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Sellafield Pile Fuel Cladding Silo

Agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability

Project Assessment Report ONR-SDFW-PAR-20-018
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EXECUTIVE SUMMARY

Title

Agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

Permission Requested

The Licensee, Sellafield Limited (Sellafield Ltd.) has requested the Office for Nuclear Regulation's (ONR) agreement under its Licence Condition (LC) 22(1) arrangements to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability. This activity will take place at the PFCS facility on the Sellafield nuclear licensed site.

Background

PFCS is a legacy radioactive waste storage facility, and the waste inventory presents one of the largest hazards at Sellafield. It is considered to present an unacceptable risk due to the outdated design and age of the building and because of the large volume of intermediate level waste that it contains, much of which is flammable and some of which is pyrophoric. Argon gas is used to maintain a low oxygen environment within the silo to prevent fire.

Sellafield Ltd's strategy is to eliminate the hazard from PFCS by retrieving the waste from the silo and transferring it to a modern storage facility on the Sellafield nuclear licensed site. This will be done by connecting an argon-inerted main containment room (MCR) to the side of the silo and over the silo containment door. Waste will then be removed from the silo using a crane that reaches through one of the silo containment doors and places the waste in a $3m^3$ container docked to the underside of the MCR. Once full, the waste loading port is closed to maintain the inert atmosphere, and the waste container is undocked, lidded and exported.

Waste retrieval operations will be undertaken in two stages. The first of these – 'Early Retrievals' – involves accessing only compartment 5. The second stage – 'Full Retrievals' is the point when waste retrievals will be undertaken from the remaining compartments and will take place once Sellafield Ltd has gained sufficient knowledge, experience and confidence from the approach taken with compartment 5 (Early Retrievals).

The 'Early Retrievals' plant consists of the Waste Container Handling Area (WCHA) and the Waste Retrievals Containerisation Area (WRCA). ONR has previously granted permission to enable installation and inactive commissioning of this equipment at the Sellafield site. Sellafield Ltd has now completed the installation work and inactive commissioning activities. This work has included testing of the installed infrastructure to provide confidence that the requisite low oxygen concentration levels can be achieved and maintained within the MCR.

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It is possible that oxygen level variations could occur when the silo door is opened and during waste retrieval operations, for example due to changes in gas flows within the silo or changes in waste height and profile. Any or all these factors could lead to changes in oxygen level concentrations hence Sellafield Ltd. has implemented a revised safety case which provides the justification for changing the limits and conditions for oxygen level concentrations. This was subject to an ONR permission which was granted February 2020.

The next phase of work is to commence active commissioning of the 'Early Retrievals' plant and equipment, which is the subject of this permission. This will be the point at which the silo containment door is opened and when the containment boundary of the silo becomes extended to include the WRCA. This is when the waste retrievals safety case will be implemented and represents a change in risk from the current quiescent storage operations.

This ONR permission will enable active commissioning of the 'Early Retrievals' plant and equipment to be undertaken and waste retrieval operations from compartment 5 to begin.

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

ONR has previously undertaken detailed assessment of the engineered design, operating parameters and the key faults and hazards associated with the waste retrievals operations through earlier safety case submissions and regulatory hold-points. Therefore, the scope of the assessment at this stage has focussed on the impact of any changes in plant, process or operating rules since previous assessment work, nuclear liabilities regulation and human factors aspects, including the extant regulatory issue 7478 related to the change in the oxygen operating rule.

I have conducted inspection activities focussed on the readiness of Sellafield Ltd to implement the safety case, including the emergency response arrangements to support this change in operational status.

The assessment and inspection activities were undertaken based on the original submission received in October 2020. During final inactive commissioning activities Sellafield Ltd. identified reliability issues with the robot lid bolting and swabbing robot. Remedial work is required to resolve the issues prior to the WCHA moving into active commissioning. To complete this work Sellafield Ltd has taken the decision to split the phased activities further enabling active commissioning of the MCR whilst the WCHA is still subject to inactive commissioning. Therefore, I requested that, in addition to the scope of the extant assessment performed, specialist inspectors include consideration of the change in approach to ensure that their existing assessments are not undermined or challenged by additional fault scenarios not previously included.

Matters arising from ONR's work

The Fault Studies inspector has focussed on verifying that no new faults have been introduced, for example from the inability to substantiate equipment during inactive

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commissioning and ensuring that outstanding ONR issues from previous submissions have been appropriately dealt with. The Fault Studies Inspector is satisfied that there are no gaps between the updated Radiological Safety Assessments (RSA) supporting this Pre-Active Commissioning Safety Report (PACSR) and those which supported the Pre-Construction Safety Report (PCSR) and changes to the oxygen Operating Rule. No new faults have been identified.

The Human Factors (HF) assessment builds on the two previous HF assessments at the Pre-Construction Safety Report (PCSR) stage. The HF inspector considered the HF aspects of the PFCS PACSR 'as built' to confirm that Relevant Good Practice (RGP) has been met and that any important human actions and administrative controls claimed in the safety case are adequately substantiated. However, the assessment identified shortfalls in relation to the operator instructions and training when moving from normal retrievals operations to credible but unlikely off-normal operations, the strategy for managing the returning Retrievals Team Leaders (RTLs) and operators, and the training strategy once the test rig at Rosyth was no longer available for training. These shortfalls were captured in regulatory issue 8460 and have subsequently been satisfactorily addressed.

The Nuclear Liabilities Regulation (NLR) assessment has focussed on characterisation of the waste during the waste retrievals for safe future management, and how that information is recorded to ensure that future waste management options are not foreclosed. It also considers generation and management of secondary waste from the retrievals process, and the interface with proposed storage facilities. The NLR inspector identified a number of shortfalls in relation to waste characterisation which required closure prior to the commencement of active commissioning. These shortfalls were captured in regulatory issue 8628 and have subsequently been satisfactorily addressed.

Conclusions

This report presents the findings of ONR's assessment of Sellafield Ltd's proposal to implement a waste retrieval capability to enable active commissioning and waste retrievals operations from compartment 5 to commence.

The assessment and inspection activities have taken account of previous activities and considered the impact of any changes in plant, process or operating rules since previous assessment work including the extant regulatory issue 7478, relating to the changes in the oxygen operating rule.

During our sampling assessment shortfalls were identified and captured in regulatory issues. Those shortfalls requiring resolution prior to commencing active commissioning have now been adequately addressed Table 1 provides a summary of those shortfalls which have been adequately addressed and those that require addressing during or post active commissioning.

Inspections have been undertaken to demonstrate the adequate implementation of the safety case. I have had no objections to Sellafield Ltd's proposal raised by the

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ONR Civil Nuclear Security Inspector, the ONR Conventional Health & Safety Inspector, ONR Nuclear Safeguards Inspector and the Environment Agency.

Commencement of waste retrieval operations is a change from the current quiescent state and will result in an increased risk profile. Taking into account the previous assessment activities carried out by ONR and the assessment and inspection activities undertaken to support this permission, I judge that Sellafield Ltd. has presented an adequate safety case that demonstrates the risks to be suitably controlled and subject to robust surveillance and monitoring. I consider that Sellafield Ltd will be able to manage this additional risk and has demonstrated that risks are reduced so far as is reasonably practicable. I also judge that the additional increase in risk is justified to facilitate PFCS waste retrievals given the significant longer term risk reduction benefit that this will bring.

In addition, Sellafield Ltd. has developed a phased approach into waste retrieval operations which introduces a controlled, gradually increasing radiological challenge to the facility, and provides formal review of the plant performance and operating envelope prior to transition to each phase. Alongside Sellafield Ltd's own internal assurance activities, ONR will continue a programme of regulatory oversight during the initial phases of active commissioning and the transition into waste retrieval operations to gain assurance that the waste behaviour and that waste retrievals are in line with the design and safety intent.

Recommendation

I recommend that ONR issues Licence Instrument 536 granting Sellafield Ltd. agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability, in response to the request to ONR under their LC 22(1) arrangements.

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LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
BEPPS-DIF	Box Encapsulation Plant Product Store – Direct Import Facility
CAR	Control of Asbestos Regulations 2012
CHS	Conventional Health and Safety
CNS	Civil Nuclear Security
DAP	Duly Authorised Person
DR	Decision Record
EPS3	Encapsulated Product Store 3
HARR	Hazardous Activity Readiness Review
HF	Human Factors
HOW2	(Office for Nuclear Regulation) Business Management System
HPCP	Hold-Point Control Plan
ILW	Intermediate Level Waste
LC	Licence Condition
LI	Licence Instrument
MAA	Malicious Actions Assessment
MBGW	Miscellaneous Beta/Gamma Waste
MCR	Main Containment Room
MEP	Magnox Encapsulation Plant
MSC	Management of Safety Committee
MSSS	Magnox Swarf Storage Silo
NLR	Nuclear Liabilities Regulation
NSC	Nuclear Safety Committee
NNLW	Notifiable, Non-Licensable Work (under Control of Asbestos Regulations 2012)
OI	Operator Instruction
OR	Operating Rule
PAR	Project Assessment Report
PACSR	Pre-Active Commissioning Safety Report
PCSR	Pre-Commissioning Safety Report
PFCS	Pile Fuel Cladding Silo

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PMP	Plant Modification Proposal
RGP	Relevant Good Practise
rOI	Required Operating Instruction
RSA	Radiological Safety Assessment
SAP	Safety Assessment Principle(s)
SDFW	Sellafield, Decommissioning, Fuel and Waste (ONR Division)
SFAIRP	So Far As Is Reasonably Practicable
WCHA	Waste Container Handling Area
WRCA	Waste Retrieval Containerisation Area

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1 PERMISSION REQUESTED

1. The Licensee, Sellafield Limited, has requested [1] the Office for Nuclear Regulation's (ONR) agreement under its Licence Condition (LC) 22(1) arrangements to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability. This activity will take place at the PFCS on the Sellafield nuclear licensed site.

2. This Project Assessment Report (PAR) records my judgement on the proposed activity as described in the Sellafield Ltd. Plant Modification Proposal (PMP) [2] [3] and gives my recommendation to the ONR Sellafield Project Delivery Sub-Division Delivery Lead. It has been produced in accordance with ONR guidance [4]. The Decision Record (DR) [5] describes the permissioning strategy for this regulatory hold point (PFCS hold-point HP7, Sellafield Ltd. Hold-Point Control Plan (HPCP) 148).

2 BACKGROUND

2.1 History and hazard

3. PFCS is a legacy radioactive waste storage facility, and the waste inventory presents one of the largest hazards on the Sellafield site. PFCS was commissioned in 1952 and Intermediate Level Waste (ILW) was routinely tipped into the silo until 1964. Ad-hoc tipping operations continued until 1972. Since then, the silo has been in a state of care and maintenance. The waste remained undisturbed in an air atmosphere within the silo until the late 1990s. Since then, it has been continuously inerted with argon gas to lower the oxygen concentration as a fire prevention measure. Oxygen levels, pressure and temperature are continuously monitored within the silo.

4. The exact composition of the waste is uncertain [1] but includes significant inventories of flammable material, for example organic/cellulose materials, graphite, and aluminium/magnesium swarf. Some of the materials present could also be pyrophoric and be capable of self-ignition in the presence of oxygen and/or water.

5. The silo is internally sub-divided into six compartments. The waste types likely to be present vary between the compartments and the waste composition varies with depth within each compartment [6].

6. Although some structural enhancement has been undertaken, PFCS is considered to pose an unacceptable risk to the workforce, public and environment due to the combination of an ageing structure, which does not meet modern nuclear design standards, and the hazardous waste inventory contained within the silo [7]. Reliance on this structure to contain the waste and to maintain argon inerting to manage the fire risk is not considered sustainable due to the risk of a bulk silo fire involving Magnox swarf, which

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could result in a large release of radioactivity on and off the site. To reduce the hazard and risk associated with this facility, the waste requires retrieving and placing into a modern storage facility as soon as is reasonably practicable. The need to retrieve the waste to reduce the significant hazard and risk is recognised by the licensee, regulators, and UK government as requiring action in the near term.

2.2 Waste retrievals strategy and enabling work undertaken to date

7. The strategy developed by Sellafield Ltd. is to remove the waste from PFCS in two stages. The first stage, 'Early Retrievals', involves accessing only compartment 5 of the silo and removing waste through a high-level penetration in the compartment wall above the level of the waste. As well as achieving the first meaningful hazard reduction, this approach will enable Sellafield Ltd. to build knowledge and experience prior to commencing 'Full Retrievals'. 'Full Retrievals' is the second stage and the point at which waste retrievals will be undertaken from the remaining five compartments of the silo. ONR has had oversight of the strategy developed by Sellafield Ltd. and consider this strategy will achieve the progressive hazard and risk reduction required. We are supportive of the approach being taken, including the rationale for the selection of compartment 5, which has been chosen by Sellafield Ltd. to maximise the potential for learning.

8. Sellafield Ltd. has already completed various enabling and preparatory works, some of these activities have been subjected to ONR assessment and permissioning [8], including:

- removal of the roof-top transfer tunnel and strengthening of the building
- construction of a superstructure next to the silo – the key feature of which is a large open platform on which the retrievals plant and equipment can be located
- provision of a metal firefighting capability for additional defence-in-depth against a silo waste fire [9] [10]
- clearance and removal of the internal deflector plates [11]
- cutting of the six retrievals access penetrations, each of which is sealed by a gas-tight silo containment door [12]
- construction and installation of the plant and equipment for the 'Early Retrievals' Waste Container Handling Area (WCHA) [13]
- construction and installation of the plant and equipment for the 'Early Retrievals' Waste Retrievals Containerisation Area (WRCA) [14]
- inactive commissioning of the early retrievals plant and equipment
- agreement to raising the oxygen operating rule (OR1) [15].

9. The 'Early Retrievals' plant is specifically designed for compartment 5 retrievals. It consists of the 'downstairs' WCHA (located in the west garage

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below the retrievals platform) and the 'upstairs' WRCA (which is located on top of the platform and will seal against the side of the PFCS building itself).

10. The WRCA houses the main containment room (MCR) which is an argon-inerted cell where the waste retrievals crane accesses the silo compartment. The crane reaches through the silo containment door, the crane grab retrieves the waste and loads the waste into a $3m^3$ stainless steel waste container docked to the underside of the MCR. Once the waste container is full, the waste loading port hatch is closed and the waste container undocked, lidded and transferred via bogie to the hoist-well where it is lowered into the WCHA. The WCHA receives the lidded waste containers, bolts the lid, weighs the boxes, swabs for contamination, and loads the box into a shielded transport package (SP/2958) for transport to the storage facility for on-site interim storage.

11. It is expected that waste retrievals from compartment 5 will take in the region of two years to complete, however these timescales could vary depending upon plant performance. Once waste retrievals from compartment 5 is complete, the 'Early Retrievals' plant and equipment will be modified to enable 'Full Retrievals' to commence.

2.3 Licensee's transition from active commissioning to sustained waste retrievals within compartment 5 ('Early Retrievals')

12. Sellafield Ltd. has developed a phased approach to achieve sustained waste retrievals from silo compartment 5 to the Box Encapsulation Plant Product Store and Direct Import Facility (BEPPS-DIF).

13. Transition to each phase is controlled through a series of internal hold-points which have been agreed by the licensee's Nuclear Safety Committee (NSC) [16]. The decision to release these internal hold-points is subject to the licensee's internal governance processes, including Hazardous Activity Readiness Reviews (HARR), Management Safety Committee (MSC) and Nuclear Safety Committee (NSC). The scope of the hold-points has been revised to take account of the issues associated with the lid bolting and swabbing robot [17].

- Phase 2 - Work to be completed prior to active commissioning
  This is the current phase of work and includes inactive commissioning activities. The scope of the inactive commissioning includes single item checks through to fully integrated system checks to verify operations as per the design and safety intent. This work is currently being undertaken under a category C PMP [18]. Inactive commissioning of the WCHA has not yet been completed due to reliability issues with the lid bolting and swabbing robot. In-active commissioning of the WCHA will be completed prior to commencing phase 3b. (refer to section 4.2.2)

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- Phase 3a - Implementation of the Early Retrievals safety case and active commissioning of the silo door and crane checks within the WRCA Main Containment Room (MCR).
  This is the initial stage of active commissioning and when the silo door is first opened. The scope of this stage of active commissioning will include opening the silo door and gas checks to demonstrate that an inert atmosphere can be maintained between the silo and MCR, testing of the silo door (including seals) and extending the waste retrieval crane into the silo to complete operating envelope checks and CCTV checks. No waste manipulation will take place at this stage.

- Phase 3b – waste interaction
  This will commence once phase 3a active commissioning operations have been completed and inactive commissioning of the WCHA has been completed (including the lid bolting and swabbing robot testing). The scope of this stage of active commissioning will include waste handling and manipulation trials to verify operations and monitor the impact of these activities on the conditions within silo compartment 5 and WRCA Main Containment Room (MCR).

- Phase 4: Active Commissioning - fill 2 boxes and temporary storage on PFCS
  This phase of active commissioning will take the plant through complete active cycles and is when waste is first transferred into a $3m^3$ box and transferred to the WCHA, creating a waste package. This will be the first active export of waste from the silo. The two waste packages produced will be temporarily stored in a designated area within the PFCS within the shielded Sellafield Package (SP/2958).

- Phase 5: First active export to stores
  This phase enables an additional ten waste packages to be generated and the twelve waste packages (including the two generated during phase 4) to be exported from the PFCS compound to the store. This scope of work will demonstrate the full route from waste retrieval operations to the waste packages being transported to an on-site storage facility. These initial twelve packages will provide operational learning on waste handling aspects, oxygen monitoring and identification of any early operational issues for example build-up of dust and contamination which may impact operator visibility or the waste loading port seals. Other learning will be on store operations, conditions for acceptance and transportation.

- Phase 6: Sustained waste retrieval operations to BEPPS-DIF
  Movement to this phase will be informed by the learning from the previous phases. Learning during this phase will focus on understanding of the different waste layers and the silo condition as the

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walls are uncovered. Performance of the plant will continue to be re-evaluated during this phase to inform the 'full retrievals' project.

14. This phased strategy into waste retrieval operations introduces a controlled, gradually increasing radiological challenge to the facility, and provides formal review of the plant performance and operating envelope prior to transition to each phase. Given this is a new operation and represents a step change in operation from quiescent storage to active waste retrievals, I am supportive of this phased approach developed by Sellafield Ltd.

2.4 ONR permissioning strategy

15. The scope of this regulatory permission will give agreement for Sellafield Ltd. to commence active commissioning of the compartment 5 plant and equipment and transition into compartment 5 waste retrieval operation (as outlined in section 2.3). Active commissioning will be the point when the waste retrievals safety case is implemented [19], and the silo containment door is first opened and the waste within the silo is disturbed. At this stage, the containment boundary of the silo becomes extended to include the WRCA. The commencement of active commissioning is a significant step change in operations and ONR must therefore have confidence that risks are reduced so far as is reasonably practicable.

16. The scope of the PMP for active commissioning [2] [3] will enable Sellafield Ltd. to undertake commissioning of the PFCS plant and equipment, including validation of specific human factors related tasks and up to phase 6 (sustained retrievals to BEPPS-DIF). At this stage, the safety case will transition into the operations phase of the safety case [17].

17. There are a number of outstanding actions which will require addressing as Sellafield Ltd. progresses through the active commissioning stages. These are summarised in table 1.

18. ONR will continue to maintain close oversight of PFCS during these phases of active commissioning and the transition into waste retrieval operations to gain assurance in the waste behaviour and that waste retrievals are in line with the design and safety intent.

19. The import of PFCS waste packages into storage facilities using either the contingency route through EPS3 for up to twelve packages or BEPPS-DIF will be subject to separate regulatory permissioning activities.

20. Work to install the second WRCA, modify the WCHA and move to 'Full Retrievals' will be the subject of a programme of ONR regulation and oversight activities, yet to be defined.

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

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21. This permission will build on the confidence in the waste retrievals safety case obtained through the ONR assessment work supporting the release of earlier hold points associated with construction and installation of the plant and equipment, inactive commissioning and agreement to raising the oxygen operating rule (refer section 2.2).

22. The engineered elements of the plant and the key faults and hazards in the safety case have already been assessed in detail by ONR through the aforementioned safety submissions and hold points. There is therefore no benefit in further re-assessment of these items unless a significant change in the design/safety case basis or unforeseen difficulty comes to light. However, there is benefit in this assessment reviewing the inactive commissioning results to confirm suitability of key safety systems.

23. I have confirmed that regulatory issues raised as part of previous assessments and inspections to have been closed [20].

24. Although the Nuclear Liabilities Regulation (NLR) specialist inspector has had regular engagement with Sellafield Ltd. for a number of years, this permission captures the NLR judgement prior to movement of radioactive material. This will include the contingency option to utilise the Magnox Encapsulation Plant (MEP) and Encapsulated Product Store 3 (EPS3). In line with the decision record for WRCA installation [21], a formal NLR safety case assessment will be undertaken in support of this decision.

25. Human factors (HF) specialist assessment includes consideration of the extant regulatory issues 7392 and 7478. Regulatory issue 7478 relates to the adequacy and reliability of operator response and support requirements associated with onset of elevated oxygen levels that was identified during the permissioning of changes to the oxygen rules [22]. It will also provide an opportunity for a final view of task design, organisation and support, specifically other operating procedures, training and substantiation of Human-Based Safety Claims (HBSCs).

26. Fault studies (FS) specialist assessment involved performing a gap analysis, taking into account the impact of any changes in plant and process and to the operating rules since detailed design.

27. I have focussed inspection activities on the readiness of the Licensee to implement the safety case, including the emergency response arrangements which require changing to support waste retrieval operations.

3.1 Recommendations arising from the ONR assessment of PMP7 – changes to the oxygen operating rule

28. The PAR [22] that supported the regulatory decision to change the oxygen operating rule identified a requirement for the licensee to emphasise the significance of all limits and conditions, highlight the importance of maintaining

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oxygen levels as low as reasonably practicable and to explicitly request that ONR is notified should the oxygen level exceed 5%. This was communicated to the licensee [23] and Sellafield Ltd provided a written response detailing the additional mitigation which would be put in place [24]. As part of the regulatory activities to support this permission, I have confirmed this additional mitigation has been put in place.

29. The PAR highlights that there were some differences of professional opinion within ONR. These were ultimately resolved and taken cognisance of in the PAR's recommendations. However, as part of the process of resolving those differences, the Fault Studies Professional Lead undertook a review [25] and made the following recommendations:

Recommendation 1: The hold on permissioning the operating rule change placed via the Difference of Regulatory Opinion Process should be released.

This recommendation has been addressed with the issue of the Licence Instrument to implement the change in the oxygen rule [26] and associated PAR [22].

Recommendation 2: ONR should ensure (1) that the future Sellafield Ltd safety case makes it clear that operating above the 5% v/v oxygen concentration rOI limit is an abnormal condition to which the PFCS operator will respond appropriately to urgently restore conditions, and not a planned normal operation, and ONR should (2) ensure it obtains assurances from Sellafield Ltd during commissioning tests that the operator is functionally capable of compensating for any small but very frequent leaks prior to the release of the future hold point for commencement of retrievals.

This recommendation has been considered as part of this permission, including the evidence to support closure of regulatory issue 7478. I am satisfied that this recommendation has been adequately addressed, noting the arrangements will be fully tested as part of active commissioning.

Recommendation 3: Sellafield Ltd should be asked to do a timely future review of PFCS Operating Rules (ORs) following experience of the new operating regime.

This recommendation will require closure as part of ONR's future programme of engagement and inspection during retrievals from compartment 5. As such, I have captured this in the following level 4 regulatory issue (10620):

On completion of the first twelve boxes, Sellafield Ltd should review the behaviour of the oxygen levels to confirm that the oxygen operating rule and arrangements for implementing and managing the oxygen levels are appropriate.

Recommendation 4: ONR and SDFW need to use the Review, Learn, and Improve (RLI) process to see if there is any learning from this permissioning

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intervention for this operating rule change to avoid getting into a position where the difference of professional opinion process is invoked. It is beyond the scope of this report to explore this in any detail but areas for consideration should be include:

- Whether there is a need to reinforce training on the use of ONR Technical Assessment Guide (TAG) 35 covering Operating Rules to avoid self-referencing by inspectors.
- Whether there should always be a Fault Analysis assessment performed for key high-risk decisions involving potentially large off-site consequences.
- Whether adequate assessment resources were made available to perform such a high-profile assessment.
- Whether the Differences of Opinion process needs to be further developed and where exactly in the decision-making process it should sit.

This recommendation was closed via a review led by regulatory assurance [27].

3.2 Availability of supporting infrastructure

30. To facilitate active commissioning and enable sustained waste retrievals there are several other activities and facilities which must be suitably mature. These include:

- Demonstrable supply of $3m^3$ waste containers manufactured to specification
- Adequate buffer storage arrangements for new waste containers
- Arrangements for the safe and secure transport of filled waste containers (waste packages) to the interim storage facility
- Availability of storage facilities to safely store the waste packages produced

31. Whilst these are not specifically within the scope of this permission, it is important that ONR has confidence that the infrastructure is in place to support the waste retrieval activities and that the waste packages produced can be safely stored on the Sellafield Licensed site. To inform this permissioning decision, I have therefore sought assurance that the wider enabling infrastructure is in place.

3.3 Consultation with respect to nuclear security, conventional health and safety, safeguards and environment

32. To inform this permissioning decision I have consulted with the ONR Civil Nuclear Security Inspector, the ONR Conventional Health & Safety Inspector, ONR Nuclear Safeguards Inspector and the Environment Agency.

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4 MATTERS ARISING FROM ONR'S WORK

33. The matters arising from the regulatory assessment and inspection work carried out by ONR to inform this permission are summarised below.

34. The assessment and inspection activities were undertaken based on the original submission received in October 2020 [28]. During final inactive commissioning activities Sellafield Ltd. identified reliability issues with the robot lid bolting and swabbing robot (refer to section 4.2.2 for further details). Remedial work is required to resolve the issues prior to the WCHA moving into active commissioning. To fully complete this work will delay the commencement of active commissioning and subsequent operations by several months therefore, to minimise the delay to commencing active commissioning and subsequent waste retrieval operations from compartment 5, Sellafield Ltd. has split the original phase 3 activities into two parts (phase 3a and 3b) enabling active commissioning of the MCR whilst the WCHA is still subject to inactive commissioning. I have therefore confirmed that the revised submission [1] which splits the phase 3 active commissioning into two parts (phase 3a and 3b) does not undermine the original assessment and inspection work carried out.

4.1 ONR nuclear safety assessment work

4.1.1 Fault studies

35. An ONR fault studies assessment has already been undertaken of the Pre-Commencement Safety Reports (PCSR) covering waste retrieval activities within compartment 5. Therefore, the Fault Studies Inspector has focussed on verifying that no new faults have been introduced, for example from the inability to substantiate equipment during inactive commissioning and ensuring that outstanding ONR issues from previous submissions have been appropriately dealt with [29].

36. The Fault Studies Inspector is satisfied that there are no gaps between the updated Radiological Safety Assessments (RSA) supporting this Pre-Active Commissioning Safety Report (PACSR) and those which supported the PCSR and changes to the oxygen operating rule (OR1). No new faults have been identified.

37. The previous fault studies assessment of the PCSR for waste retrieval activities within compartment 5 identified several recommendations. The recommendations were satisfactorily closed out as part of the ONR permissioning of the installation and setting to works of the WRCA. However, to confirm that Sellafield Ltd has adequately captured the recommendations within the PACSR, the fault studies inspector sampled the Sellafield Ltd. case for avoiding waste retrieval crane impacts with the silo wall. The fault studies inspector has confirmed that the design provision for minimising crane

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impacts with the silo wall is captured within the PACSR and that Sellafield Ltd. has justified that the risks from these faults are reduced to ALARP.

38. In relation to the change in the oxygen operating rule, the fault studies inspector has taken account of the findings from the PAR [2] and the difference of regulatory opinion [3]. The Fault Studies Inspector has confirmed that the PACSR makes it clear that operating above the 5% v/v oxygen concentration is an abnormal condition to which the PFCS operator will respond appropriately to urgently restore conditions.

39. In addition, the Fault Studies Inspector has discussed the implementation of the rOI (OA/747) associated with ceasing to disturb the Silo waste (except for making safe retrievals operations) with the ONR Human Factors (HF) specialist and confirmed that the operator is functionally capable of compensating for any small but frequent leaks of argon from the silo. From a fault studies perspective, the relevant aspects outstanding from the PAR [22] and the difference of regulatory opinion [25] to emphasise the significance of all limits and conditions associated with the silo oxygen concentrations, have been addressed.

40. Inactive commissioning of the waste retrieval plant and equipment was successfully completed in 2019, however due to the delays in availability of the downstream storage facilities PFCS undertook a phase of inactive operations to test the reliability of the plant and equipment. The output from this inactive commissioning has been considered as part of the fault studies assessment and confirms that there are no outstanding issues which impact the ability of the identified safety measures to perform their safety function.

41. The fault studies assessment was undertaken based on the request received from Sellafield Ltd. in October 2020 [28]. The fault studies inspector has confirmed that the revised request received from Sellafield Ltd. which implements the revised commissioning strategy for PFCS [4] has no impact on the assessment undertaken or the conclusions from it [30].

42. The fault studies inspector judged that Sellafield Ltd. had provided an adequate safety case and that risks had been controlled ALARP. To conclude, the fault studies inspector supports the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

4.1.2 Human factors

43. The HF assessment [31] builds on the two previous HF assessments at the Pre-Construction Safety Report (PCSR) stage [32], [33]. The HF inspector has considered the HF aspects of the PFCS PACSR 'as built' to confirm that Relevant Good Practice (RGP) has been met and that any important human

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actions and administrative controls claimed in the safety case are adequately substantiated. Areas sampled as part of the HF assessment include:

- HF aspects of the design including the extent to which HF aspects of the design 'as built' are compliant with RGP including the closure of Regulatory Issue (RI) 7392 relating to the Housekeeping (Predator) manipulator arm.
- Important human actions and administrative controls claimed in the safety case
- Training and competence assurance
- Assessment of maintenance errors
- Manning and work organisation
- Learning from experience (including trials and commissioning activities)

44. The HF assessment has also considered the HF aspects of the 'outliers' operations, which are credible but unlikely off-normal operations and delay only faults. These operations were not considered from a regulatory perspective at Pre-Inactive Commissioning Safety Report (PICSR) and are considered to be a novel approach.

45. The HF inspector undertook a detailed sample of Fault Sequence Groups (FSGs) and the associated claims on the operator. These were focussed on important operator actions and were selected taking cognisance of the assessment completed by the previous ONR HF Inspector and in discussion with the ONR Fault Studies inspector. The FSGs sampled were:

- FSG A4.1 – Increased oxygen concentration in silo leading to silo fire
- FSG B4.1 - Impacts to silo leading to loss of containment and potentially silo fire
- FSG C4.1 – Increased operator dose in the MCR due to the Silo Containment Door being open

46. Based on the evidence sampled, the HF inspector concluded that:

- there is adequate evidence that the 'as built' design generally meets HF design standards and guidance and that where trade-off have been necessary, that these have been informed by consideration of HF principles.
- Sellafield Ltd. has taken a structured and systematic approach to the assessment and minimisation of maintenance error and considers that the work completed meets the Sellafield Ltd. HF arrangements for maintenance and went beyond Sellafield Ltd.'s arrangements at the time that the work was undertaken.
- The trials work completed on Unit B at Rosyth provided valuable evidence in support of the substantiation of operator claims, and the subsequent improvements made to task and equipment design and operator training and practice.

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- Overall, the information was well presented and, in the HF inspector's opinion, it provides a suitable and sufficient substantiation of the safety important tasks.

47. However, the assessment identified two recommendations which require resolution prior to commencement of active operations. The recommendations are described below, and captured in level 3 regulatory issue 8460:

- Recommendation 1 - Sellafield Ltd to provide evidence that work to integrate the links from the instructions to the outlier flowcharts, and the provision of training to the operations team on the transition between normal and off-normal, is complete prior to 'Early Retrievals' operations commencing.
- Recommendation 2 - The Pre-operations Team should provide evidence of an adequate plan with timeline to demonstrate how the competence of new and returning staff will be ensured along with their integration into the existing PFCS operations team. This plan should align with and cross-refer to the Training Implementation Plan to demonstrate alignment prior to 'Early Retrievals' operations commencing.

48. The HF inspector was content for ONR to issue the licence instrument for active commissioning of the Early Retrievals plant, subject to Sellafield Ltd satisfactorily addressing the recommendations captured in regulatory issue 8460.

49. To address the recommendations captured in RI 8460, the HF inspector and I had follow-up engagements with Sellafield Ltd [34], with final closure of the RI based on discussions with the Retrievals Team Operators during the readiness inspection [35].

50. The HF assessment was undertaken based on the request received from Sellafield Ltd. in October 2020 [28]. The HF inspector has confirmed that the revised request received from Sellafield Ltd. which implements the revised commissioning strategy for PFCS [1] has no impact on the assessment undertaken or the conclusions from it [36].

51. The HF inspector judged that Sellafield Ltd. had provided an adequate safety case and that risks had been controlled ALARP. To conclude, shortfalls captured in RI 8460 have now been satisfactorily addressed by Sellafield Ltd. and the HF inspector supports the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

4.1.3 Nuclear liabilities regulation

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52. The Nuclear Liabilities Regulation (NLR) assessment [37] has focussed on characterisation of the waste during the waste retrievals for safe future management, and how that information is recorded to ensure that options are not foreclosed. It also considers generation and management of secondary waste from the retrievals process, and the interface with proposed storage facilities.

53. Based on the evidence sampled, the NLR inspector concluded that:

- a credible silo inventory had been established, which will be kept up to date through a learning plan.
- Management options are in place for items not possible to manage by crane and grab alone.
- Whilst the approach to characterisation was suitable, the arrangements for basic characterisation by operators had not yet been finalised and further clarity was required on how the arrangements for detailed characterisation by the offline technical team will be implemented.
- PFCS has suitable buffer storage capacity outside the facility for filled waste containers waiting to be transferred to storage.
- Sellafield Ltd. had identified the causes of potential non-conformance with the Conditions for Acceptance for BEPPS-DIF and put in place arrangements to manage the non-conformances when they occur. However, these criteria and arrangements only apply to BEPPS-DIF, and not to the alternative contingency route EPS3 via MEP.
- The content of the characterisation forms produced by Sellafield Ltd meet ONR expectations associated with the contents of a radioactive waste record, however the video footage upon which the characterisation is based is automatically overwritten after 30 days. To meet the expectations of SAP RW. 7, Sellafield Ltd. need to develop adequate arrangements in relation to identifying and retaining retrievals video footage which could be of future value.

54. To address the shortfalls identified as part of the assessment, the NLR inspector raised fourteen recommendations which are captured in level 4 regulatory issues 8628, 8629, 8630 and 8631 and summarised in table 1. The recommendations captured in 8629 and 8630 require closure prior to transition into phase 6. Regulatory issue 8631 requires closure on longer term timescales. The NLR inspector judged that the three recommendations captured in regulatory issue 8628, have an impact on the future safe management of radioactive waste and require closure prior to the start of active commissioning (Phase 3a). These three recommendations are**:**

- Recommendation 2: Sellafield Ltd. to provide a copy of the finalised Operating Instruction (for waste retrieval operators) and to ensure that it includes the question set for waste characterisation and guidance on identifying and bookmarking an item of issue or interest.

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- Recommendation 13: Sellafield Ltd. should justify how long video footage of waste retrieval operations is retained, independent of the constraints of the silo CCTV system
- Recommendation 14: Sellafield Ltd. should produce adequate arrangements for identifying and retaining video footage of waste retrievals which could be of future value.

55. As part of the readiness inspection [35], Sellafield Ltd. provided evidence to enable closure of recommendation 2. In relation to recommendation 13 and 14, the NLR inspector has confirmed that Sellafield Ltd. has now produced adequate arrangements in relation to the identification and retention of video footage of the waste retrievals to enable closure of RI 8628 [38]. The remaining recommendations, captured in RI 8629, 8630 and 8631 will be addressed as part of on-going regulatory oversight and in line with ONR issues management process. The NLR assessment was undertaken based on the request received from Sellafield Ltd. in October 2020 [28]. The NLR inspector has confirmed that the revised request received from Sellafield Ltd. which implements the revised commissioning strategy for PFCS [4] has no impact on the assessment undertaken or the conclusions from it [39].

56. The NLR inspector judged that Sellafield Ltd. had provided an adequate safety case and that risks had been controlled ALARP. To conclude, shortfalls captured in RI 8628 have now been satisfactorily addressed by Sellafield Ltd. and the NLR inspector supports the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

4.2 ONR inspection activities

4.2.1 Emergency Arrangements

57. The commencement of active commissioning and subsequent waste retrievals introduces the potential for a waste fire occurring in the waste retrievals plant. Therefore, Sellafield Ltd has installed additional metal firefighting capability to provide further mitigation in the event of a waste fire occurring in the waste retrievals plant.

58. To gain assurance that the changes to the PFCS emergency response arrangements are aligned to the safety case, and can be effectively implemented on the facility, ONR undertook a Licence Condition 11 (LC11) emergency arrangements inspection [40].

59. This inspection focused on the local emergency response arrangements which will change once active commissioning and waste retrievals commence from PFCS compartment 5, noting that ONR undertakes a programme of compliance inspections of Sellafield Ltd.'s LC11 emergency arrangements. The inspection comprised of discussions with Sellafield Ltd. staff, examination

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of emergency instructions, inspection of facilities and equipment, observation of a desktop exercise and demonstration of Sellafield Fire and Rescue (SF&R) response on the facility.

60. From the evidence sampled during the inspection, no shortfalls were identified, and I judge that the licensee provided a sufficient demonstration to support the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

61. At the point of the inspection, ONR noted that Sellafield Ltd. had not completed the update to the Severe Accident Management Strategy (SAMS) to reflect the implementation of the 'Early Retrievals' safety case. ONR has now received the updated SAMS [41] and I have confirmed that this adequately reflects the change from quiescent storage to active waste retrieval operations.

4.2.2 Readiness Inspection

62. The purpose of the readiness inspection was to inspect Sellafield Ltd's implementation of the waste retrieval operations safety case. In particular, to gain confidence that the safety case is understood by the licensee and that the people, plant and processes will be in place prior to commencing active commissioning and subsequent waste retrievals [42]. The inspection scope covered the following areas:

- Inactive safety commissioning status, and outstanding issues to be resolved prior to commencement of active commissioning.
- Outstanding aspects of the Human Factors Issues and Assumptions Register (HFIAR).
- Outstanding aspects associated with regulatory issues 8460 and 7478.
- Training profiles and status.
- On plant discussions with a sample of key personnel to establish awareness of the safety case and talk through of key required Operating Instructions (rOIs) and Operating Assumptions (OA) including:
  - Plant Operations Control Centre (POCC) Operators
  - Retrievals Operators
  - Retrievals Team Leaders
- On plant and technical team discussions related to waste characterisation activities, records management and how associated learning from retrievals is captured and analysed (RI 8628 and 8629).
- Plant Visit to the control rooms and waste retrievals plant and equipment at the 14.8m level.

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63. During the inspection, inactive safety commissioning activities were sampled and no areas of concern in relation to the inactive commissioning completed to date were identified. However, at the time of the inspection there were some emerging issues associated with the lid bolting robot, which had delayed the completion of the inactive safety commissioning activities. Initially, the robot had experienced some alignment difficulties and the associated remedial work had resulted in some inadvertent robotic movements which resulted in mechanical clashes and minor damage. Since then, further checks of the physical integrity of the system have revealed that the fixings that hold the robot and plinth into the floor had come loose. This small movement in the robot during lid bolting and swabbing activities, although relatively small was sufficient to result in the misalignment issues experienced to date. Currently, Sellafield Ltd. anticipate that work to address the issues and complete inactive commissioning will be completed May 2022. Prior to transition to active commissioning phase 3b, Sellafield Ltd will need to demonstrate that lessons learnt from the events associated with the lid bolting and swabbing robot have been identified, and appropriate actions to address shortfalls in arrangements identified. This will be followed up as part of routine regulatory oversight.

64. As part of the revised safety case submission, Sellafield Ltd. has submitted the revised inactive safety commissioning report to enable transition into phase 3a [43]. Taking this into account, the original inactive commissioning considered as part of the fault studies assessment and evidence sampled as part of the readiness inspection, I have not identified any concerns which would prevent ONR granting agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

65. In relation to regulatory issue 7478, relating to the monitoring and control of oxygen levels within the silo, there are three actions. In relation to action 1 and 2, the HF inspector has considered the responses provided by Sellafield Ltd and was satisfied that the actions could be closed out [44] [45], however suggested areas to follow-up as part of the readiness inspection. Prior to the inspection, the HF inspector confirmed that the 'command and control' document clearly defined the required action levels. During the inspection, the operators talked through the hourly readings/checks that are completed, including the oxygen concentration levels. The HF inspector and I were satisfied that the operators understood the action levels and that the operating procedures supported the approach. The evidence sampled during the inspection has enabled RI 7478 action 3 to be closed. It is noted that the communications between the two control rooms will be tested during active commissioning and is an area ONR will follow-up as part of routine regulatory oversight.

66. To conclude, the readiness inspection closed out the key assessment findings and concluded that Sellafield Ltd were making reasonable steps in

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implementing the safety case in line with their implementation plan. No new regulatory concerns were identified which would prevent ONR granting agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

4.3 Availability of supporting infrastructure

67. To facilitate active commissioning and enable sustained waste retrievals from compartment 5 there are several other activities and facilities which I consider must be suitably mature. These include:

- Demonstrable supply of $3m^3$ waste containers manufactured to specification
- Adequate buffer storage arrangements for new $3m^3$ waste containers
- Arrangements for the safe and secure transport of filled waste containers (waste packages) to the interim storage facility
- Availability of storage facilities to safely store the waste packages produced

4.3.1 Supply $3m^3$ PFCS waste containers

68. Sellafield Ltd. is reliant on the supply chain to reliably supply waste containers to specification and to the specified timescales. To support waste retrievals from compartment 5, Sellafield Ltd require approximately 200 PFCS $3m^3$ waste containers.

69. Early engagement provided a level assurance that the supply chain has the capability to manufacture PFCS $3m^3$ waste containers to specification and to the specified timeline [46]. ONR continues to have engagement with Sellafield Ltd. in relation to supply of $3m^3$ waste containers and in particular the current transition to a single supplier. However, I have confirmed with Sellafield Ltd. that there are currently 65 PFCS $3m^3$ boxes available within the buffer storage facility to support the commencement of active commissioning [47] and I consider that there is adequate demonstration that the supply chain can manufacture PFCS $3m^3$ boxes to specification. I am therefore satisfied that the manufacture and supply of PFCS $3m^3$ boxes is at a level of maturity to support the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

4.3.2 Buffer storage of manufactured $3m^3$ waste containers

70. Sellafield Ltd. has established an off-site facility to buffer store PFCS and MSSS 3 m^3 boxes after manufacture, and to deliver empty boxes to site to support waste retrieval from MSSS and PFCS. ONR undertook an inspection in July 2019 [48] to gain confidence that the facility would be available to

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support MSSS and PFCS waste retrieval operations. This was followed up in December 2019 [49] and confirmed that the 3 m^3 box storage and distribution facility is complete and available to store, assemble and dispatch boxes. I am therefore satisfied that ONR does not require any further intervention prior to the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

4.3.3 Transport of waste packages

71. Waste packages are transported to the storage facility in Sellafield Package SP/2958. Transport of the waste packages across the Sellafield site is considered as part of the permissioning scope for import into the storage facilities, which is when the package is first exported off the PFCS facility. The safety case for transport has not been sampled as part of this permission but has previously been considered by the internal hazards inspector [50], in particular in relation to a fire. This concludes that Sellafield Ltd. has undertaken finite element modelling to demonstrate that the package meets the requirements for fire in the IAEA Transport Regulations and demonstrates that the most onerous temperature, stress and strain experienced by the package when exposed to the IAEA Transport Regulations fire test are sufficiently low to ensure that structural integrity of SP/2958 would be maintained. The internal hazards inspector is satisfied that the internal temperature of the waste container following exposure to the fire test would be insufficient to initiate a waste fire and judges that the SP/2958 package has been designed to meet the IAEA transport regulations, which is considered to be relevant good practice. The internal hazards assessment recommends that Sellafield Ltd. consider fitting engine fire suppression to prevent escalation of a fire starting in the transporter unit. This is captured in regulatory issue 8455 and will require resolution prior to phase 5 (first export from PFCS to the storage facility).

72. On the basis that the package is designed to meet IAEA transport regulations and the consequence of a fire on the transporter has been previously considered from an internal hazards perspective, I consider this an adequate position to support the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability.

73. I have confirmed that there are SP/2958 packages available on the site, therefore I do not expect availability to impact waste retrievals. Prior to transition into phase 4, I will confirm that commissioning activities have considered the interaction between the 3m^3 box and transport package and a trial inactive transfer to the storage facility has been completed.

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4.3.4 Availability of storage facilities

74. A storage facility is required to be in place prior to phase 5 commencing, i.e. when the first twelve waste packages are exported to stores. Sellafield Ltd. baseline assumption is that all the PFCS waste packages (approximately 2,200) will be stored in BEPPS via DIF, including the approximately 400 waste packages produced as part of waste retrievals from compartment 5. However, BEPPS-DIF will not be available until August 2022 at the earliest. To address a potential twelve month programme gap between when BEPPS-DIF would be available and PFCS would be in a position to export filled waste packages, Sellafield Ltd. took the decision in July 2020 to develop a contingency route for up to twelve PFCS waste packages. The intention would be to export the waste packages to EPS3 via MEP clean stillage route, enabling some initial learning in relation to the retrieval plant and equipment performance prior to BEPPS-DIF being available. To establish this contingency route requires Sellafield Ltd. to implement some engineering modifications and due to delays the route is unlikely to be available until June/July 2022.

75. As mentioned previously, the PFCS transition into active commissioning and waste retrieval operation has been delayed due to issues with the lid bolting and swabbing robot. The large programme gap between when PFCS will be ready to export and when BEPPS-DIF will be available to receive PFCS waste packages may not materialise. The final decision by Sellafield Ltd. on which storage facility the first twelve boxes will be consigned to will be driven by the relative timing of when each route becomes available and when PFCS is ready to commence export of waste packages. Noting that whilst the timescales to complete the initial phases of active commissioning (phase 3a, 3b and 4) are expected to take approximately four months, there is some uncertainty depending upon identification of any issues during active commissioning. Utilisation of both BEPPS-DIF and MEP-EPS3 for storage of PFCS waste packages will be subject to regulatory permission.

76. If the first phases of active commissioning are completed before the route to store is available, there is limited safety detriment. The silo door can be closed, and the safety case allows for two filled waste packages on the facility. In considering whether to issue the LI to enable Sellafield Ltd to commence active commissioning, there is a need to balance the uncertainties associated programme timescales and risks (availability of the waste storage facilities, active commissioning timescales, findings from the active commissioning phases which may delay movement to sustained operations) against the benefits of commencing active commissioning to gain learning in the performance of the retrievals plant and equipment and taking the first steps towards commencing waste retrievals and high hazard risk reduction. On balance, I consider it would be disproportionate to delay the issue of the LI until the storage facility is operational, given the benefits of commencing active commissioning to gain learning in the performance of the retrievals

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plant and equipment and taking the first steps towards commencing waste retrievals and high hazard risk reduction.

4.4 Consultation with respect to nuclear security, conventional health and safety, safeguards and environment

4.4.1 Civil Nuclear Security (CNS)

77. The ONR CNS inspector has confirmed that from a physical security perspective there is no objection to the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability [51].

78. The CNS inspector did identify a potential vulnerability in relation to cyber security [51]. Sellafield Ltd has not yet completed an adequate cyber justification report for early retrievals, in particular the robotics used for bolting and swabbing. The cyber security specialist inspector has confirmed that there is no objection to the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability [52], noting that there is limited impact for phase 3a. To address the shortfall, the following recommendation is made and captured in level 3 regulatory issue 10619.

Recommendation:
Prior to commencing phase 3b (active commissioning of the WCHA and waste interaction) Sellafield Ltd must demonstrate that an adequate cyber security justification report is in place

4.4.2 Conventional Health and Safety (CHS)

79. PFCS is suspected to contain asbestos although the nature and quantities are unknown due to the limited tipping records. Suspicious fibrous material was noted on CCTV footage during deflector plate clearance work in 2016 but, given the radiological conditions, it has not been possible to undertake any sampling.

80. Sellafield Ltd has developed an asbestos plan to set-out the approach to safe management of asbestos during the work to commence waste removal from compartment 5. Sellafield Ltd's compliance with Control of Asbestos Regulations 2012 (CAR) was discussed with the licensee in May 2019 [53] and ONR subsequently provided comments on the asbestos plan of work and confirmed that the work would meet the classification of Notifiable, Non-Licensed Work (NNLW) [54]. To support this permission, the ONR CHS inspector has had a follow-up engagement with Sellafield Ltd and has confirmed the adequacy of the arrangements in place [55].

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81. The ONR CHS inspector has confirmed that they have no objection to the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability [56].

4.4.3 Safeguards

82. In relation to nuclear material safeguards arrangements, Sellafield Ltd has confirmed the Basic Technical Characteristics (BTC) and Accountancy and Control Plan (ACP) will be updated prior to export of waste packages from PFCS to the storage facility (phase 5). In relation to the regulatory decision to release the hold-point associated with commencement of active commissioning to support waste retrievals from PFCS compartment 5, no additional regulatory activity was identified from a safeguards perspective [57].

4.4.4 Environment Agency

83. In line with the ONR Memorandum of Understanding with the Environment Agency the responsible Environment Agency Inspector has confirmed they have no objection to the issue of the LI giving ONR's agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability [58] [59].

5 CONCLUSIONS

84. This report presents the findings of ONR's assessment of Sellafield Ltd's proposal to implement a waste retrieval capability to enable active commissioning and waste retrievals operations from compartment 5 to commence.

85. The assessment and inspection activities have taken account of previous activities and considered the impact of any changes in plant, process or operating rules since previous assessment work including the extant regulatory issue 7478, relating to the changes in the oxygen operating rule.

86. During our sampling assessment shortfalls were identified and captured in regulatory issues. Those shortfalls requiring resolution prior to commencing active commissioning have now been adequately addressed. Table 1 provides a summary of those shortfalls which have been adequately addressed and those that require addressing during or post active commissioning.

87. During the assessment work shortfalls were identified, however these have subsequently been addressed.

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88. Inspections have also been undertaken to demonstrate the adequate implementation of the safety case. I have had no objections to Sellafield Ltd's proposal raised by the ONR Civil Nuclear Security Inspector, the ONR Conventional Health & Safety Inspector, ONR Nuclear Safeguards Inspector and the Environment Agency.

89. Commencement of waste retrieval operations is a change from the current quiescent state and will result in an increased risk profile. Taking into account the previous assessment activities carried out by ONR and the assessment and inspection activities undertaken to support this permission I judge that Sellafield Ltd has presented an adequate safety case that demonstrates the risks to be suitably controlled and subject to robust surveillance and monitoring. I consider that Sellafield Ltd will be able to manage this additional risk and has demonstrated that risks are reduced so far as is reasonably practicable. I also judge that the additional increase in risk is justified to facilitate PFCS waste retrievals given the significant longer term risk reduction benefit that this will bring.

90. In addition, Sellafield Ltd has developed a phased approach into waste retrieval operations which introduces a controlled, gradually increasing radiological challenge to the facility, and provides formal review of the plant performance and operating envelope prior to transition to each phase. Alongside Sellafield Ltd's own internal assurance activities, ONR will continue a programme of regulatory oversight during the initial phases of active commissioning and the transition into waste retrieval operations to gain assurance that the waste behaviour and that waste retrievals are in line with the design and safety intent.

6 RECOMMENDATIONS

91. I recommend that ONR issues Licence Instrument 536 granting Sellafield Ltd agreement to commence active commissioning of the Pile Fuel Cladding Silos (PFCS) 'Early Retrievals' plant and equipment and transition into 'Early Retrievals' operations - Implementation of a retrievals capability, in response to the request to ONR under their LC 22(1) arrangements.

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Table 1: Status of regulatory issues considered/raised during this assessment

Regulatory issue (RI)	Origin	Actions	Status/basis of closure
10619 (Level 3)	ONR-SDFW-PAR-20-018 (CM9 2021 /78456)	Prior to commencing phase 3b (active commissioning of the WCHA and waste interaction) Sellafield Ltd must demonstrate that an adequate cyber security justification report is in place	**New issue.** Requires closure prior to transition into phase 3b.
10620 (Level 4)	ONR-SDFW-PAR-20-018 (CM9 2021 /78456	After twelve boxes, Sellafield Ltd should review the behaviour of the oxygen levels to confirm that the revised oxygen rule and operational arrangements for implementing and managing the oxygen levels are appropriate	**New issue.** Requires closure once twelve boxes have been retrieved prior to transition into active operations
8631 (Level 4)	NLR assessment of early retrievals PACSR ONR-SDFW-AR-20-039 (CM9 2020/318045)	Recommendation 11: Sellafield Ltd to develop the method for reconciling conflicting waste container records.	**Action on-going**. Requires closure on longer timescales
8630 (Level 4)	NLR assessment of early retrievals PACSR ONR-SDFW-AR-20-039 (CM9 2020/318045)	Recommendation 6: Sellafield to define the criteria for success of the characterisation process whereby review is no longer required.	**Closed** The output (including adequacy of information) from the characterisation process will be considered through the Learning Steering Committee (LSC), which collects and analyses learning from waste retrievals against the requirements within the learning plans. The LSC will determine when learning is no longer required, this is

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Regulatory issue (RI)	Origin	Actions	Status/basis of closure
			captured in the LSC terms of reference (B**/TOR/042) are established. The NLR inspector is content that adequate arrangements are in place and this action can be closed.
8629 (Level 4)	NLR assessment of early retrievals PACSR ONR-SDFW-AR-20-039 (CM9 2020/318045)	Recommendation 3: Sellafield Ltd to demonstrate that the offline technical team training is suitable and sufficient.	**Action on-going.** Requires closure prior to commencing phase 4
		Recommendation 4: Sellafield Ltd to consider future proofing the waste characterisation by giving guidance on what descriptions of waste are suitable, and by defining the term discrete item.	**Action on-going.** Requires closure prior to commencing phase 4
		Recommendation 5: Sellafield Ltd to demonstrate how assurance of detailed characterisation is carried out in accordance with Sellafield Ltd's arrangements (SLP 1.02.42).	**Closed (refer to RI database for the full closure statement)** The assurance principles and requirements have been detailed in the assurance section of the Container Record Process (NFR/PFCSPROG/PROJ/ 00463/B). The NLR inspector is content that this action is satisfactorily addressed.
		Recommendation 6: Sellafield Ltd to make the link to the learning plan explicit in the detailed characterisation process	**Closed (refer to RI database for the full closure statement)** During the readiness inspection [2021/87230], the Technical Manager provided an update on the Learning

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Regulatory issue (RI)	Origin	Actions	Status/basis of closure
			plans being developed based on the technical baseline assumptions. The Learning Steering Committee (LSC) collects and analyses learning from waste retrievals against the requirements within the learning plans. The LSC Terms of Reference (B**/TOR/042) are established. The NLR inspector is content that the process of characterisation is sufficiently included in the Learning Plan and overseen by the LSC.
		Recommendation 7: Sellafield Ltd to demonstrate how the waste identification guide will be used and developed during Early Retrievals, including how it will be used by the operators.	**Closed (refer to RI database for the full closure statement)** The Waste Examples Operator Aid (B**/OPAID/82) shows pictures of expected waste types and is used by retrievals operators to complete the characterisation question set. Based on the discussions with the retrievals operators and technical manager during the readiness inspection, the NLR inspector was satisfied that the retrieval operators had access to and were familiar with the Waste Examples Operator Aid. A process is in place to update the images, as the retrievals progress. The NLR inspector was satisfied adequate arrangements are in place
		Recommendation 9: Sellafield Ltd should explain how the derived inventory, and safety assessments based upon it, are updated	**Closed (refer to RI database for the full closure statement)**

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Regulatory issue (RI)	Origin	Actions	Status/basis of closure
		based on the observed waste retrieved from PFCS.	The Learning Steering Committee (LSC) collects and analyses learning from waste retrievals against the requirements within the learning plans and technical baseline. This is a multi-disciplinary committee, which feeds into the existing operational and technical committees. A change control process is in place to manage changes to the baseline. The NLR inspector was satisfied adequate arrangements are in place.
		Recommendation 10 Sellafield should provide a copy of the finalised Outliers Plan, which should include appropriate reference to the learning plan.	**Closed (refer to RI database for the full closure statement)** Sellafield Ltd has provided a copy of the finalised Outliers Plan, associated flow diagrams and guidance note. The NLR inspector has confirmed they include the same scope as the draft versions considered during the assessment.
8628	NLR assessment of early retrievals PACSR ONR-SDFW-AR-20-039 (CM9 2020/318045)	Recommendation 2: Sellafield Ltd to provide a copy of the finalised Operating Instruction (for waste retrieval operators) and to ensure that it includes the question set for waste characterisation and guidance on identifying and bookmarking an item of issue or interest.	**Closed (refer to RI database for the full closure statement)** Sellafield Ltd has provided copies of the relevant operator instructions and during the readiness inspection the operators demonstrated an understanding of the instructions. The NLR inspector is content that arrangements for the retrievals operators to characterise waste are in place and have been adequately implemented.

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Regulatory issue (RI)	Origin	Actions	Status/basis of closure
		Recommendation 13: Sellafield Ltd should justify how long video footage of waste retrieval operations is retained, independent of the constraints of the silo CCTV system Recommendation 14: Sellafield Ltd should produce adequate arrangements for identifying and retaining video footage of waste retrievals which could be of future value.	**Recommendations 13 and 14 closed (refer to RI database for the full closure statement)** Sellafield Ltd has identified what information will be retained for the first 12 boxes, and an outline for what will be kept more generally. This is suitable given the lead an learn nature of active commissioning and early retrievals. A location for saving the data has been assigned separate to the CCTV system, which overwrites data withing 30 days. A system to find and view the saved video footage and photographic images is in place based on metadata. An initial retention period aligned with waste package records is suitable, accepting that the data will not form part of the Waste package Disposability Record. The NLR inspector is therefore content that Sellafield Ltd has appropriately set out how CCTV footage will be identified and retained.
8460	HF assessment of the early retrievals PACSR ONR-SDFW-AR-20-034 (CM9 2020/318342)	Recommendation 1 - Sellafield Ltd to provide evidence that work to integrate the links from the instructions to the outlier flowcharts, and the provision of training to the operations team on the transition between normal and off-normal, is complete prior to 'Early Retrievals' operations commencing.	**Closed (refer to RI database for the full closure statement)** Engagement with the Retrievals Training Lead and the PFCS Operations Manager (CM9 Ref 2021/60912), outlined the expectations on the retrievals operators in relation to off-normal events, noting that they are trained to stop retrievals if they identify anything unusual and seek advice from the Retrievals Team Leader (RTL) Discussions with retrievals operators as part of the readiness Inspection [2021/87230] provided confidence

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Regulatory issue (RI)	Origin	Actions	Status/basis of closure
			that they were able to explain when they would cease retrieving and what action that they would take (i.e. contact the RTL). The transition between normal and off-normal operations is very simple for the operators and any action decision is made by the DAP. The 'outliers' guidance document has been compiled to support the DAP in identifying the most appropriate solution to an off-normal scenario and its use was demonstrated during the PFCS LC11 Inspection desktop exercise (2021/60726). On the basis of the above evidence, action 1 of RI 8640 has been closed.
		Recommendation 2 - The Pre-operations Team should provide evidence of an adequate plan with timeline to demonstrate how the competence of new and returning staff will be ensured along with their integration into the existing PFCS operations team. This plan should align with and cross-refer to the Training Implementation Plan to demonstrate alignment prior to 'Early Retrievals' operations commencing.	**Closed (refer to RI database for the full closure statement)** During the engagement with the Retrievals Training Lead and the PFCS Operations Manager [CM9 2021/60912] the returning operations team members were discussed. This provided confidence in the plan and noted the assumption that the returning operator have zero competency, therefore will go through the full panel assessment. I also note the conservative throughput of the first 12 exports which lends itself to training and building competence. On the basis of the above evidence, action 2 of RI 8640 has been closed.
7478 (level 4)	Identified during HF consideratin of	Action 1 Sellafield Ltd to clarify what constitutes 'corrective action' once the 5% O2	**Closed (refer to RI database for the full closure statement)**

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Regulatory issue (RI)	Origin	Actions	Status/basis of closure
	oxygen rule change PMP (CM9 2019/247078).	concentration has been reached - due end March 2020 Action 2. SL to confirm command and control arrangements for these actions (e.g. who will be responsible for decision-making, when would a CDM panel be convened and which SMEs would be involved? How will SL confirm their availability during 24/7 retrievals?) - due end March 2020 Action 3. SL to confirm suitable procedures and training are in place to support this approach. Due end May 2020	In relation to action 1, 2and 3 the HF inspector has considered the responses provided by Sellafield Ltd and was satisfied that the actions could be closed out however suggested areas to follow-up as part of the readiness inspection [CM9 Ref. 2021/11644] Prior to the readiness inspection [CM9 Ref 2021/60912], the HF inspector confirmed that the 'command and control' document clearly defined the required action levels. During the inspection, the operators talked through the hourly readings/checks that are completed, including the oxygen concentration levels. We were satisfied that the operators understood the action levels and that the operating procedures supported the approach. On the basis of the above evidence, RI 7478 has been closed.