks and Shiplift/submarine preparations, the nuclear submarine is manoeuvred into the Facility by the headwinch, capstans and the tugs and aligned below the diesel exhaust extraction system.
- 3093 Submarine Diesel Generators/Battery State. - The vessel diesel generators (DG) is/are to be shutdown, on the order of the Berthing Officer, as the vessel passes under the VED. The battery will discharge during berthing, but will be charged as soon as electrical shore supplies are connected. The battery capacity will not be permitted to

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fall below 60% at any time and will be kept at or above 80% whenever possible. From the experience gained in previous dockings, the berthing operation should take approximately 50 minutes and the battery capacity should remain at around 75%. If the Shiplift diesel extraction system is not connected and the submarine's battery is depleted to 60%, then the submarine's DG(s) is/are to be restarted in accordance with EOP 977(N) (Ref. ²⁸).

- 3094 The current configuration enables the running of both DGs on full load for any class of submarine.
- 3095 In an emergency. - The submarine's DG(s) may be started within the Shiplift building in accordance with EOP 977(N) (Ref. 28).

Raising the Platform and Connection of Services

- 3096 The occurrence of Design Trip, Safety Trip, Fault, Hazard or other failures are safeguarded against by use of recovery procedures, including SOPs and Emergency Operating Procedures (EOPs). A number of potential Loss of/Failure of situations have already been identified by Platform O&M Manuals (S 2849 CSB Faslane (Ref. ²⁹)) and detailed by Shiplift EOPs.
- 3097 Fault conditions were identified by 1350-221-R001 (Ref. ³⁰) and procedures written and approved as detailed above. If there are no approved procedures to govern a post fault situation, the DNSAG are required to assess and approve a specific procedure developed by the Docking Officer at the time. In the short term, SOPs/EOPs will put systems into a safe state for the DNSAG to consider under the arrangements detailed in Part 4 of this FSC.
- 3098 Once the submarine is berthed to the satisfaction of the Berthing Officer, nuclear safety implicated (NSI) communications (Faslane Communications Systems DSR (Ref. 13)) are connected and proved and electrical oversight services are connected. The VED is confirmed shut and electrical oversight services are energised and proved. The submarines diesels may be shutdown and the Diesel Exhaust Extraction System stowed. The oversight services are manned throughout the platform raising. The Diesel Exhaust Boom (DEB) can remain in place up to the 1m/2m beyond grounding level at which point it is removed to the stowed position on the North Quay wall.
- 3099 Submarine Alignment. - Accurate nuclear submarine positioning is achieved by the use of wires and Tirfor winches. Alignment above the cradle is achieved with reference to datum marks on the nuclear submarine's hull forward and aft and refuelling datum on SSBNs, which permits plumb-bobs to give the precise position of the nuclear submarine with respect to the datum marks/plates on the docking cradle and the platform elevation at grounding. The alignment also takes account of systematic effects such as variation of the platform longitudinal position with platform depth (hoist reeling effect), tidal currents acting on the platform and cross wind (SOP 920(N) (Ref. 21)).
- 3100 Sliding Blocks. - To accommodate the passage of the Vanguard class nuclear submarine during berthing at extreme low tide states, special cradles with sliding keel blocks are positioned at the seaward end of the platform. Once the nuclear submarine is positioned over the platform, the sliding blocks are winched into position and pinned in the docked position by divers to accept the nuclear submarine contour (SOP 955(N) (Ref. ³¹)).

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