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Sellafield Programme

ONR review of the MSSS LTPR submission

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EXECUTIVE SUMMARY

ONR review of the MSSS LTPR submission

This report summarises ONR's assessment of Sellafield Ltd's (SL's) Long Term Periodic Review (LTPR) of its Magnox Swarf Storage Silo (MSSS) safety case.

Permission Requested

The LTPR was received by ONR by its due date, in January 2013. No Licence Instrument or formal permission is required under the SL's Licence Condition 15 (LC 15, Periodic Review) arrangements.

In view of the perceived limited value of assessing a LTPR of a safety case for a plant with acknowledged significant safety shortcomings, and in light of the significant resource commitments used in regulating the previous MSSS LTPR, ONR initially decided not to commit resources to assessing this LTPR. However, having revisited this decision in the summer of 2013, we concluded that a high-level review of the LTPR, focussing on the most important (i.e. high public dose consequence) fault sequences was a good use of ONR resources.

The ONR assessment therefore started in September 2013, about eight months later than normal for a LTPR, and only around 4 months before the Decision Date (January 2014). Rather than delay SL's work to improve safety at a plant that is a UK national priority with risks that can only be reduced to tolerable levels by retrieving its contents, ONR decided to provide an interim close-out letter (February 2014) ahead of completing our assessments. As our assessments had by then reached a stage where we were able to identify any substantive issues, we were able to provide a positive response. As such, our interim letter confirms that we are satisfied that SL has performed a fit for purpose review of safety for MSSS in the context of addressing the most significant public dose consequence fault sequences.

This Project Assessment Report (PAR) records the basis for our decision to issue the interim letter and documents the position our assessment had reached by December 2014.

Background

MSSS is located within the Separation Area at Sellafield and consists of 22 large-scale concrete silos (or "compartments") that are partially below ground level and used for the storage of various Intermediate Level Waste (ILW) materials that arose from operations at Sellafield and other UK licensed nuclear sites. The vast majority of the waste is stored underwater to mitigate against the risk of fire.

Corrosion of the fuel and swarf inventory has already released large amounts of caesium and strontium into the silo liquor along with other radionuclides. The risks from MSSS are therefore high and have made retrieving the waste promptly from this facility a national priority.

The specific project work to retrieve the wastes does not however form part of SL's LTPR and is being regulated separately by ONR. Nevertheless, our LTPR assessment work has been organised and conducted in a manner aimed at facilitating early retrievals.

Assessment and inspection work carried out by ONR

The previous MSSS LTPR proved challenging and resource-intensive for ONR as the risks were rated "intolerable" and a traditional safety case could not be made. This was an

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important factor in ONR's initial decision not to assess the latest LTPR, but instead focus on helping SL accelerate retrievals and implement other risk reduction measures.

However, as part of the change in approach that ultimately became ONR's new regulatory strategy for Sellafield, ONR decided that a limited, context-driven assessment of the LTPR was an appropriate use of our resources. As such, our assessment concentrated on ensuring SL's LTPR continued to enable retrievals to proceed in a timely manner whilst identifying and implementing improvements to plant and structures to improve safety margins and plant resilience. The focus was on ensuring SL has suitable implementation plans to address the most significant fault sequences in terms of potential public doses.

A key aspect of our assessment was the substantial number of recommendations identified by SL at the previous LTPR. Though SL has been progressively closing these via projects to improve the plant infrastructure and prepare for retrievals, ONR has concerns that progress has been slow. The recent drive within SL towards programme management and the Managing Successful Programmes methodology have however helped expedite matters. Nevertheless, as part of ONR's regulatory strategy, this is a matter requiring high levels of attention to ensure SL keeps its programmes on track.

Our assessment focussed on three key themes:

- Control of hydrogen (and in particular preventing and protecting against deflagration)
- Managing excursions (i.e. exothermic transients in the stored waste)
- Maintaining containment (e.g. avoiding leaks to ground)

This required specialist technical assessments commissioned in the following areas:

- Civil Engineering
- Internal Hazards concentrating on Nuclear Fire Safety
- Fault studies
- Control and Instrumentation
- Human Factors
- Process Engineering
- Mechanical Engineering

Matters arising from ONR's work

As noted above, based on these assessments, ONR wrote to SL in February 2014 to confirm our general satisfaction with SL's LTPR. We did not however identify which (if any) of our findings need to be progressed as Regulatory Issues, since fact-finding on these matters was at too early a stage. Since sending our interim letter, discussions with SL have continued. However, as of December 2014, these had still not reached the point where we could advise SL of our final decisions.

ONR has nevertheless been able to progress several matters of key safety importance within the LTPR project. The most substantive of these has been working with SL to improve the protection against hydrogen accumulation. Here, the assessment team encouraged SL to introduce quiescent passive ventilation as an early safety benefit from the LTPR. This system, now installed, provides continuous passive ventilation so that in the event of a failure of the powered extract system, adequate ventilation will continue without the need for intervention by operators.

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Several of ONR's LTPR findings relate to ongoing safety analysis we consider SL should complete in order to complete the LTPR. This includes a number of engineering Design Assessment Reports (DARs), Human Factors analysis, Internal Hazards analyses, and substantiation studies of safety-significant Structures, Systems and Components (e.g. to validate assumptions on capability of civil structures to withstand accidental or extreme loadings). ONR continues to work with SL to oversee completion of these activities.

Conclusions

This report documents the progress made by ONR's MSSS LTPR project up until December 2014.

Our team carried out a high-level assessment of SL's MSSS LTPR focussing on the most important (i.e. high public dose consequence) fault sequences. No substantive issues were identified, though we noted that several ongoing safety analyses need to be completed in order to complete the LTPR.

ONR's high level approach to this LTPR is appropriate since reducing the risks at MSSS to as low as reasonably practicable requires the prompt retrieval of its stored wastes. So in line with our regulatory strategy for Sellafield, ONR has focussed our activities on achieving timely risk reduction and early waste retrievals, while seeking to avoid distracting the licensee from other agendas.

ONR is broadly satisfied that SL has performed a fit for purpose review of safety for MSSS. This was formally documented in the interim close-out letter sent in February 2014. It is however, ONR's expectation that SL maintains satisfactory progress as set out in the commitments made in its December 2013 Confirmation of Safety Letter. SL also needs to maintain its recent progress in completing the project work to deliver commitments remaining from its MSSS LTPR.

Early delivery of quiescent passive ventilation at MSSS is a welcome and important safety improvement deriving in part from SL's LTPR process.

Work continues with SL to define which, if any, of ONR's findings should be identified as Regulatory Issues (requiring resolution through an agreed delivery plan). Once this step is completed, ONR will regulate activities deriving from the LTPR as part of normal regulatory business.

Recommendation

ONR should continue to assist SL so that its MSSS LTPR work is completed to an appropriate point and in a manner that assists timely risk reduction and early waste retrievals projects being undertaken at the plant. In particular, ONR should complete its discussions with SL and identify which, if any, of our findings warrant identification as Regulatory Issues.

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LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
BSL	Basic Safety Level (in SAPs)
BSO	Basic Safety Objective (in SAPs)
CNS	Civil Nuclear Security (ONR)
HOW2	(Office for Nuclear Regulation) Business Management System
HSE	The Health and Safety Executive
IAEA	The International Atomic Energy Agency
NDA	Nuclear Decommissioning Authority
ONR	Office for Nuclear Regulation
PCER	Pre-construction Environment Report
PCSR	Pre-construction Safety Report
PSA	Probabilistic Safety Assessment
PSR	Periodic Safety Review
RGP	Relevant Good Practice
SAP	Safety Assessment Principle(s) (HSE)
SFAIRP	So far as is reasonably practicable
SSC	System, Structure and Component
TAG	(ONR) Technical Assessment Guide

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1 PERMISSION REQUESTED

1. The Long Term Periodic Review (LTPR) was received by ONR in January 2013 (References 1 and 2). No Licence Instrument is required under the SL's LC 15 arrangements
2. ONR assessment did not start until September 2013 with the Decision Date for the MSSS LTPR of 31 January 2014, thus ONR had a reduced assessment period. ONR would normally be expected to spend 12 months assessing the LTPR and advise Sellafield of issues it has with the adequacy of the review and the associated implementation plan by 31 October 2013. In view of the reduced time available and the limited value of an LTPR on a plant which all parties acknowledge has significant safety shortcomings resulting in the urgent need to expedite retrievals to reduce the hazard, it was decided that ONR would undertake only a high level assessment of this LTPR. The intent is to ensure Sellafield have demonstrated the adequacy of the arrangements to maintain safety until the next PSR or the end of life taking account of the retrieval initiatives in place, in respect to the highest impact fault sequences (Reference 15)
3. The reduced timescales also meant that ONR needed to provide its decision on the LTPR before we were in a position to document its basis. Rather than delay SL on improving safety at a plant that is a UK national priority with risks that can only be reduced to tolerable levels by retrieving its contents, ONR decided to provide an interim close-out letter (Reference 13) and complete the reporting of this work retrospectively. Reference 13 confirms that ONR is satisfied that SL has performed a fit for purpose review of safety for MSSS in the context of addressing the most significant public dose consequence fault sequences.
4. This Project Assessment Report (PAR) records the basis for our decision to issue Reference 13 and documents the position the work had reached by December 2014. At this point the project had not progressed to the point where we had decided which (if any) of our findings should be progressed with SL. The identification of findings to be taken forward is subject to ongoing engagement with SL and will be documented separately.

2 BACKGROUND

MSSS History and Function

5. MSSS is located within the Separation Area at Sellafield and consists of 22 large-scale concrete silos (or "compartments") that are partially below ground level and used for the storage of various Intermediate Level Waste (ILW) materials that arose from operations at Sellafield and other UK licensed nuclear sites. The vast majority of the waste is stored [REDACTED] to mitigate against the risk of fire.
6. The facility was built in 4 phases, with the silo structure being expanded in a step-wise manner over a number of years in order to meet the demand for storage of ongoing waste accumulations (principally by-products from fuel reprocessing). Each extension features improved standards of engineering when compared to its predecessor(s).
7. The earliest compartments (1-6) have been in use since 1964. Compartments 7-12 were added as an extension and started to receive waste in 1972. Compartments 13 and 14 were added as part of a 2nd Extension and became active in 1981. The final eight compartments (15-22) were constructed within the 3rd Extension and received waste from 1983 onwards. A 4th Extension to MSSS was planned but never built.

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8. Corrosion of the fuel and swarf inventory has already released large amounts of caesium and strontium into the silo liquor along with other radionuclides. In 2003 the radioactive inventory within MSSS exceeded 230,000TBq in Cs-137 terms alone. Without intervention, the level of dissolved radioactivity will continue to increase over time such that the silo liquors may now be approaching the Highly Active range, particularly in the early compartments.
9. MSSS is the source of the most significant leak of activity to ground that has occurred at Sellafield, Reference 16. An estimated cumulative activity of 5.05×10^4 TBq leaked to ground between 1970 and 1979, mainly comprising fission products. The leak is thought to have originated from the original structure, but the precise emergent point was never found.
10. The last LTPR proved challenging and resource intensive for ONR as the risks were considered intolerable, so a traditional safety case could not be made. Reference 3 describes our assessment of the previous LTPR (2002) and Reference 4 is the letter we sent out in 2004 to close out the work. As part of this LTPR SL reviewed the outstanding improvements from the previous LTPR and incorporated those which it considered still relevant into the MSSS improvement plan.

3 ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR

11. In scoping the ONR assessment of the 2013 LTPR, ONR recognised that the risks within the facility remain high (assumed intolerable) and that the hazard imposed by the facility can only be significantly reduced when the waste within the facility is retrieved (and ideally processed into a form suitable for long term storage). Thus the ONR review concentrated on ensuring SL's LTPR continued to enable retrievals to proceed in a timely manner whilst identifying and implementing improvements to plant and structures to improve safety margins and plant resilience. The focus was on ensuring SL have suitable implementation plans to address the most significant fault sequences in terms of public doses. Therefore the ONR LTPR review was strategic in nature, aimed at confirming:
 - The adequacy of the arrangements in place to maintain safety until the next PSR or the end of life or new safety case.
 - There is a baseline safety case that supports the quiescent condition but enables the plant to introduce progressively new capabilities in support of retrieval operations.

3.1 ASSESSMENT THEMES

12. The ONR review of the LTPR was undertaken in the context that a substantial number of recommendations were raised following the 1st PSR cycle and the facility has been progressively closing these via projects to improve the plant infrastructure and prepare for retrievals. ONR has concerns that progress has been slow. The recent drive towards programme management and Managing Successful Programmes methodology (reference 22) has helped expedite things by the development of credible plans but will require constant vigilance to keep the programme on track. The LTPR review did not consider the safety case for existing projects in the improvement plan which are captured in the Stream Activity Plans (Reference 5) as these will be regulated under the LC22 arrangements (Plant Modification Proposals, PMPs).

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13. Whilst it is recognised that many safety-related projects are planned, the assessors had to consider whether the risks are ALARP until such time as the new systems are commissioned.
14. Based on this strategy 3 key themes were identified:
 - 1 Control of Hydrogen: Control of doses to the workforce and public resulting from a Hydrogen Deflagration accident
 - 2 Excursions: Control of doses to the workforce and public resulting from unplanned transients e.g. due to exothermic reactions in the waste.
 - 3 Containment: Control of doses to the workforce and public or leak to ground, resulting from a breach of Silo containment.
15. As project inspector, I selected an assessment team to review these aspects of the safety case which comprised:
 - Civil Engineering
 - Internal Hazards (concentrating on Nuclear Fire Safety)
 - Fault Studies
 - Control and Instrumentation
 - Human Factors
 - Process Engineering
 - Mechanical Engineering
16. Assessors communicated with the licensee using technical queries to seek clarification of specific aspects of the LTPR via emails copied to the project inspector. Substantive findings were raised via a Regulatory Observation (RO). Any remaining fundamental concerns ONR has with the LTPR, the implementation plan or the associated safety case for MSSS at the end of the assessment period will be proposed as Regulatory Issues and will require a resolution plan to be agreed and incorporated into SL's LTPR implementation plan. Decisions on whether any of our findings should be progressed as RIs will be documented separately.
17. The ONR Assessments are described in the relevant technical area assessment reports (References 6-12); the conclusions are summarised below and the underlying findings are listed in Annexes 1-7.
18. References 6 to 12 completed due process subsequent to ONR's decision to issue the interim close-out letter (Reference 13) confirming we are satisfied that SL has performed a fit for purpose review of safety for MSSS in the context of addressing the most significant public dose consequence fault sequences. As noted above, this was to avoid delaying SL in its priority work to reduce the acknowledged high risks at MSSS. Before issuing the letter I confirmed that the assessors had no substantive issues with SL's LTPR. References 6 to 12 confirm this remained the case through to the formal completion of the assessment process.

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3.2 CIVIL ASSESSMENT

19. The Civil Engineering assessor considered the LTPR has delivered a generally effective assessment of the adequacy of the Civil Engineering safety structures, systems and components necessary to maintain safety in line with current safety case methodology. The assessor's findings are documented in Reference 6 and summarised in annex 1.
20. The LTPR focused on short term consequence and controlling immediate public dose resulting from a fault sequence. The supporting Civil, Structural and Architectural (CS&A) DAR was not completed prior to the production of the summary LTPR documentation. As a result, the findings of the final version of the CS&A DAR are still to be appropriately incorporated into the LTPR Engineering Review and Improvement Plan.
21. The assessor judges the silos are currently performing satisfactory under quiescent conditions. However, there is inadequate structural capacity to resist the forces which could result from a significant seismic event or thermal excursion above the current operating limits. Defects resulting from historic thermal excursions further reduce the ability of the Original Building and 1st Extension silos to resist exceptional forces.
22. The silos are at risk of a loss of containment in the event of a hydrogen deflagration, particularly the Original Building, where there is no secondary containment and liquor recirculation. Mitigation from the risks of hydrogen generation from the waste is dependent upon the successful completion of the Passive Ventilation (PV) project, which SL implemented in summer 2014.
23. In the event of a seismic event which creates peak horizontal accelerations of 0.125g or greater, there is a high probability of leakage from the primary containment of the 3 older phases. It is anticipated that aging will result in further deterioration of the silo structures that will reduce the ability of the silos to perform their containment function. Loss of primary containment is of particular concern to the Original Building, where the lack of secondary containment would mean that any leak from the primary containment would result in contamination of the ground, surface water system or external surfaces.
24. It is very important to highlight however that it would be exceptionally difficult, may entail large dose uptake and be disruptive, to strengthen or supplement the existing silo containment. Any such work would be of questionable reliability and could result in delays to the retrievals process. Hence no structural strengthening works are recommended to the silo structures. Thus, maintenance activities to Civil and Structural Engineering elements of the facility need to be given a higher priority to ensure that deterioration does not become structurally significant e.g.:
 - Monitoring of the depth of concrete carbonation,
 - Better operational data on material properties, load magnitude and load combinations
 - Verify coefficient of thermal expansion used for Finite Element Analysis (FEA)
25. For the Original Building silo, the historic cracks present a risk of leakage during the retrievals process when the loading conditions experienced by the silo are changed. Liquid Activity Reduction (LAR) after removal of the bulk of the sludge but prior to pumping out of the liquor would reduce the consequence of any leak and is likely to prove more effective than LAR activities undertaken prior to sludge removal.

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3.3 INTERNAL HAZARDS: NUCLEAR FIRE SAFETY ASSESSMENT

26. The Internal hazard assessor, given the scope of ONR's review of SL's LTPR submission, is broadly satisfied that all Design Basis faults have been identified and their consequences assessed (see Reference 7). The assessor identified several assessment findings (see annex 2), for which SL are expected to implement a credible resolution plan.
27. The assessor found that both the Internal Hazards assessment and the Nuclear Fire Safety Assessment (NFSA) fail to demonstrate that the hazards from MSSS are reduced so far as is reasonably practicable within their assessments which has meant that the assessor had to interrogate the wider safety case for confirmation of this.
28. The consequences of the major hazards within MSSS will be mitigated with the improvements to the ventilation system, including the introduction of the passive ventilation system, and the waste retrieval project. However, until these measures are implemented interim arrangements are required to control risks. As a result of ONR's intervention, the MSSS LTPR team has produced ALARP justifications for high consequence events and identified shortfalls on the LTPR Implementation plan (Reference 17).
29. There is a site-wide issue with the approach adopted by SL for Internal Hazards Assessments, which is the subject of ongoing discussions between SL and ONR, and is captured on the ONR Issues database. The assessor did not judge that the shortfalls in the methodology are a cause to delay the implementation of the LTPR.
30. The assessor has raised a number of findings, which when implemented, should produce an adequate nuclear fire safety case once these findings are incorporated in the final issue of the LTPR NFSA. On this assumption, the assessor found no reason to withhold the implementation of the LTPR awaiting update of the NFSA.

3.4 FAULT STUDIES ASSESSMENT

31. The fault studies assessor, given the scope of ONR's review of SL's LTPR submission, is broadly satisfied that all Design Basis faults have been identified and their consequences assessed (Reference 8). The assessor identified several assessment findings (see annex 3), for which SL are expected to implement a credible resolution plan.
32. The assessor was not convinced that the duty and standby ventilation systems in their current state give sufficiently diverse and reliable protection against faults arising from either chronic hydrogen accumulation or the more rapid accumulation arising from an excursion event. However, the existence of the battery-driven extract fans (C system), along with diesel generators that can continuously recharge the batteries gave him increased confidence that there is sufficient defence-in-depth on this facility to guard against hydrogen faults. There are also diesel-driven air ejectors which can be used on the 2nd and 3rd extensions (where the hydrogen rate is highest), that can purge the hydrogen in the event of failure of the fan-driven systems.
33. At the time of the assessment the implementation of the PV system was sufficiently advanced such that the licensee will claim the use of the PV in their existing safety case in the near future. As such, the PV will be a claimed measure for hydrogen mitigation in the event of prolonged power loss. This is a passively-driven (i.e. needs no external power source) safety system that relies on buoyancy-driven flow to

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mitigate the hydrogen and his view is that timely implementation of this system is the best approach to reducing hydrogen risks to ALARP.

34. The assessor reviewed the process calculations (Reference 18) for removal of the vent lids to introduce PV and advised it would be beneficial to safety to take the lids off, so considers there is no reason to delay their removal. However, SL will need to monitor the operational area for contamination during loss of forced ventilation because of the potential for diffusion through the open ventilation tubes. However, he caveated this statement by stating that, in his view, the current duty and standby ventilation systems should still be maintained to a high standard, and that the reliability of these primary vent systems should be more accurately quantified by the licensee.
35. Silo fire faults are not included in the extant safety case, but have been assessed (Reference 21) external to the LTPR submission. Given the arguments presented by the licensee in this analysis, He has no remaining concerns regarding the possibility of a silo fire, for reasons given previously in this report. In his view, the implementation of the PV system also serves to significantly reduce the risks arising from a silo fire, as the primary initiating event for this fault is a hydrogen deflagration or detonation leading to loss of containment and exposure of the waste to air

3.5 CONTROL AND INSTRUMENTATION ASSESSMENT

36. The C&I assessor did not identify any concerns with the adequacy of SL's MSSS Long Term Periodic Review and considered that SL had taken due account of the need to progressively introduce new capabilities in support of MSSS retrieval operations (Reference 9). The assessor identified one assessment finding (see annex 4), for which SL are expected to implement a credible resolution plan that supports the LTPR implementation plan.
37. SL had categorised some LTPR shortfalls as acceptable in the short to medium term while risk reduction projects are progressed to completion. The C&I assessor's sample-based assessment did not identify any shortfalls which he considered inappropriately categorised.
38. The assessor, however, did consider that the licensee's maintenance of the facility's safety case in the period between the previous LTPR and this LTPR as having been below standard. The LTPR process revealed that some shortfalls identified in the 1st LTPR cycle were still outstanding and also revealed that many safety case documents were out of date and had not been maintained in the period since the first cycle LTPR.
39. The assessment revealed that SL does not envisage that loss of ventilation faults will be adequately addressed until the PV scheme has been fully implemented (see assessment finding). As a consequence the assessor supports the ONR project inspector in the steps he were taken to influence the licensee to accelerate the implementation of this capability. The licensee responded by agreeing to implement the physical modifications to the plant significantly in advance of the previously established programme. These are now in place (Reference 20).

3.6 HUMAN FACTORS ASSESSMENT

40. The Human factors assessor identified several assessment findings (see annex 5), for which SL are expected to implement a credible resolution plan. The assessor is

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however content for SL to complete these activities within the 2 year post decision date period and has no objections to continued operations under the LTPR (reference 10).

41. The assessor considered that the MSSS LTPR did not have a complete, coherent, holistic human factors argument. There are a number of outstanding assessment work-streams.
42. The assessor identified shortfalls against the expectations of a periodic review both in terms of the completeness of the review and the adequacy of the review that has been undertaken to date. There is a potential underestimation of the contribution to risk from human error due to a number of issues and hence the adequacy of the HF aspects of the MSSS safety case, which SL needs to resolve. The most important of these are:
 - The adequacy of the operational experience review used to inform the LTPR.
 - The adequacy of substantiation of human factors assessment of current operations.
 - Evidence of human factors in optioneering, design and implementation of design solutions in response to identified engineered shortfalls such as passive venting.
 - Evidence of human factors substantiation of administrative controls required due to enhanced reliance upon operational safety measures in the interim until such engineered solutions and hazard remediation is implemented.
43. The assessor considered that SL's LTPR HF submission for ventilation faults is presented in a reasonably coherent and accessible manner, but it is a discrete assessment of a single fault group focused upon substantiation of individual claims. This needs to be supplemented by analysis of the remaining safety significant tasks, actions and those performance influencing factors affecting all tasks within MSSS e.g. training, alarm management, etc.
44. The assessor recommends that Regulatory follow-up is required to ensure that the Licensee addresses the findings to an agreed programme of work beyond the LTPR 'decision date'

3.7 PROCESS ENGINEERING ASSESSMENT

45. The ONR Process Engineering assessment considered the MSSS 2013 LTPR as adequate (Reference 11). However, the assessor identified ten assessment findings (see annex 6), for which SL are expected to implement a credible resolution plan that supports the LTPR implementation plan. In the context of ongoing regulatory intervention, these are not significant enough to undermine his judgement of adequacy of the LTPR.
46. The focus of this assessment has been to ensure that until the risk reduction projects are delivered, the risks posed by the MSSS facility are ALARP. The assessment priority was placed on those projects that will facilitate waste retrievals. This assessment has recognised that many shortfalls must be viewed in the wider context of the overriding need to empty the MSSS facility.
47. Lines of enquiry were pursued across two main technical aspects: excursion and containment. SL's responses to those lines of enquiry allowed the assessor to conclude that SL's treatment of Safety Significant and Lesser Safety Significant shortfalls is generally appropriate; accepting and dismissing shortfalls appropriately in many cases. Where shortfalls have been accepted, some progress has been made in

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closing them out, although some have been assigned to existing projects that are yet to be delivered.

48. Some of these improvements are complex and delivery is not necessarily in line with ONR guidance on shortfall closure, which expects safety significant improvements to be implemented by the decision date.
49. Ten findings have been raised and these are listed in annex 6. All of the findings relate directly or indirectly to the coolers. This was also the general determination of the cooling systems inspection (reference 19) that further regulatory action should be undertaken as part of the projects enabling retrievals, rather than under the banner of this LTPR intervention.

3.8 MECHANICAL ENGINEERING ASSESSMENT

50. The ONR Mechanical assessment considered the MSSS 2013 LTPR as adequate (Reference 12). However, the assessor identified 4 assessment finding (see annex 7), for which SL are expected to implement a credible resolution plan that supports the LTPR implementation plan. In the context of ongoing regulatory intervention, these are not significant enough to undermine his judgement of adequacy of the LTPR in the context of ongoing retrievals programme.
51. The assessor's primary concern related to the absence of mechanical engineering DARs. The Engineering Report identified 8 mechanical engineering DARs, which are still in the process of being produced/approved. Thus, the assessor was unable to confirm that the MSSS mechanical engineering items have been adequately substantiated and consequently is recommending that these are produced and ONR considers reviewing some of these DARs when they become available. The assessor was particularly interested in the maintenance aspects of the current ventilation DAR. It should be noted that the assessor did not assess the proposed passive system design because it is out of the scope of his assessment and will be covered by SL's PMP process.
52. The assessor noted that the shortfalls from the LTPR were subjected to ALARP review with subsequent implementation interrogated through SL proven 'Analysis, Trending, Learning and Safety' reporting (ATLAS) tracking database. The assessor is concerned about the high level of the items identified as open from the previous LTPR (2003) and how the shortfalls are taken into account in the Live Safety Case and the implementation plan.
53. The assessor has reviewed the mechanical aspects of the improvement plan and was satisfied with the assigned categories of mechanical engineering related shortfalls.
54. The assessor identified some issues with some out-dated configuration diagrams which could affect the adequacy of HAZOP recommendations. These drawings should be properly updated, signed off and impact on HAZOPs considered.

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4 MATTERS ARISING FROM ONR'S WORK

55. ONR's assessment findings fall into 3 categories:

1. Risk reduction measures
2. Documentation supporting LTPR and
3. Further studies

Risk reduction measures

56. The most substantive safety improvement identified is to improve the protection against hydrogen accumulation and so ONR encouraged SL to introduce quiescent passive ventilation as soon as practicable. This would provide continuous passive ventilation that would be effective in the event of a failure of the powered extract system such that it would operate without the need for intervention by operators. This would effectively address the loss of ventilation faults within the facility and associated chronic hydrogen accumulations. It is also seen as mitigating many of the shortfalls in basket safety measures identified in the LTPR and would help simplify some operations during retrievals.

57. SL have enabled the quiescent passive ventilation by removal of the ventilation lids (under a PMP) but retained the existing safety mechanisms until a new safety case can be implemented. This has provided an early safety benefit in terms of hydrogen control rather than wait for documentation to be completed which could delay the improvement until summer 2016. (reference 20).

Documentation supporting LTPR

58. SL have completed the LTPR process in accordance with their arrangements, with the exception that the supporting DARs which are not completed, but the work is planned. As a result SL will need review the findings from DARs to ensure approved improvement recommendations are implemented. and Engineering drawings and configuration diagrams will need to be updated

Future studies

59. SL needs to complete outstanding safety studies e.g. Human Factor analysis, Internal Hazard, and substantiation studies of safety significant SSCs e.g. to validate assumptions on capability of civil structures to withstand accidental or extreme loadings.

Post assessment work

60. Decisions on how to progress the findings listed in annexes 1-7 will be documented separately. Individually, the findings may not merit specific regulatory intervention. However, they do represent shortfalls in SL's LTPR process and as such I expect SL to resolve them. I sent the ONR findings to SL (Reference 23) and a meeting was held with SL (Reference 24) in September 2014 to discuss SL's response. The SL response (Reference 25) confirmed that SL was making suitable progress to address most of the findings. Specifically, SL reported that the out of date documentation is being reviewed and updated and the points raised by ONR taken into account. However, the process assessor still had some concerns (Reference 26) related to the provision of coolers.

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Subsequently SL responded to the outstanding process matters and this was accepted by the ONR process engineer (Reference 27). Based on this I am satisfied that SL are implementing the improvements identified by the PSR of MSSS. Furthermore ONR welcome's how SL has significantly accelerated the ventilation improvements giving the plant better resilience to hydrogen releases (Reference 20).

5 CONCLUSIONS

61. This report presents the findings of the ONR MSSS LTPR assessment team which the project inspector has summarised. This LTPR recognised that the risks within the facility remain high (assumed intolerable) and that the hazard imposed by the facility can only be significantly reduced when the waste within the facility is retrieved (and ideally processed into a form suitable for long term storage). The assessment team have assessed the LTPR in this context and rated the submitted report as follows:

Specialism	IIS Rating	Comment
Civil Engineering	3 – Adequate	
Internal Hazards concentrating on Nuclear Fire Safety	4 – Below Standard	This is due to the fact that both the Internal Hazards and NFSA fail to present a coherent safety case based on a claims, arguments, and evidence approach. Both assessments fail to demonstrate that the hazards from MSSS are reduced so far as is reasonably practicable within their assessments, which has meant that, I (<i>IH assessor</i>) have had to interrogate the wider safety case for confirmation of this.
Fault studies	4 – Below Standard	In view of the layers of defence in depth now present on this facility to protect against hydrogen explosion faults, my the fault studies assessor's (<i>the fault studies assessor</i>) view is that the licensee has done everything reasonably practicable to reduce ALARP the risks arising from this hazard by implementation of the PV system.
Control and Instrumentation	3 – Adequate	

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Human Factors	4 – Below Standard	<p>The basis for this rating is that whilst I consider that the licensee's LTPR HF submission for ventilation faults is presented in a reasonably coherent and accessible manner, as submitted it does not represent a complete modern standards HF assessment in the context of a periodic review of safety.</p> <p>SL's responses to the findings are adequate however, and represent an appropriate way forward to provide assurance of human factors aspects of the safety case.</p>
Process Engineering	3 – Adequate	
Mechanical Engineering	3 – Adequate	

62. Despite some of the ratings being Below Standard, all the assessors have advised that they consider SL has undertaken an adequate review. Thus, I am broadly satisfied that SL has performed a fit for purpose review of safety for MSSS in the context to driving forward the hazard reduction programme. This conclusion is subject to satisfactory progress being maintained on the improvement programmes which SL has committed to in the confirmation of safety letter (Reference 14)
63. The fact that ONR was broadly satisfied with the PSR was confirmed in a letter to SL (reference 13) which also welcomed SL's risk reduction strategy described in the confirmation of safety letter (Reference 14) which focuses on 4 elements:
1. Continue to progress modifications to close the Safety Significant modifications to enable implementation of the chemotoxic safety assessment on the facility (Urgent LTPR action identified by SL). To ensure the asphyxiation risks to the workers within the facility are ALARP.
 2. To accelerate delivery of Passive Ventilation, and continue progressing Pressurised Inerting and Routine Cooling to ensure radiological risks to the public are ALARP.
 3. To progress production and implementation of the baseline safety assessments to ensure the risks from ongoing waste storage operations to the workers within the facility are ALARP.
 4. In parallel with 1, 2 and 3 above, continue with the design, manufacture and safety case development of the waste retrievals scheme to enable hazard reduction activities to commence as soon as reasonably practicable.

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6 RECOMMENDATIONS

64. ONR should confirm SL are implementing the LTPR improvements and closing out the ONR findings in a timely manner through an update meeting in early 2015. At this meeting SL should report and provide evidence of progress. Based on the outcome of this meeting, ONR should document which (if any) of our findings should be progressed as Regulatory Issues.

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7 REFERENCES

- 1 MSSS LTPR SUBMISSION JANUARY 2013 TRIM 2013/90022
- 2 MSSS LTPR SUBMISSION JANUARY 2013 PART 2 TRIM 2013/90116
- 3 NII ASSESSMENT OF THE BXX PERIODIC REVIEW 2003 TRIM 2013/343759
- 4 SEL75826N LETTER TO CLOSE OUT PSR 2003 TRIM 2013/343761
- 5 BXX LTPR VISIO-FULL STREAM ACTIVITY PLANS FINAL VERSION 30 JAN 13 TRIM 2014/197838
- 6 SELLAFIELD ASSESSMENT REPORT - [REDACTED]
- 7 - CIVIL ENGINEERING ASSESSMENT - [REDACTED] - 27TH MARCH 2014 TRIM 2014/125725
- 8 INTERNAL HAZARDS ASSESSMENT OF THE MSSS 2013 LTPR [REDACTED] TRIM 2014/102307
- 9 SELLAFIELD - ASSESSMENT REPORT [REDACTED] - MSSS LTPR SUBMISSION - APRIL 2014 TRIM 2013/347395
- 10 MSSS CONTROL AND INSTRUMENTATION LTPR ASSESSMENT REPORT - [REDACTED] TRIM 2014/77029
- 11 [REDACTED] SELLAFIELD LTD - HUMAN FACTORS ASSESSMENT OF THE MSSS LTPR - MAY 2014 TRIM 2014/248775
- 12 SELLAFIELD - MSSS LTPR - PROCESS ASSESSMENT REPORT NUMBER - 19 MAY 2014 TRIM 2014/254946
- 13 MECHANICAL ENGINEERING ASSESSMENT – MAGNOX SWARF STORATE SILO OPERATIONAL SAFETY CASE LONG TERM PERIODIC REVIEW – (LTPR) TRIM 2014/262465
- 14 [REDACTED] - LETTER TO SELLAFIELD LTD TO T PRICE FAO PHIL ATHERTON - BUILDING BXX PERIODIC REVIEW OF SAFETY AND FORWARD WORK PLANS - 12TH-FEB 2014 TRIM 2014/59062
- 15 BXX LTPR [REDACTED] - SELLAFIELD LTD - CONDITION 15 - SHED 2 OF THE NUCLEAR SITE LICENCE NO:31G SELLAFIELD (W & C WORKS) SUBMISSION OF 2ND CYCLE PSR DELIVERABLES FOR MSSS - CONFIRMATION OF SAFETY LETTER - 19TH DECEMBER 2013 TRIM 2013/477311
- 16 BXX LTPR ASSESSMENT APPROACH + INFO SEAN O'NEILL TRIM [REDACTED]
- 17 INFORMATION SERVICES - HSE ARCHIVED DOCUMENT - REPORT ON THE SILO LEAK AT WINDSCALE (BXX) TRIM 2009/473810
- 18 BXX LTPR SECTION F - ALARP SUMMARY ISSUE 7.2 DRAFT ADDRESSING MSC COMMENTS 24-12-13 TRIM 2013/476738

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- 19 BXX LTPR RE OPS FLOOR PASSIVE VENTILATION INFORMATION REQUEST [REDACTED] TRIM 2014/187665
- 20 IR [REDACTED] - PLANNED INTERVENTIONS (COOLING SYSTEM INSPECTION OF MSSS, FOLLOW UP ON EVENT; ACTIVE HANDLING FACILITY, ATTENDANCE AT MSSS OPERATIONS MEETING) [REDACTED] [REDACTED] 2014/101446
- 21 MSSS PASSIVE VENTILATION TRIM 2014/0236460
- 22 TRIM 2014/132893 - SECOND CYCLE PERIODIC SAFETY REVIEW: QUIESCENT STATE WASTE FIRE ASSESSMENT - [REDACTED] [REDACTED]
- 23 TRIM 2014/0434884 - GUIDELINES-FOR-PROGRAMME-MANAGEMENT
- 24 TRIM 2014/434235 - FINDINGS FROM MSSS LTPR REVIEW
- 25 TRIM 2014/335181 [REDACTED] LEVEL 4: WEDD & INFRASTRUCTURE ONR LTPR INTERFACE MEETING AND MSSS LTPR UPDATE - 04 SEPTEMBER 2014 - [REDACTED]
- 26 TRIM 2014/333763 [OFFICIAL-SENSITIVE] EMAIL FROM BNET - SELLAFIELD LTD - MSSS LTPR FINDINGS INITIAL RESPONSE - 08 SEPTEMBER 2014
- 27 TRIM 2014/455804 - REVIEW OF SL INITIAL RESPONSE TO MSSS PROCESS FINDINGS
- 28 TRIM 2014/455776 - PROCESS RESPONSE TO SL'S UPDATE TO ONR FINDINGS TO ENABLE CLOSE OUT OF BXX LTPR REVIEW

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ANNEX1: FINDINGS FROM CIVIL ENGINEERING ASSESSMENT

ONR Civil Engineering MSSS LTPR assessment Findings	
1	The MSSS LTPR: Engineering Review Report and MSSS 2 nd Cycle Long Term Periodic Review (LTPR) Improvement Plan should be updated to reflect the final version of the CS&A DAR and address all shortfalls so identified
2	SL needs to justify the steel frame on grid 113 within the 2 nd Extension Service Annexe, considering the cross bracing in its actual location.
3	SL should ensure the long term performance of the embedded reinforcement and ONR expects that: <ul style="list-style-type: none"> • SL undertake a second carbonation depth survey on the external faces of the concrete silos as soon as practicable and • SL should undertake a Chloride content test at the same time.
4	SL needs to consider extreme snow loading upon the roofs or demonstrate that extreme snow loading is not a critical load case.
5	SL needs to provide a summary of the adequacy of the stacks to the service annexes. If shortfalls are identified, these need to be carried through to the MSSS LTPR: Engineering Review Report and MSSS 2 nd Cycle Long Term Periodic Review (LTPR) Improvement Plan
6	SL needs to demonstrate that the masonry infill wall panels to the annexes do not provide a threat to the operation of safety systems when the walls are subject to accidental loading.
7	SL should complete the Passive Ventilation project as soon as reasonably practicable to further reduce the risk of a hydrogen deflagration occurring which would challenge the silo containment.
8	SL should undertake enhancements which will improve the seismic event withstand, where practical, on the remaining structural elements; most notably the 3 rd Extension silo superstructure and service annexe.
9	SL should implement measures to prevent a potential above ground leak from the Original Building silo spreading across external impermeable surfaces or entering the surface water disposal system.

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ANNEX 2 FINDINGS FROM NUCLEAR FIRE SAFETY ASSESSMENT

ONR MSSS Internal Hazards LTPR Findings	
1	The NFSA does not explicitly consider the impact of fire hazards from adjacent buildings, design changes, assessment against modern standards, or expected operations over the next 10 years as claimed.
2	SL has not adequately demonstrated that the risks from fire are controlled so far as is reasonably practicable.
3	Where claims made on operator actions in the event of a fire constitute a Basket Safety Measure, these should be clearly identified within the NFSA, included within the Fire Safety Management Strategy for the building and substantiated by an acknowledged task analysis process.
4	SL should satisfy itself that all plant modifications implemented since the last COSR, and all proposed Plant Modification Proposals have been considered within the MSSS LTPR NFSA fire hazard analysis.
5	The NFSA does not adequately capture shortfalls in the substantiation of safety measures. Once identified, the interim measures established to address the compliance gap should be articulated or raised as a shortfall within the MSSS LTPR NFSA.
6	The NFSA does not consider the hazards from future operations as part of the Periodic Safety Review process and therefore fails to make an adequate look ahead into future life cycle phases for the MSSS facility.
7	The MSSS LTPR NFSA fails to assess the adequacy of fire prevention, protection and detection measures against modern standards.
8	The final issue of the LTPR NFSA should address the ONR LTPR NFSA findings.

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ANNEX 3 FAULT STUDIES

ONR MSSS Fault Studies LTPR Findings	
1	SL should implement the silo cooling systems re-commissioning project as soon as possible to reduce the chronic hydrogen evolution rates.
2	SL should substantiate the passive ventilation system to a level that allows it to be claimed in the extant safety case as protection against loss of ventilation faults
3	SL should provide additional assurance and evidence that the facility is adequately protected by the currently existing duty and standby vent systems.

ANNEX 4 C&I STUDIES

ONR MSSS Fault Studies LTPR Finding	
1	SL to implement the Quiescent Passive Ventilation scheme as soon as practical to prevent excessive hydrogen accumulation.

ANNEX 5 HF FINDINDINGS

ONR MSSS LTPR HF Findings	
1	SL should undertake a gap analysis between the revised HAZAN for ventilation faults and the extant human factors assessment.
2	SL should undertake a human factors review of operating experience; this is expected as part of SL's HF methodology. SL should review the extant human factors report for ventilation faults against the findings of Operational Experience (OPEX).
3	ONR should monitor the progress of human factors support to MSSS across relevant projects including, PMPs, retrievals projects etc.
4	SL should undertake suitable assessment of Initiating Errors potential in the scope of future HF assessment.
5	ONR should examine the adequacy of the system alignment controls as this is a key administrative control that serves to reduce the potential frequency of initiating errors.
6	ONR should undertake proportionate inspection/assessment of the management of the chemotoxic hazard on MSSS.

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7	ONR undertakes proportionate assessment of the proposed body of human factors assessment and any shortfalls that this assessment identifies.
8	ONR should include a detailed examination of the adequacy of emergency arrangements and should monitor SL's planned programme of review and improvements through the inspection programme.
9	SL should undertake a review of the generic emergency arrangements for MSSS, supplemented as necessary by examination of arrangements for specific faults.

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ANNEX 6 PROCESS ENGINEERING FINDINGS

	ONR MSSS LTPR Process Findings
1	SL to provide evidence that the Mk V cooler can be successfully operated using the pressure/flow charts used without System Engineer/Subject Matter Expert supervision.
2	SL to provide evidence that that the pipe work for cooling water header to Mk V cooler is appropriately designed for the expected working pressure.
3	SL to provide evidence that pressure relief valve datasheets are complete,
4	Sellafield Ltd should assess the move to Pressurised Inerting (with the currently installed equipment) now as part of MSSS Severe Accident Analysis, to ensure that when the required, its introduction has been fully thought through.
5	SL to provide a credible programme to recommission the 2 nd and 3 rd extension cooling systems to enable routine cooling.
6	SL to implement a method that will give indication of the health of the cooler exchanger(s).
7	SL to demonstrate adequate measures are in place to prevent cooler failure affecting compartment cooling through the design and /or arrangements to maintain the facility in a safe position following failure rather than relying on the time an excursion take to develop).
8	SL should demonstrate the coolers are sufficiently robust (i.e. reliable and with suitable critical spares) to deliver the safety function required of them.
9	SL should take in to account the reliability of the anti-siphon valves when considering this fault sequence [relating to compartment liquor breakthrough into the cooling water] and cooler start-up operations.
10	SL to provide a credible programme of improvements to prevent the consequence of a cooling water lock-in within the Mk V cooler are made before routine cooling is placed under the control of the operators (i.e. without System Engineer/Subject Matter Expert supervision).

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Annex 7 Mechanical Engineering Findings

ONR Mechanical MSSS LTPR assessment findings	
1	SL should produce complete set of mechanical DARs to confirm the adequacy of maintenance regime, asset condition and management of equipment obsolescence.
2	SL should update Engineering Review Report and MSSS 2 nd Cycle Long Term Periodic Review (LTPR) Improvement Plan to reflect the final version of the mechanical DARs and address all shortfalls so identified
3	SL should ensure that all configuration diagrams are properly updated, signed off and HAZOPs updated as necessary
4	SL should progress and report on shortfalls identified as open from the previous LTPR (2003) and explain how the shortfalls are taken into account in the Live Safety Case and the implementation plan.