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| ONR Project Assessment Report  HMS Victorious submarine maintenance at Devonport Royal Dockyard – commencement of docking and associated deep maintenance period upkeep of HMS Victorious submarine in 9 Dock |



ONR Project Assessment Report

**Project Name**: Victorious Submarine Maintenance at Devonport Royal Dockyard

**Report Title**: HMS Victorious submarine maintenance at Devonport Royal Dockyard – commencement of docking and associated deep maintenance period upkeep of HMS Victorious submarine in 9 Dock

**Dutyholder/ Applicant**: Devonport Royal Dockyard Ltd.

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# Executive Summary

Devonport Royal Dockyard Ltd. (DRDL), as the licensee of the Devonport Royal Dockyard nuclear licensed site, has requested the Office for Nuclear Regulation’s (ONR) agreement to undertake the docking and associated deep maintenance period upkeep of Vanguard Class (VDMP) of the HMS Victorious submarine in 9 Dock. This request has been made in accordance with DRDL’s arrangements made under Licence Condition (LC) 22(1): Modification or experiment on existing plant.

DRDL has a developed capability to carry out VDMP in the 9 Dock facility, located within the nuclear licensed site at Devonport Royal Dockyard. This facility is a purpose-built dry dock which has been used for the continual upkeep of nuclear submarines, with HMS Vanguard submarine being the most recent. In preparation for readiness to commence VDMP, 9 Dock has been subject to an extensive outage, which has included maintenance, refurbishment and upgrade works on the facility structures, systems and components. DRDL’s request is supported by a plant safety case which has been written to modern standards, to remove the capability to defuel and refuel and to justify the safety of the associated activities for the VDMP of HMS Victorious submarine.

The regulatory permissioning decision for DRDL to commence its proposed activity has been informed by discipline specific advice from specialist fault studies, human factors, radiological protection, control and instrumentation, mechanical engineering and civil engineering safety inspectors via a combination of targeted assessments, interventions and inspections.

All specialist inspectors have advised that there are no safety shortfalls that would prevent ONR agreeing to DRDL’s request. The inspectors did identify some shortfalls against regulatory expectations and have raised associated recommendations. However, all the inspectors judge that they are not prerequisites to ONR’s agreement as they don’t undermine DRDL’s demonstration that risks have been reduced to as low as reasonably practicable (ALARP) and can be addressed as forward action plans.

Based on the work carried out by ONR, I judge that for the requested agreement, DRDL has provided adequate documentation to justify the safety of the proposed modification and demonstrated that there will be suitable and sufficient safety measures in place to ensure that the risks from normal activities and reasonably foreseeable faults will be ALARP. We have not identified any safety shortfalls that would prevent agreement to DRDL’s request and as such, I judge that DRDL has adequately implemented its arrangements made under LC 22(1).

In accordance with the provisions made in DRDL’s arrangements under LC 22(1), it is recommended that Licence Instrument 570 agreeing to DRDL’s request for ONR’s agreement to undertake the docking and associated deep maintenance period upkeep of the HMS Victorious submarine in 9 Dock should be issued. It is recommended that regulatory oversight and routine monitoring of progress against the identified assessment recommendations via formal regulatory issues is maintained to ensure that they are adequately addressed by DRDL within the required timescales.

Table 1: List of abbreviations

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| Term/Acronym | Description |
| ALARP | As low as reasonably practicable |
| DRDL | Devonport Royal Dockyard Ltd. |
| DNSR | Defence Nuclear Safety Regulator |
| EIM&T | Examination, maintenance, inspection and testing |
| LC | Licence Condition |
| NSC | Nuclear Safety Committee |
| ONR | Office for Nuclear Regulation |
| PSC | Plant Safety Case |
| RGP | Relevant Good Practice |
| SAP | Safety Assessment Principle(s) |
| SFAIRP | So far as is reasonably practicable |
| SSC | Structure, System and Component |
| TAG | Technical Assessment Guide (ONR) |
| VDMP | Vanguard Deep Maintenance Period |

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# Permission Requested

1. Devonport Royal Dockyard Ltd. (DRDL), as the licensee of the Devonport Royal Dockyard nuclear licensed site, has requested the Office for Nuclear Regulation’s (ONR) agreement to undertake the docking and associated deep maintenance period upkeep of Vanguard class (VDMP) of the HMS Victorious submarine in 9 Dock [ref. [1]]. This request has been made in accordance with DRDL’s arrangements made under Licence Condition (LC) 22(1): Modification or experiment on existing plant[ref. [2]].

# Background

1. DRDL has delivered the capability to carry out the ongoing maintenance programme for the Vanguard class of submarines at Devonport Royal Dockyard. The Vanguard class submarine maintenance programme will require the use of 9 Dock to carry out work to support the VDMP. 9 Dock is a purpose-built facility located within the nuclear licensed site at Devonport Royal Dockyard and has been used for the continual deep maintenance of Vanguard class nuclear submarines, with the last Vanguard class submarine completing its VDMP in 2022.
2. In preparation for readiness to commence the next VDMP, 9 Dock has been subject to an extensive outage, which has included maintenance, refurbishment and upgrade works on the facility structures, systems and components (SSCs). A significant proportion of these works has focussed on the dockside cranes and dock water retaining boundary. The outage has also included implementation of the new plant safety case (PSC) which has removed the need to refuel the reactors, in the form of revised operating instructions and associated personnel training.
3. In accordance with its arrangements, DRDL has sought ONR’s agreement to commence the VDMP in 9 Dock with the safety of these activities being justified by a supporting PSC [ref. [3]] and [ref. [4]].
4. This project assessment report recommends the permissioning decision on DRDL’s request. It is deliberately circumspect in some of the facility and process descriptions and details to be consistent with the document security classification. It has been produced in accordance with ONR’s business management system and associated relevant guidance [ref. [5]].

# Assessment and inspection work carried out by ONR in consideration of this request

1. In accordance with the agreed regulatory permissioning strategy for DRDL’s request [ref. [6]] advice has been sought from specialist safety inspectors in the following specialisms to inform the recommended permissioning decision:
   * + - Fault studies
       - Human Factors
       - Control and instrumentation (C&I)
       - Mechanical engineering
       - Civil engineering
       - Radiological Protection
2. The recommended permissioning decision for DRDL to commence its proposed activity has been informed by a combination of discipline specific advice via targeted assessments and inspections with the latter focussing on the adequacy of DRDL’s implementation of its arrangements for compliance with LC 22: Modification or experiment on existing plant and LC 28: Examination, inspection, maintenance and testing.
3. In accordance with the ONR and Environment Agency Memorandum of Understanding [ref. [7]], we have consulted with the Environment Agency to ascertain if it had any objections on environmental grounds to ONR agreeing to DRDL’s request. Similarly, in accordance with the ONR and Ministry of Defence Memorandum of Understanding [ref. [7]], we have consulted with the Defence Nuclear Safety Regulator (DNSR) whether it had any objections to ONR agreeing to DRDL’s request from a through-life nuclear safety perspective of the submarine nuclear reactor plant including seeking mutual assurances on relevant safety claims relating to this plant (for which DNSR is the competent body to the ONR).
4. To initiate the regulatory engagement on DRDL’s proposed activity, an initial intervention was held between DRDL and other relevant regulatory bodies that focussed on clarifying understanding of the activity being requested and structure and content of the supporting PSC [ref. [8]].

# Matters Arising from ONRs Work

## ONR’s Work

1. The matters arising from the work carried out by our specialist inspectors are summarised as follows.
2. The fault studies inspector has reviewed DRDL’s PSC and undertaken a targeted  
   assessment of DRDL’s control of criticality, as this was considered to be the  
   primary risk associated with the requested activity. Specifically this focussed on any  
   new or novel activities when compared to previous dockings.
3. In summary, the inspector advised that the:
   * + - Modification justified by the PSC has been categorised in accordance with  
         regulatory expectations, specifically ONR technical inspection guide for LC 22  
         [ref. [9]].
       - Hazard identification has undergone a reasonable process of review and was  
         complimented by new studies, as appropriate when compared to relevant good  
         practice (RGP) of ONR Safety Assessment Principles (SAPs) FA.2 [ref. [9]].
       - Inclusion of severe accident analysis in the PSC now aligns to regulatory  
         expectations when compared to the relevant ONR SAPs.
       - The improvements and forward actions identified by the PSC are risk informed,  
         consistent with regulatory expectations when compared to RGP of ONR SAPs,  
         including FA.6 and FA.7.
       - DNSR has, as the competent body, provided sufficient assurance against  
         certain claims made by the PSC such as the intrinsic withstand of the submarine, which align with ONR analysis validation (AV) range of SAPs and associated  
         technical assessment guide.
4. The inspector did note some shortfalls against regulatory expectations. However, the  
   inspector is satisfied that DRDL has both demonstrated that the risks are reduced  
   to as low as reasonably practicable (ALARP) for the next docking, and recognised  
   these shortfalls with forward commitments to manage the risk below the regulatory  
   target limits identified in the ONR SAPs on a risk prioritised basis.
5. In conclusion, the inspector has not identified any safety issues that would prevent  
   ONR agreeing to DRDL’s request and supports permission being granted [ref. [10]].
6. The C&I inspector has reviewed DRDL’s PSC and undertaken targeted assessment of the dockside cranes control protection systems as they protect against various mechanical handling faults. The C&I inspector has reviewed DRDL’s PSC and targeted the dockside cranes’ hoist rope payout protection system. This is because it has been modified including the addition of a computer-based protection channel which is unlike the extant crane protection systems that utilise hard-wired relay logic. This system protects against ledged loads which could result in dockside crane collapse.
7. In summary, the inspector acknowledges DRDL’s introduction of a second diverse channel to improve the engineered protection to reduce the possibility of a hazardous ledged load occurring. Noting that DRDL has placed conservatively reduced claims on the system pending future work to improve them based on operational and test data, the inspector advises that a suitable justification has been provided to demonstrate that the risks have been reduced to ALARP. In forming this view, the inspector judges that the risks have been reduced in accordance with regulatory expectations when compared to RGP of ONR SAPs ESS.27, ESS.21, EDR.1 and EDR.2 and associated technical assessment guides [ref. [9]​].
8. The inspector did raise a query associated with configuration control if replacing the smart devices. Specifically, this was related to unknown software modifications that could undermine the proven in use data underpinning the claimed reliability. At the time, the inspector was unable to source any documented evidence that formal arrangements exist to mitigate this risk. The inspector has therefore raised a recommendation for DRDL to provide adequate arrangements for procuring smart devices including assurance that the device firmware version is aligned to the relevant safety system substantiation. The inspector does not consider this to be a prerequisite to granting permission and therefore it will be subject to regulatory monitoring via a formal regulatory issue [ref. [11]​​].
9. In conclusion, the inspector has not identified any safety issues that would prevent ONR agreeing to DRDL’s request and supports permission being granted [ref. [12]​].
10. The human factors inspector has reviewed DRDL’s PSC and undertaken a targeted  
    assessment of the potential risk significant faults that place the greatest reliance on  
    human actions including both operator event initiators and safeguards to prevent,  
    protect or mitigate the consequences of a fault. This focussed on whether the PSC  
    provided evidence of the feasibility and reliability of claimed human actions.
11. In summary, the inspector advises that:
    * + - DRDL has undertaken a systematic approach to identify actions important to  
          safety and the operating rules that ensure the safe operating envelope is  
          maintained.
        - DRDL has adequately integrated human factors within the design and PSC.
        - Human factors involvement in the design has resulted in the application of general good practice design principles and improvements to useability. In forming this opinion, the inspector did require DRDL to provide additional validation and verification evidence of the design to support reliable operations and associated safety important tasks.
12. The inspector did identify some gaps from regulatory expectations when compared to RGP of ONR SAPs EHF.1-.10 and associated technical assessment guides [ref. [9]]. This included a minor shortfall in the effective interfacing between the human factors design and PSC work. However, following several engagements with DRDL, the inspector judges that these are evidential reporting gaps to the work undertaken by DRDL rather than gaps to nuclear safety. The inspector therefore advises that it would be disproportionate to withhold granting permission when no specific safety gaps have been identified. The inspector does however, raise a recommendation for DRDL to review the gaps to identify any associated improvements to DRDL’s arrangements and their implementation. The inspector does not consider this to be a prerequisite to granting permission and therefore it will be subject to regulatory monitoring via a formal regulatory issue [ref. [11]].
13. In conclusion, the inspector has not identified any safety issues that would prevent ONR agreeing to DRDL’s request and supports permission being granted [ref. [13]]
14. In addition, the human factors inspector also provided advice via the inspection of DRDL’s compliance with implementation of its LC 22 arrangements [ref. [14] & [15]] with a specific focus on LC 10: Training and LC 24: Operating Instructions. These were targeted given the PSC identifies administrative controls are required to keep the facility within its safe operating envelope during both normal operations and potential fault scenarios. The purpose of the inspections was to gain assurance of DRDL's ability to implement the PSC’s administrative requirements and readiness of the people and processes to commence the requested activity.
15. Based on the evidence sampled at the time of the inspection against DRDL’s  
    arrangements and documentation, and regulatory guidance DRDL was judged to  
    have implemented adequately its arrangements for compliance with LC 22:  
    Modification or experiment on existing plant. Specifically that for the proposed  
    modification DRDL has:
    * + - Provided adequate documentation to justify the safety of it;
        - Provided suitable training for those on site who have responsibility for any  
          operations which may affect safety; and,
        - Operating instructions that include instructions in the interests of safety and  
          instructions necessary to ensure operating rules are implemented.
16. In conclusion, it was judged that RGP was met when compared with appropriate  
    benchmarks; legal duties were complied with; and, no safety shortfalls were  
    identified in the delivery of safety functions.
17. Both the mechanical and civil engineering inspectors provided advice via inspections of DRDL’s compliance with implementation of its LC 28 arrangements for the facility’s mechanical and civil engineering SSCs respectively [refs. [16] & [17]].
18. The purpose of the inspections was to gain assurance of DRDL's ability to implement the PSC’s requirements for these SSCs and plant readiness to commence the requested activity.
19. Based on the evidence sampled at the time of the inspections against DRDL's arrangements and documentation, and regulatory guidance DRDL was judged to have demonstrated the required compliance with LC 28: Examination, maintenance, inspection and testing (EIM&T). Specifically that EMI&T was carried out:
    * + - By suitably qualified and experienced persons;
        - In accordance with schemes laid down in writing;
        - Within the intervals specified in the plant maintenance schedule;
        - Under the control and supervision of a suitably qualified and experienced person appointed by the licensee for that purpose; and,
        - With a signed and dated report of completed EIM&T.
20. In addition, the civil engineering inspector carried out a separate intervention through a site meeting convened to discuss civil engineering topic areas in support of the ONR fault studies assessment of the 9 Dock facilities new safety case (ref. [18]).
21. In conclusion, the inspector advises that:
    * + - From the information provided by DRDL at the meeting, they consider that no further civil engineering assessment is required to support the forthcoming boat entry.
        - It is recommended that ONR continues to engage with DRDL regarding the longer term maintenance and replacement of the seismic seals. However, they are content that this constitutes normal regulatory business.
22. In conclusion, both inspectors advised that RGP was met when compared with appropriate benchmarks; legal duties were complied with; and, no safety shortfalls were identified in the delivery of safety functions.
23. The Radiological Protection inspector has undertaken an intervention which has targeted shielding and dose controls during the planned activities onboard the platform [ref [19]].
24. In conclusion, the inspector was adequately assured that radiation dose uptake will be managed through established arrangements and advises that they will provide continued regulatory oversight of dose accrual during routine regulatory interactions.

## External governance and assurance

1. As part of my initial consideration of DRDL’s request, I confirmed that in accordance with its established governance and assurance arrangements, the PSC justifying DRDL’s request has been subject to independent consideration and advice from its Nuclear Safety Committee (NSC) [ref. [20]] & [ref. [21]]. No formal advice was provided by the NSC to the licensee other than that it should endorse it.
2. The Environment Agency and DNSR regulatory bodies have both advised that they have no objection to ONR agreeing to DRDL’s request [refs. [22] & [23]].

# Conclusions

1. Based on the work carried out by ONR, I judge that for the requested agreement, DRDL has made an adequate safety justification to demonstrate that there will be suitable and sufficient safety measures in place to ensure that the risks from normal activities and reasonably foreseeable faults will be ALARP. We have not identified any safety shortfalls that would prevent agreement to DRDL’s request and as such, I consider that DRDL has adequately implemented its arrangements made under LC 22(1).

# Recommendations

1. In accordance with the provisions made in DRDL’s arrangements under LC 22(1), ONR should issue Licence Instrument 570 [ref. [24]] agreeing to DRDL’s request [ref. [1]].
2. I also recommend that ONR’s regulatory oversight and routine monitoring of progress against the assessment recommendations identified via regulatory issues should be maintained to ensure that they are adequately addressed by DRDL within the required timescales.

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