MSSS First Extension Liquor Activity Reduction

Agreement to commence MSSS First Extension Liquor Activity Reduction Active Commissioning and Operations

Project Assessment Report ONR-SDFW-PAR-17-058
Revision 0
29 March 2018
EXECUTIVE SUMMARY

Title
Agreement to commence MSSS First Extension Liquor Activity Reduction Active Commissioning and Operations.

Permission Requested
Sellafield Limited (SL) has requested the Office for Nuclear Regulation’s (ONR) agreement to the implementation of a Plant Modification Proposal (PMP) that will result in the start of active commissioning (defined as transfer of active liquor using the LAR system), and implementation of associated safety case changes to support the move into operational phase 1 and phase 2 of the first extension Liquor Activity Reduction (LAR) system. This request is made in accordance with SL’s arrangements made under licence condition 22.

Background
The Magnox Swarf Storage Silo (MSSS) has stored Intermediate Level Waste under water from Magnox reprocessing for approximately forty years and is currently assessed as the highest risk nuclear facility in the Nuclear Decommissioning Authority estates. In order to accelerate hazard and risk reduction, SL has commenced a programme of work to retrieve solid waste from MSSS and transport it for storage in a more modern facility. It has also initiated a process to reduce the radioactive content of liquor associated with the solid waste storage.

Liquor Activity Reduction (LAR) is an integral part of the MSSS retrievals programme and has successfully been trialled in the MSSS third extension where it is now considered a routine operation. A similar approach to LAR is now being applied in the first extension (FE) utilising a similar engineered solution. One difference is that the concentration of potassium ions in the FE liquor is higher than the third extension, such that a single batch transfer directly to Effluent Distribution Tanks (EDT) would increase the potassium concentration beyond the conditions for acceptance at Site Ion Exchange Plant (SIXEP). Consequently, for phase 1 FE LAR operations, liquor conditioning is required. This will be achieved by feeding FE liquor into the third extension and blending. FE liquor levels are subsequently topped up by an engineered water top up system to ensure FE solid waste remains covered. Third extension LAR activities will then be performed in accordance with current practice. Once FE potassium ion concentrations have been reduced to a level acceptable for SIXEP processing, FE liquors will be routed direct to the EDT thereby omitting the blending with third extension liquor (phase 2 operations).

Assessment and inspection work carried out by ONR in consideration of this request
Although LAR is an existing operation in the MSSS third extension, the new plant and arrangements for FE LAR if inadequately implemented could lead to significant operator dose. In addition, there is potential for significant disruption to SIXEP operations which could delay other strategic hazard and risk reduction activities across the SL site. To support my judgement I identified the requirement for specialist inspector assessment and advice in the following areas: fault studies, control & instrumentation, chemical engineering, mechanical engineering, human factors and radiological protection.

The ONR specialist inspector advice was focused in the following areas:
- Liquor sampling
- Use of the engineered water top up (EWTU) to replenish liquor removed during LAR
- Wash down of transfer pipework following batch transfers
- Detection of overfilling scenarios
- Testing and commissioning of safety related equipment including safety mechanisms
Radiological protection of workers from normal operations
Substantiation of any claims on human performance including that in response to alarms
Substantiation of crane operations.

The assessment consisted of review of the licensee’s PMP and the supporting safety case substantiation documents, inspection of the operational area and operational procedures, and readiness inspection and reviews to confirm that the people, plant and procedures are available to support safe FE LAR active commissioning and operations.

**Matters arising from ONR’s work**

ONR’s assessment of SL’s proposal identified a short fall in the licensee’s arrangements that we judge to be necessary in the interests of safety for control lifting operations in the vicinity of FE LAR pipework whilst liquor transfers are in progress. As a result, SL has implemented an appropriate restriction on the relevant lifting operations until the necessary safety arrangements have been implemented and considered adequate by ONR.

Additionally, ONR identified a concern related to a potential corrosion issue associated with the medium to be used for flushing the FE LAR pipework after a liquor transfer has occurred. SL has considered our reservation and implemented an appropriate administrative control to ensure that only demineralised water is used as part of FE LAR flushing operations.

The licensee’s case identifies a shortfall in its design basis assessment of compartment overfilling faults, regarding insufficient diverse and redundant compartment level indication. ONR is satisfied that the licensee has a suitable programme of work to implement a new reasonably practicable safety measure, and has identified alternative arrangements to provide adequate safety measure redundancy in the interim period. ONR has assessed these interim arrangements and considers them acceptable.

All ONR specialists who have undertaken assessment of SL’s proposal have advised they have no objection to ONR issuing a license instrument to permit FE LAR active commissioning and operations. I have considered SL’s implementation of these restrictions and considered them acceptable.

**Conclusions**

Commencement of FE LAR is judged to be an important activity to reduce the radiological risk presented by the MSSS facility. Based on the evidence sampled and the safety controls implemented by the licensee, I am satisfied with the adequacy of SL’s proposal and supporting safety case. SL has recognised and accepted ONR’s assessment findings regarding lifting arrangements and the FE LAR flushing medium and has taken appropriate action to address these.

**Recommendation**

I recommend that ONR issues License Instrument number 509 giving permission to Sellafield Ltd to commence the activities described in the licensee’s proposal that will result in FE LAR initially commencing active commissioning and subsequent full operation.
# LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>ALARP</td>
<td>As low as reasonably practicable</td>
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<td>CCSC</td>
<td>Construction Crane Safety Committee</td>
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<td>CfA</td>
<td>Conditions for Acceptance</td>
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<td>C&amp;I</td>
<td>Control and Instrumentation</td>
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<td>CP</td>
<td>Crane Proposal</td>
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<td>EDT</td>
<td>Effluent Distribution Tank</td>
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<td>EWTU</td>
<td>Engineered Water Top Up</td>
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<td>FE</td>
<td>First Extension</td>
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<td>FE LAR</td>
<td>First Extension Liquor Activity Reduction</td>
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<td>HF</td>
<td>Human Factors</td>
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<td>LAR</td>
<td>Liquor Activity Reduction</td>
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<td>LRT</td>
<td>Lateral Restraint Tower</td>
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<td>MSSS</td>
<td>Magnox Swarf Storage Silo</td>
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<td>ONR</td>
<td>Office for Nuclear Regulation</td>
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<td>OA</td>
<td>Operating Assumption</td>
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<td>PMP</td>
<td>Plant Modification Proposal</td>
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<td>rOI</td>
<td>required Operating Instruction</td>
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<td>RP</td>
<td>Radiation Protection</td>
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<td>SAP</td>
<td>Safety Assessment Principle</td>
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<td>SFAIRP</td>
<td>So far as is reasonably practicable</td>
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<td>SL</td>
<td>Sellafield Ltd</td>
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<td>SIXEP</td>
<td>Site Ion Exchange Effluent Plant</td>
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<td>TAG</td>
<td>Technical Assessment Guide</td>
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<td>WEC</td>
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Figure 1: FE LAR Process schematic
1 PERMISSION REQUESTED


2 BACKGROUND

2. The Magnox Swarf Storage Silo (MSSS) has stored Intermediate Level Waste under water from Magnox reprocessing for approximately forty years and is currently assessed as the highest risk nuclear facility in the Nuclear Decommissioning Authority estates. ONR considers this risk to be intolerable [3]. In order to accelerate hazard and risk reduction, SL has commenced a programme of work to retrieve waste from MSSS and transport it for storage in a more modern facility. It has also initiated a process to reduce the radioactive content of liquor associated with the solid waste storage.

3. Liquor Activity Reduction (LAR) was first trialled in the MSSS third extension compartments; this trial was successful and third extension LAR is now a routine operation. Third extension LAR consists of transferring the active liquor to the Effluent Distribution Tanks (EDT) whereupon the liquor is sentenced and transferred to Site Ion Exchange Effluent Plant (SIXEP) for treatment. The third extension liquor levels are then restored via an engineered water top up system to maintain compartment levels such that the waste contained within remains covered. The process thereby reduces activity in the third extension by batch extraction and subsequent dilution of remaining liquor.

4. Third extension LAR continues to achieve its purpose in reducing radiological inventory of compartment liquors. SL has recognised that the same benefit could be achieved through LAR operations in the first extension (FE) including:

- reduced operational dose
- reduce aerial discharges
- reduced hazards from accidental releases
- reduce retrieval time
- reduced constraints on retrievals.

5. SL has identified that the concentration of potassium ions in FE liquor is higher than the third extension, such that a single batch transfer directly to EDT would increase the potassium concentration in EDT’s liquor and exceed the Conditions for Acceptance (CfA) at SIXEP. Consequently, FE liquor must be diluted within MSSS to ensure that the potassium concentration does not exceed the EDT and SIXEP CfA. Liquor blending to achieve CfA criteria is not novel. Should the CfA be exceeded there is no direct radiological consequence, however there is potential for significant disruption to SIXEP operations which could delay other strategic hazard and risk reduction activities across the SL site.

6. The treatment of liquors within MSSS is an integral activity to achieve the overall MSSS hazard and risk reduction programme. The FE LAR programme supports this objective by allowing a programme of batch conditioning and processing of liquors to reduce the FE active inventory.
7. **FE LAR process overview:**

![FE LAR schematic](image)

8. During phase 1 FE LAR operations the potassium ion concentration will be reduced by blending liquor with third extension liquors (with a lower potassium concentration that has been reduced through ongoing third extension LAR operations), prior to transfer from the third extension to the EDT Centre Chamber.

9. The FE liquor will be pumped in batches from FE compartment 12\(^{st}\) to the third extension overflow tank. The liquor level will then be lowered in the third extension by transfer to the EDT to accommodate the additional FE liquor. Liquor will then be transferred to the third extension compartment 16 using an existing steam ejector where it will be blended with the third extension liquor. The mark IV coolers are utilised to circulate liquors to mix and dilute the potassium concentration within the third extension. FE compartments will then be topped-up to replace the extracted liquor batch.

10. Blended liquor in the third extension will be transferred from compartment 22 to the EDT Centre Chamber using an existing steam ejector before the third extension compartments are topped-up to replace the extracted liquor batch. Liquor in the EDT is then transferred to SIXEP for processing in line with the existing third extension LAR process.

11. When SL has demonstrated that the FE potassium ion concentration complies with SIXEP CfA, FE LAR will transition to phase 2 operations whereby liquor is directed from the third extension overflow tank directly to the EDT, thereby omitting the blending operation. Once a transfer to EDT has been completed, the liquor held in the EDT Centre Chamber will be transferred to SIXEP.

12. Following each batch transfer of liquor, process pipework is flushed with demineralised water to minimise internal contamination.

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\(^{2}\) Note first extension compartments 1-10 and 12 are hydraulically linked; third extension compartments 16-22 are hydraulically linked.
13. **Proposed modification:** SL has raised a category C PMP [2] to implement changes to the MSSS third extension LAR safety case that will:

- Combine third extension LAR safety case with the new FE LAR safety assessment
- Approve the start of active commissioning (defined as transfer of active liquor using the LAR system and implementation of the safety case changes) followed by ongoing operational phases 1 & 2.

14. ONR would not normally permission category C modifications via a Licence Instrument. However, ONR considers that the potential fault consequences as identified in the following section indicates that the LI approach is a more appropriate form of regulatory oversight and control.

3 **ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR IN CONSIDERATION OF THIS REQUEST**

15. ONR’s strategy for regulating the Sellafield site is identified in reference 4. The strategy’s focus is on stimulating, facilitating and expediting hazard and risk reduction. ONR has prioritised the retrieval of waste stored in MSSS under this strategy. Following ONR’s permissioning guidance [5], inspectors have engaged with the SL project to build confidence in SL’s proposed activity.

16. I consider that the most significant radiological hazard identified in SL’s proposal [2] results from loss of containment due to overfilling faults of the first extension compartments after batch transfer of LAR to the third extension overflow tank has been completed. This has potential to give radiological consequences of 1-10 mSv to the public and 20-1000 mSv to workers [6].

17. In addition, I have identified that SL’s Radiological Safety Assessment [6] references out to the MSSS building crane hazard assessment [7] for consideration of lifting operations. This identifies < 0.1 mSv consequence to the public and 20-1000 mSv to workers for damage to FE LAR pipework.

18. The SL proposal identifies that there is potential for hydrogen build up within the FE LAR pipework. Deflagration of any hydrogen build up has the potential to lead to a loss of containment from the FE LAR pipework system. I therefore considered it appropriate for a specialist inspector to consider the licensees assessment of hydrogen management.

19. At the expected time of ONR’s permissioning for FE LAR, there will be extant construction crane lifting operations for installation of ventilation plant on the MSSS Lateral Restraint Tower (LRT). These lifting operations have previously been subject to ONR permissioning decision [36]. The safety case justifying these construction crane lifting operations [8] has been updated by SL [9, 10] to reflect the new hazard of FE LAR operations and the potential for crane impacts with the external sections of the FE LAR pipework. The revised assessment identifies a worst case consequence of approximately 0.5 mSv public dose for damage to FE LAR pipework. The assessment methodology does not define a potential dose to the worker, however I judge that for the purposes of informing the ONR assessment strategy it is appropriate to use the same dose value range as that identified for damage to FE LAR pipework from the building cranes [7] i.e. 20-1000 mSv.

20. I have focused ONR’s assessment of these significant hazards, namely; operations that could give rise to overfilling of the first extension compartments, lifting operations that could lead to loss of containment from the FE LAR pipework and the licensee’s assessment of hydrogen management.
21. Although not giving rise to a direct radiological consequence, failure of FE LAR process controls has the potential to significantly disrupt SIXEP operations. This could delay other strategic hazard and risk reduction activities from across the SL site.

22. Given the potential radiological consequences I judged that it was proportionate to obtain the following specialist inspector advice:

- Chemical / process engineering
- Radiological protection
- Human Factors
- Fault studies
- Mechanical engineering
- Control and Instrumentation.

23. Following my consideration of SL’s proposal to commence active commissioning and operation of FE LAR, I targeted ONR specialist inspector advice in the following areas:

- Liquor sampling
- Use of the Engineered Water Top Up (EWTU) to replenish liquor removed during LAR
- Wash down of transfer pipework following batch transfers
- Detection of overfilling scenarios
- Testing and commissioning of safety related equipment including safety mechanisms
- Radiological protection of workers from normal operations
- Substantiation of any claims on human performance including that in response to alarms
- Substantiation of crane operations.

24. In addition to the above and to support the permissioning decision, I judged that it was proportionate to undertake a readiness inspection [11, 12]. The purpose of the readiness inspection was to give confidence that the physical installation and inactive safety commissioning had been completed, operating instructions were complete and reflected the requirements of the safety case, and that sufficient numbers of people are suitably qualified and experienced, including completion of all relevant training to operate the FE LAR system.

4 MATTERS ARISING FROM ONR’S WORK

4.1 ONR ASSESSMENT

25. This assessment considers SL’s proposal to combine third extension LAR safety case with the new FE LAR safety assessment, and agree to the start of active commissioning (defined as transfer of active liquor using the LAR system and implementation of the safety case changes) followed by ongoing operational phases 1 & 2. ONR specialist assessment of SL’s proposal has been completed and their advice summarised below.

4.1.1 FAULTS STUDIES ASSESSMENT

26. An ONR Fault studies specialist inspector has undertaken an assessment [13] of SL’s proposal [2] and considered the adequacy of the licensee’s identification and assessment of potential fault sequences and the safeguards claimed to prevent a radiological consequence. Although LAR has been in operation in the MSSS third extension for a number of years, FE LAR will represent an extension to the existing process, and introduces new equipment and challenges to FE compartment liquor
level management from water top up and wash down activities. The scope of this assessment therefore focused on SL’s assessment of these significant new activities and their associated fault sequences of:

- Overfilling of the first extension compartments through the liquor transfer wash system
- Overfilling the first extension compartments through the C10 EWTU System.

27. This assessment considered adequacy of the presented safety case and challenged scenarios relating to plant evacuation during EWTU system, level monitoring during ETWU, potential to deliver the wrong wash water batch size and potential overflow routes and detection.

28. The fault studies specialist has reviewed the proposal against ONRs Safety Assessment Principles (SAPs) [14]. On the basis the licensee has demonstrated that design basis criteria are met for the overfilling faults, the inspector was satisfied with the claims arguments and evidence presented within the licensee’s safety case and the proposed modifications are ALARP.

29. The assessment found that SL had identified a shortfall against design basis criteria for two independent safety measures for the EWTU system. For this system there is only one safety measure which is the instrumentation that activates closure of the top up system valve upon detection of high compartment levels. The shortfall is being addressed by SL by the installation of a second, independent, compartment level measurement system utilising a radar system. Until such time as the radar system is operational, as an interim measure, an independent operator check of the liquor levels will be undertaken by the operator during FE top-up using local gauges. This is discussed in more detail as part of the Control & Instrumentation (C&I) specialist inspector assessment below (section 4.1.3). Taking into account ONRs Technical Assessment Guidance (TAG) on the demonstration of ALARP [15]; on the basis of the implementation of operator checks, the inspector judged that this interim solution was acceptable as there is a risk reduction benefit gained from reducing the activity of the compartment at the earliest opportunity.

30. Following assessment, the fault studies specialist confirmed that they support ONR permissioning of commencement of FE LAR active commissioning and normal operations.

4.1.2 CHEMICAL ENGINEERING ASSESSMENT

31. An ONR chemical engineering specialist inspector has undertaken an assessment [16] of SL’s proposal [2]. The assessment focused on:

- Phase 1 – third extension chemistry to gain confidence that SL has adequately assessed the potential impact of introducing first extension liquor into the third extension
- Chemical considerations during phase 2 operation with respect to the SIXEP conditions for acceptance
- First extension level management of faults that could leave to overfilling of the FE compartments through the liquor wash system and through the EWTU system
- Hydrogen assessment and management in liquor transfer pipework.

32. The assessment considered and challenged the adequacy of the presented case against the requirements of ONR SAPs [14] and TAGs [15] in following key areas of safety:
33. The assessment noted that SL had identified a shortfall against design basis criteria for two independent safety measures for the EWTU system and concluded that the licensee has performed an adequate exercise in identifying a number of reasonably practicable improvement options. These include installation of an independent and diverse means (radar) to monitor compartment liquor levels [17] to be implemented post FE LAR implementation. To ensure ONR oversight of the implementation of these ALARP options Regulatory Issue 6019 has been raised. As part of the C&I specialist inspector assessment (below) it has been identified that secondary compartment readings that are independent from the level trips and alarms can be taken. This is discussed in more details as part of section 4.1.3 below.

34. The ONR chemical engineering specialist inspector raised one recommendation which related to performing a readiness review to confirm implementation of the safety case as assessed. Details of the readiness review are recorded in section 4.1.7 below and the specialist inspector has confirmed that no actions remain outstanding [18].

35. For the key safety aspects sampled (paragraph 32) the chemical engineering specialist inspector was satisfied with the claims, arguments and evidence laid down within the licensee’s safety case. They concluded that, in their opinion the licensee has identified and reduced risks SFAIRP and that the benefits of the modification outweigh the associated risks and hazards and recommended the permissioning FE LAR active commissioning and operations.

4.1.3 CONTROL & INSTRUMENTATION SPECIALIST ASSESSMENT

36. An ONR C&I engineering specialist inspector has undertaken an assessment [19] of SL’s proposal [2] against the requirements of ONR’s SAPs [14] and TAGs [15]. The assessment focused on the highest risk fault sequences relating to MSSS compartment overfill and considered:

- Adequacy of the safety case
- Adequacy of the design for the C&I safety system
- Substantiation of reliability claim for the C&I system
- Demonstration that risk is reduced to an ALARP position.

37. The inspector also confirmed that SL’s safety case had identified a safety significant shortfall with respect to overfilling of compartments as there was insufficient diversity in the compartment liquor level detection instrumentation. As noted above by other inspectors, SL has identified a number of reasonably practicable improvement options [17]. The provision of a compartment RADAR system, to provide the diverse means for monitoring liquor levels will not be fully installed and commissioned prior to first use. As a result of this regulatory assessment finding, SL has identified two local level gauges that will be used as an interim measure to provide an alternative means of compartment liquor level detection. The subsequent operating and maintenance instructions for use of these gauges were updated by SL and reviewed during the readiness inspections section 4.1.7 below. The specialist inspector was content that
the local gauges, updated operating and maintenance instructions provide an acceptable interim arrangement.

38. The C&I specialist inspector raised two recommendations. The first relates to performing a readiness inspection to confirm that the physical plant and work instructions reflect the assumptions and description identified in the safety case. Details of the readiness review are recorded in section 4.1.7 below. The specialist inspector subsequently confirmed that all actions have been closed and that this recommendation has been addressed [20].

39. The second recommendation related to a number of minor shortfalls with the licensee’s safety assessment, including the omission of a fault scenario regarding overfilling triggered by operators starting a new top up activity when the compartment level is close to the overfill limit. Because the new scenarios are protected by existing safety mechanisms, the C&I specialist inspector did not consider this sufficient to withhold the FE LAR permissioning decision and has raised a regulatory issue number 6092 to ensure that SL’s revises its radiological safety assessment, D585 to incorporate this new scenario.

40. For the key safety aspects sampled (paragraph 36) the C&I specialist inspector judged that the safety case, design and reliability claims were adequate. The inspector concluded that the licensee has identified the hazards associated with the modification and adequate measures to reduce the risk ALARP. The assessment recommends permissioning of FE LAR active commissioning and operation.

4.1.4 RADIOLOGICAL PROTECTION ASSESSMENT

41. An ONR Radiological Protection (RP) specialist inspector has undertaken an assessment [21] of the radiological protection aspects of SL’s proposal [2] against the requirements of ONR’s SAPs [14] and TAGs [15]. In addition the inspector has also considered the proposal against the appropriate national and international standards. The assessment focused on the adequacy of the arguments and evidence of licensee’s submission that support the claim that the shielding provided will maintain the radiological classification of the operating areas.

42. The assessment considered the derivation of SL’s assessment source term (i.e. the bounding case FE liquor activity), the design of both lead and steel shielding components and the capability of the shielding to limit exposure to ionising radiation so far as is reasonably practicable (SFAIRP).

43. The ONR specialist assessor concluded that the design of the shielding restricts, so far as is reasonably practicable (SFAIRP), exposure to ionising radiation by means of engineering controls and design features. However the licensees claim that “the design will meet the safety functions and performance requirement targets of < 7.5 μSv/h contact and < 1 μSv/h at 1m from the pipe” was not considered met. The specialist inspector is of the opinion that exceedance of the contact dose rate criterion is not a significant shortfall, as they have confidence that SL will put in place adequate administrative controls to ensure that no activities that would require contact with the shielding would be undertaken during liquor transfer operations.

44. The inspector has therefore recommended that during active commissioning and prior to the commencement of normal operations, SL should provide ONR with details of all additional administrative controls that will be applied in order to restrict the exposure of workers to ionising radiation. This recommendation has been added to Regulatory Issue 6159 which has been raised to allow ONR to monitor key SL activities post permissioning.
45. Notwithstanding the above reservation, the specialist inspector also concluded they were satisfied with the claims, arguments and evidence laid down within the Licensee’s safety case with regard to the design of the FE LAR shielded transfer system. The inspector supports ONR granting permission for the implementation of FE LAR active commissioning and operation.

4.1.5 HUMAN FACTORS ASSESSMENT

46. An ONR Human Factors (HF) specialist inspector has undertaken an assessment [22] of SL's proposal [2] against the requirements of ONR's SAPs [14] and TAGs [15]. The assessment focused on the human factors aspects of the equipment and operational controls to ensure that they are suitable for:

- Controlling the liquor movements within MSSS and onwards to EDT
- Monitoring levels within the First and Third Extension compartments, Third Extension Overflow Tank, EDT centre chamber and cavity sumps
- Supporting any assumptions or claims on human reliability within the safety case
- Preventing lifting over LAR pipework during transfers*.

47. The assessment specifically considered:

- Allocation of safety actions
- Safety significant HF claims have been substantiated as achievable and feasible through suitable and sufficient assessment
- Administrative controls for LAR transfers and lifting operations
- The design of control panels and manual valves associated with FE LAR
- Adequacy of supporting documentation
- Response to alarms.

48. The inspector noted that training had been reviewed to a limited extent, since the skills required to conduct FE LAR operations are broadly the same as those already required for extant third Extension LAR operations and extant MSSS control room tasks. The assessment therefore focussed on the transfer of specific FE LAR knowledge rather than overall competence of operators. The specialist inspector was content with the proposed training strategy and the progress to date on the basis that training has been designed in accordance with SL’s Systematic Approach to Training (SAT) process and relevant good practice, and more than the minimum number of operative had completed the self-assessment training. The training will only be complete when on the job element of training has been given, under supervision of the subject matter expert. This will take place post permissioning as part of active operations. When fully implemented, the assessor considers that the training will deliver the required complement of SQEP operatives.

49. The HF specialist inspector identified that SL intends to update the substantiation of the building crane safety case for lifting operations in the vicinity of FE LAR. This safety case is subject to ONR permissioning at a later date. The HF assessment notes that in the interim period SL intends to introduce a temporary restriction on lifting operations in the vicinity of FE LAR. In relation to this, the inspector has recommended that during this interim period, SL implements a required Operating Instruction (rOI) that had been considered by SL in earlier assessments:

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* This is a temporary restriction to apply until the case for lifting operations within MSSS has been updated and permissioned by ONR.
50. The details of this lifting restriction are discussed further as matters arising (section 4.1.8).

51. For the key safety aspects sampled (paragraph 47), the assessment concluded that the administrative controls in place to manage LAR transfers are suitable and aligned with regulatory expectations. Training has been designed in accordance with SL’s SAT process and procedures have been updated to reflect the proposed tasks and support key safety claims.

52. With the exception of the controls for lifting operations discussed above, the specialist inspector was satisfied with the claims, arguments and evidence laid down within the Licensee’s safety case for FE LAR activities. The specialist inspector supports the granting of permission for implementation of the proposal in reference 2.

4.1.6 MECHANICAL ENGINEERING ASSESSMENT

53. An ONR mechanical engineering specialist inspector has undertaken an assessment [23] of SL’s proposal [2] against the requirements of ONR’s SAPs [14] and TAGs [15]. The assessment sampled the mechanical engineering aspects pertaining to:

- Examination Inspection Maintenance and Test (EIMT)
- FE LAR pipebridge
- Prevention of pipe blockage
- Operating temperature limits
- Pipework welds
- Crane lifting operations
- Commissioning.

54. The ONR mechanical assessment [23] also identified shortcomings in the licensee’s ALARP argument for conducting lifting operations over FE LAR pipework whilst liquor transfers are in progress, when assessed against ONRs TAG for demonstration of ALARP [15]. Lifting operations in the vicinity of FE LAR transfers are discussed further as a matter arising in section 4.1.8 below.

55. The assessment raised three recommendations. The first relates to providing further assessment of crane dropped loads as discussed above.

56. The second recommendation concerns ONR consideration of the SL arrangements that underpin incident investigation and root cause analysis. I note that the origin of this concern relates to a historic event and the detail of the investigation undertaken at that time. This recommendation has been passed to the ONR corporate inspector who has subsequently confirmed that SL has significantly improved its arrangements for sentencing and investigation of events since the event of concern [24]. The recommendation does not materially affect the FE LAR permissioning decision.

57. The third recommendation identifies that the SL corporate arrangements for asset management have not been updated to reflect the latest relevant good practice [15] on asset management. This recommendation has been passed to the ONR corporate inspector and as it was judged that the issue related to SL corporate arrangements and that the FE LAR project had implemented suitable Examination Inspection, Maintenance and Test arrangements. The recommendation was not considered to materially affect the FE LAR permissioning decision.
58. With the exception of lifting operations, for the key safety aspects sampled (paragraph 53), the specialist inspector concluded that they were satisfied with the claims, arguments and evidence laid down within the Licensee’s safety case, and confirmed that there were no objections to granting the permission as requested [1].

4.1.7 ONR READINESS INSPECTIONS

59. ONR undertook two readiness inspections of the FE LAR project. The purpose of these was to gain confidence that the processes and instructions that support the claims made in the licensee’s safety case are available to support permissioning decision.

60. The first of the readiness inspections [25] permitted the specialist inspectors to assess the plant, process and personnel in support of their individual assessments and provide a view on FE LAR general readiness. The inspection noted that state of readiness and provided focused inspection on:

- Operation of safety mechanisms
- Training
- Limitations on LAR if compartment cooling was not operational
- Liquor sampling and monitoring regime
- Compartment liquor level monitoring and gauges.

61. The inspection concluded that the FE LAR project was not sufficiently advanced at the time to support a decision to move into active commissioning and operations. The inspection gave rise to a number of actions for the licensee to provide additional information and evidence to support its safety case and implementation. These actions have subsequently been adequately addressed [26].

62. ONR conducted a follow-up inspection [27] focused on:

- Plant status
- Completion of commissioning
- Availability of operating instructions
- Completion of operating clearance certificates and the safety case implementation plan
- An update on the licensee’s human factors assessments.

63. This inspection confirmed that the licensee had made progress in all areas since the first readiness inspection. This inspection identified a number of actions primarily relate to confirming that SL has completed all the relevant operational documentation and governance processes. No safety significant short falls were identified. I am satisfied that all actions have subsequently been addressed [28].

64. The second inspection also identified actions required to be completed post permissioning in order to close out the PMP [2]. Such actions include HF walkdown of the operating FE LAR facility and labelling of new safety mechanisms once permission is granted. ONR Regulatory Issue 6159 has been raised to provide oversight of the licensee's progress in addressing the actions.

65. The inspections have provided sufficient confidence that the licensee has sufficiently progressed plant, process information and training to support permissioning of FE LAR active commissioning and operations. All actions required before permissioning from the readiness review inspections have been adequately addressed by the licensee and none remain outstanding.

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4.1.8 MATTERS ARISING

66. Blue tinting of final weld

67. The licensee has identified [29] that one of the final welds of the liquor transfer system primary containment pipework (weld 104RW1) proved satisfactory through radiographic inspection but was deemed to have a degree of heat tint. This was out of specification such that immediate sign-off was not possible. This heat tint could indicate that the pipework may be susceptible to a higher rate of corrosion than anticipated in the design.

68. SL has concluded [30] that it was appropriate to accept a concession on the level of blue tint as it was considered that the routine requirement to flush FE LAR pipework directly after each liquor transfer will minimise the suspect weld exposure to excessive chloride levels and hence corrosion risk.

69. I engaged an ONR welding specialist inspector to review the licensee's assessment and conclusions. The specialist inspector concluded that whilst a concession is appropriate [31], they noted as part of the SL concession that Wastwater may be used as a back up to demineralised water as the pipework flushing medium. Wastwater is known to have higher concentrations of chloride and therefore it's suitability as a flushing medium has been challenged by ONR.

70. SL has subsequently committed to only using demineralised water, implemented via an amendment to an existing safety case Operating Assumption (OA) [34]. I have added oversight of the update of these arrangements to Regulatory Issue 6159.

71. Internal lifting arrangements

72. The licensee’s hazard assessment for the MSSS building cranes [7] identifies that the consequence of severe damage to the FE LAR pipework could give rise to a radiological dose to the operator of between 20-1000 mSv. This is a significant consequence and therefore demands a proportionately higher level of ONR scrutiny.

73. The FE LAR radiological safety assessment [6] with respect to internal lifting operations is underpinned by a hazard analysis generated to support introduction of a new MSSS facility east end crane which in itself is subject to a future ONR permission. Until this permission is granted, lifting operations can only be undertaken by the facility west end crane under extant safety case arrangements. The hazard analysis will not be formally configured into the MSSS safety case until implementation of the revised building crane safety case.

74. As noted under section 4.1.6, the ONR mechanical assessment identified that there are shortcomings in the licensees ALARP argument made in reference 7 for conducting lifting operations over FE LAR pipework whilst liquor transfers are in progress.

75. The HF specialist inspector (section 4.1.5) was not content [32] with the controls identified for controlling lifting operations by the West End Crane (WEC) procedure.

76. I concur with the HF inspector that the procedure [32] does not give adequate prominence to the FE LAR transfers lifting restriction. I informed the licensee [33] that ONR considers that a safety case limit and condition in the interest of safety in the form of an rOI, is required to provide the equivalent safety prominence as given to that for lifting over the MSSS compartment coolers which has similar consequences.
77. SL has subsequently provided written assurance [34] that before the first LAR transfer commences, use of the WEC will be embargoed until an appropriate RoI covering use of the crane in the vicinity of FE LAR transfer system has been implemented into the Live Safety Case. ONR is satisfied that this assurance and associated arrangements will provide the necessary interim level of safety to control lifting operations until the appropriate safety case limit and condition is implemented. This decision has been formally communicated to SL via an enforcement letter [35].

78. **External lifting arrangements**

79. The lateral restraint tower ventilation plant installation requires the use of a construction (mobile) crane to undertake lifting operations. This activity was previously permissioned by ONR [36]. FE LAR transfers were not considered within the crane proposal that supported this permission, therefore as FE LAR goes into active commissioning and operation the crane proposal (CP) and supporting safety assessment requires updating to reflect this new hazard.

80. SL has produced a variation order to the extant crane proposal [Error! Bookmark not defined.37]. The variation order identifies that, whilst the calculated risk is small, due to the potential consequences, it is appropriate to consider all options to minimise the risk. SL has identified a management restriction to plan and co-ordinate lifts with FE LAR transfers. The approved variation order places a restriction (OA) to de-conflict FE LAR transfers to the third extension and LRT ventilation plant construction crane lift operations as far as reasonably practicable. This requirement has been added to the Lifts method statement and requires the Duly Authorised Person to sign for and record any decision which concludes a co-incident operation is required.

81. Due to site layout, there is no requirement for LRT ventilation plant lifts to be conducted directly above FE LAR pipework and none are planned.

82. SL’s internal regulator has confirmed that the variation order has undergone correct due process in accordance with SL arrangements [38]. I have also confirmed that the assessment of the variation order has been undertaken in a manner consistent with SL’s construction crane assessment methodology which has previously been assessed and permissioned by ONR [39].

83. Whilst SL has not completely de-conflicted FE LAR transfers to the third extension with LRT ventilation plant construction crane lifts, SL has confirmed [40] that the majority of lifts will be conducted out of hours and therefore de-conflicted by design. For the remaining lifts, the DAP will assess whether further steps can be taken to de-conflict operations and record his decision. I consider SL has taken reasonably practicable steps to reduce this risk SFAIRP and that the decision to de-conflict lifting operations co-incident with FE LAR transfers to the third extension is proportionate and consistent with established methodology.

4.1.9 **SL INTERNAL ASSURANCE AND GOVERNANCE**

84. SL’s internal regulator function has undertaken a programme of inspections and assessments to gain confidence that the substantiation and implementation of SL’s proposed activity has been completed in accordance with SL’s arrangements to comply with the nuclear site license conditions and SL’s processes. SL’s internal regulator has provided an observation record [38] to ONR that provides a judgement on the adequacy and governance process surrounding the safety case documentation required to implement FE LAR. I consider that the report demonstrates that the licensee’s independent oversight function has sampled the safety significant areas (see below) and applied an appropriate level of challenge.
85. SL’s internal regulator’s observation record confirms it remains satisfied with the following:

- Project governance arrangements
- Safety case and associated safety documentation
- Changes to emergency and contingency management
- Quality assurance arrangements applied to manufactured pipework modules and life time quality records
- Commissioning and test required to demonstrate safety
- Training provision
- Operator and maintenance instructions.

86. The internal governance process that SL adopted has provided ONR with evidence of adequate scrutiny given by the licensee to the project.

87. SL’s proposals and supporting documentation have been approved by the SL management safety committee (MSC) at the following meetings:

- PMP - MSC166 [41]
- Radiological Safety Assessment – MSC140 [42]
- Civil structures design justification report (DJR) – MSC163 [43]
- Process, CE&I and mechanical DJRs – MSC161[44]
- Human Factors Assessment substantiation - MSC162 [45]

88. The FE LAR proposal has also been presented to the SL Nuclear Safety Committee (NSC) for noting as detailed in reference 46.

89. As noted in the internal regulator’s observation report and the above references, I am satisfied that the proposal has been subject to SL internal governance arrangements.

4.1.10 STAKEHOLDER ENGAGEMENT

90. In accordance with the ONR/Environment memorandum of understanding, I have consulted the relevant EA inspector regarding whether the EA has any objections to commencement of this licensee proposal. The EA inspector has confirmed that the EA has no objection to ONR granting the license permission to commence this activity [47].

5 CONCLUSIONS

91. On the basis of ONR specialist’s advice and my own interventions including a readiness inspection, this PAR confirms that:

- High consequence fault sequences have been adequately assessed, there are suitable and sufficient safety measures in place and adequate arrangements have been made and implemented to monitor compartment levels utilising diverse instrumentation
- Safety related commissioning of the safety mechanisms has been completed during the inactive phase.
- Adequate arrangements have been introduced to safely control crane operations in the vicinity of FE LAR transfers
- Process controls have been adequately assessed and operating instructions updated to reflect the safety case requirements
- Safety claims on operators have been adequately substantiated and the administrative controls in place to manage LAR operations are suitable and aligned with regulatory expectations.
92. ONR readiness inspections have given confidence that installation work is complete, processes support operation of FE LAR and that people are suitable qualified and experienced.

93. Furthermore I gained confidence that SL has followed its own governance arrangements and that a robust internal assurance review of the project was undertaken.

94. ONR's assessment of SL's proposal identified a shortfall in the licensee's arrangements that we judge to be necessary in the interests of safety for control lifting operations in the vicinity of FE LAR pipework whilst liquor transfers are in progress. As a result, SL has implemented an appropriate restriction on the relevant lifting operations until the necessary safety arrangements have been implemented and considered adequate by ONR.

95. Additionally, ONR identified a concern related to a potential corrosion issue associated with the medium to be used for flushing the FE LAR pipework after a transfer of liquor has occurred. SL has considered our reservation and implemented an appropriate restriction to ensure that only demineralised water is used as part of FE LAR flushing operations.

96. The licensee's case identifies a shortfall in its design basis assessment of compartment overfilling faults, regarding insufficient diverse and redundant compartment level indication. ONR is however satisfied that the licensee has a suitable programme of work to implement a new reasonably practicable safety measure, and has identified alternative arrangements to provide adequate safety measure redundancy in the interim period. To conclude, I am satisfied with the claims, arguments and evidence provided by SL to support its proposal to commence active commissioning and operation of the FE LAR system. I am satisfied that SL's proposal has completed the licensee's internal due process including MSC and NSC and internal regulatory oversight.

6 RECOMMENDATIONS

97. I recommend that ONR issues License Instrument number 509 giving permission to commence the activities described in the licensee's proposal that will result in FE LAR commencing active commissioning and operations.
7 REFERENCES


3. ONR Assessment note: Risks from legacy facilities on the Sellafield site, ONR-SEL-AN-14-010 Revision 1, dated 12 June 2014. TRIM 2014/257959.


15. ONR’s Technical Assessment Guides


   Asset Management, NS-TAST-GD-098 Revision 0, dated October 2016. TRIM 2016/412631


18. Email, ONR Chemistry Specialist to ONR Project Inspector – Completion of readiness review actions. TRIM 2018/107783.


20. Email, ONR C&I Specialist to ONR Project Inspector – Completion of readiness review actions. TRIM 2018/107799


37. Sellafield Limited: Variation order to Approved Crane Proposal SLF 1.03.146, CCSC/CP/2016/005 Variation 1, dated 12 March 2018. TRIM 2018/103683.


42. Sellafield Limited: Management Safety Committee Meeting, Minutes of Meeting MSC 140 dated 5 October 2017. TRIM 2018/67700.


