Magnox Swarf Storage Silo Retrievals Project

Agreement to commence retrievals of Miscellaneous Beta Gamma Waste from MSSS compartment 10

Project Assessment Report ONR-SDFW-PAR-21-016
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EXECUTIVE SUMMARY

Agreement to Implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10

Permission Requested

In accordance with its arrangements made under Licence Condition 22 (1), modification or experiment on existing plant, Sellafield Ltd, the licensee for Sellafield Site, has requested the Office for Nuclear Regulation's (ONR) Agreement to Implementation of PMP B*Stream/*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

Background

MSSS is a legacy waste storage facility and one of the highest nuclear hazards in the United Kingdom. The facility was constructed in four stages between 1964 and 1983 and has been in quiescent operation since the last bulk waste deposited in the 1990s.

The facility consists of twenty-two reinforced concrete silo compartments and contain approximately 10 000 m^3 of mixed solid intermediate level waste (ILW) arising from reprocessing of irradiated fuel from Magnox nuclear power stations. The waste is stored under water to prevent ignition of the magnox swarf. The cover water is radioactive and is classified as intermediate level waste (ILW).

In the 1970's the licensee identified that cover liquor from the original building (OB) compartments was leaking to ground. The leakage subsequently abated, but the Nuclear Installations Inspectorate (a forerunner of ONR) required the licensee to remove the bulk waste and so remove the leakage source term. Achieving this aim has proven to be highly complex and challenging.

ONR judges that the risk posed by MSSS is unacceptable (previously referred to as intolerable) and the facility is under significantly enhanced regulatory attention. The unacceptable risks come from shortfalls in the seismic withstand (1 in 1000 year event) of the OB and first extension leading to the possibility for loss of bulk liquor containment from an above-ground leak and spread of contamination.

Sellafield Ltd. has developed a programme of work for the phased retrieval of bulk waste from MSSS. The approach commences with retrieval of MBGW from first extension compartment 10 (C10), following successful completion of enabling and preparation work phases. ONR has permissioned key MSSS retrievals enabling activities leading up to commencement of waste retrieval. Retrieval of C10 MBGW and transport of ILW to safe interim storage on site is the subject of this project assessment report that presents ONR's assessment of Sellafield Ltd.'s proposal.

On completion of removal of C10 MBGW, Sellafield Ltd. plans to commence to further phases for the retrieval of the remaining bulk waste from all MSSS

compartments. This work, which is planned to be completed in 2045-50, will be followed by removal of residual waste, decontamination, demolition and transition to the final facility end state. ONR will consider requisite regulatory oversight and control of nuclear safety, security and safeguard- significant future activities in accordance with our guidance and Sellafield site regulatory strategy.

In November 2019, Sellafield Ltd. notified regulators that the MSSS original building leakage to ground had recommenced. The company subsequently instigated an extensive programme of work to ensure that the risks associated with the leakage will remain as low as reasonably practicable.

ONR investigated the leak, which concluded with issue of an enforcement letter which required Sellafield Ltd. to address ten actions within an ONR Level Two Regulatory Issue. Sellafield Ltd. has resourced a sub-programme to address these actions. Progress is being made against agreed timescales and a number of the actions have been closed at the time of writing this report. Based on the evidence gained from the continued engagements since being notified of the increased liquor loss rate, ONR is confident that Sellafield Ltd. will provide satisfactory responses to the outstanding actions within the planned timescales.

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

I have assessed Sellafield Ltd.'s request for ONR Agreement under the company's LC 22 compliance arrangements. I have followed ONR's permissioning guidance and permissioning strategy. I have obtained advice from inspectors in the following areas: criticality, Nuclear Liabilities Regulation, fault studies, chemical engineering, human factors, internal hazards, mechanical engineering, control and instrumentation, radiological protection, conventional health and safety, external hazards/civil and structural engineering.

ONR's specialist advice was focused on:

- Acute hydrogen hazard management to enable safe retrieval
- Adequacy of engineering and operational protective measures
- Silo liquor level management
- Radiological shielding and containment
- Nuclear lifting
- Original building leak to ground management
- Emergency response and capability

To inform this permissioning decision I have consulted with ONR Civil Nuclear Security - cyber security, ONR Safeguards and the Environment Agency. All parties have confirmed that they support ONR agreeing to Sellafield Ltd. commencing retrieval of MBGW from MSSS C10.

Matters arising from ONR's work

ONR's assessment identified a number of shortfalls in Sellafield Ltd.'s proposal to commence retrieval of MBGW from MSSS C10. During engagement, the shortfalls were raised as technical queries on the MSSS technical query tracker or at technical meetings recorded in contact records.

Inspectors captured outstanding safety significant shortfalls as assessment recommendations that were included as actions in regulatory issues. Where inspectors judged that Sellafield Ltd. needed to provide adequate responses to issues prior to commencement of HP41b, the inspectors' confirmation of responses acceptability are recorded in this report. Where inspectors judged that Sellafield Ltd. could address the issues after commencement of retrievals, the inspectors will continue to engage with the company as appropriate to achieve resolution. Sellafield Ltd. has provided satisfactory responses to all issues that needed to be addressed prior to ONR Agreement.

Conclusions

ONR has assessed the adequacy of Sellafield Ltd.'s submission justifying commencement of retrieval of MBGW from MSSS C10. Assessments focused on the hazards introduced by the submission, in particular acute hydrogen, silo liquor level management, nuclear lifting operations and radiological shielding.

Based on the safety case evidence ONR has sampled during this assessment process, it is my opinion that for the proposed modification Sellafield Ltd. has provided adequate arguments and evidence to demonstrate that:

- The company has done all that is reasonably practicable within the conduct of its undertaking, such that for the proposed activity it has reduced the risks to the public and workers so far as is reasonably practicable.
- Suitable and sufficient safety measures have been designed and implemented to provide adequate control of the hazards.
- The company has developed an adequate safety case and means of implementation under LC 22 such that there are no safety shortfalls that would prevent ONR agreeing to the request for Agreement under their relevant arrangements.
- The proposal has been subject to an adequate level of independent internal challenge and governance in accordance with the company's established arrangements.

Where ONR identified shortfalls, these have been captured in regulatory issues which state the actions Sellafield Ltd. needs to take to address our concerns. Sellafield Ltd. has provided satisfactory responses to issues ONR required to be addressed prior to granting the Licence Instrument (Agreement). ONR is satisfied that Sellafield Ltd. can address the remaining issues further to granting the Licence Instrument on a timeframe agreed with the respective ONR Specialist Inspector.

Based upon the sample assessments performed, the specialist inspectors judged that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. All the inspectors therefore recommend that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10 and support ONR issuing Agreement within Licence Instrument 540.

Recommendation

I recommend that ONR issues Licence Instrument 540, Agreement to Sellafield Ltd.'s request to implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

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LIST OF ABBREVIATIONS

ACoP	Approved Code of Practice
ALARP	As low as reasonably practicable
BNFL	British Nuclear Fuels Ltd.
BSL	Basic Safety level (in SAPs)
BSO	Basic Safety Objective (in SAPs)
CfA	Conditions for Acceptance
CNS	Civil Nuclear Security (ONR)
C10	Compartment 10
C&SE	Civil and Structural Engineering
EEC	East End Crane
EFT	Enriched Fissile Tippings
EMIT	Examination Maintenance Inspection and Testing
EPS/WTR	Encapsulation Product Store / Waste Transfer Route
FE	First Extension
EPM	Engineered Protective Measure
FELAR	First Extension Liquor Activity Reduction
HAZOP	Hazard and Operability study
HARR	Hazardous Activity Readiness Review
HHRR	High Hazard Risk Reduction
HOW2	(Office for Nuclear Regulation) Business Management System
HP41b	Hold Point 41b
INES	International Nuclear and Radiological Scale
ILW	Intermediate level radioactive waste
LAR	Liquor Activity Reduction
LBM	Liquor Balance Model
LC	Licence Condition
LIN	Liquid Nitrogen
LLM	Liquor Level Management
LOLER	Lifting Operations and Lifting Equipment Regulations 1998
MBGW	Miscellaneous Beta Gamma (Radioactive) Waste
MSSS	Magnox Swarf Storage Silo

mSv	milliSievert
NDA	Nuclear Decommissioning Authority
NGP	Nitrogen Generation Plant
NII	Nuclear Installations Inspectorate
NI&IO	Nuclear Intelligence and Independent Oversight
NLR	Nuclear Liabilities Regulation
NSC	Nuclear Safety Committee
OA	Operating Assumption
OB	Original Building
ONR	Office for Nuclear Regulation
OPM	Operational Protective Measure
OR	Operating Rule
OSM	Operational Safety Memorandum
MSSS	Magnox Swarf Storage Silo
NFSA	Nuclear Fire Safety Assessment
PAR	Project Assessment Report
PMP	Plant Modification Proposal
PSA	Probabilistic Safety Analysis
PSR	Preliminary Safety Report
RGP	Relevant Good Practice
RVS	Retrieval Vent System
rOI	required Operating Instruction
SAP	Safety Assessment Principle(s)
SEP	Silo Emptying Plant
SFAIRP	So far as is reasonably practicable
SMF	Silo Maintenance Facility
SQEP	Suitably Qualified and Experienced Person
SSC	Structure, System and Component
TAG	Technical Assessment Guide (ONR)
WEC	West End Crane

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1 PERMISSION REQUESTED

1. In accordance with its arrangements made under Licence Condition 22(1), modification or experiment on existing plant, Sellafield Ltd, the licensee for Sellafield Site, has requested [1] the Office for Nuclear Regulation's (ONR) Agreement, to implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

2. Sellafield Ltd. plans to commence retrieval of MBGW from MSSS silo compartment 10 (C10) and transport the waste for interim storage in the Encapsulation Product Store 3 via the Waste Transfer Route (EPS/WTR). The proposal encompasses phase 4 commissioning operations and subsequent transition into normal operations. The proposal is the latest stage of the programme to remove the bulk of the waste from the facility.

3. Sellafield Ltd. has submitted the C10 MBGW retrievals Plant Modification Proposal 0929 (PMP), safety summary report-phase 4 [2] and supporting safety case evidence that it considers provides sufficient evidence to justify commencing retrievals. Sellafield Ltd. categorised the PMP at category B (radiological safety); may have more than minor radiological safety significance. This project assessment report (PAR) presents ONR's assessment of Sellafield Ltd.'s proposal, justifying the recommendation to issue Agreement.

2 BACKGROUND

4. MSSS is a legacy waste storage facility and one of the highest nuclear hazards in the United Kingdom. The facility was constructed in four stages between 1964 and 1983 and has been in quiescent operation since the last bulk waste deposited in the 1990s.

5. MSSS consists of twenty-two reinforced concrete silo compartments and contain approximately 10 000 m^3 of mixed solid intermediate level waste (ILW), mostly arising from reprocessing of irradiated fuel from Magnox nuclear power stations. The ILW is stored under water to mitigate the risk of igniting the Magnox fuel magnesium alloy can swarf, which constitutes approximately 80% of the MSSS waste. The cover water is radioactive and is classified as intermediate level waste (ILW). The cover water needs to be topped up to counter, in the main, evaporative losses in the first, second and third extension compartments. Original building (OB) compartments' liquor levels also need to be topped up to replace leakage losses. Operators monitor and control silo liquor levels and monitor the liquor loss rates.

6. In the 1970's, excavation work for construction of the first extension (FE) revealed high levels of activity around the OB civil structure base. The source of the activity was attributed to a leak of contaminated liquor, most likely from a wall to base construction joint. The leakage rate peaked at

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around 3m^3/day before reducing over the next decade to below the limit of detection (taken as 0.5m^3/month).

7. The Nuclear Installations Inspectorate (NII), the predecessor organisation to ONR, investigated the leak, culminating in the publication of a public report into the leak [3] .One of the requirements placed on the licensee, British Nuclear Fuels Limited (BNFL), the predecessor organisation to Sellafield Ltd., was to develop methods to retrieve and subsequently process the waste stored in the leaking silo. BNFL and later Sellafield Ltd. subsequently developed a programme to retrieve all the bulk waste stored in MSSS. The task of developing and implementing a programme to safely retrieve the bulk of MSSS waste has proven to be highly complex, taking over twenty years to get to the position where retrievals are due to commence in early 2022. Completion of bulk retrievals is currently planned to take until 2045-50.

8. ONR judges that the risk posed by MSSS is unacceptable (previously referred to as intolerable) [4] [5]and the facility is under significantly enhanced regulatory attention. The unacceptable risks come from shortfalls in the seismic withstand (10^{-3} return event) of the OB and FE, the construction of which do not meet modern standards, leading to the possibility for loss of bulk liquor containment from an above-ground leak and spread of contamination.

9. Key stakeholders, including ONR, support SL's retrievals programme to remove the unacceptable risk posed by MSSS. Implicit with stakeholders' support was the understanding that commencement of retrievals operations will increase the MSSS risk profile. This includes the possibility that retrievals may cause recommencement of leakage to ground. Notwithstanding the changes to risk profile, Sellafield Ltd. is legally obliged to continue to reduce risks so far as is reasonably practicable throughout MSSS waste retrievals.

2.1 RETRIEVALS

10. Sellafield Ltd. has developed a programme for the phased retrieval of the bulk waste from the MSSS silo compartments using three silo emptying plant caves (SEP). Retrievals will commence on C10 using SEP 2 cave and the two other caves and supporting systems will enter service in subsequent years, will full retrievals capacity planned to be achieved by 2026.

~~11.~~ The phased strategy progressively introduces, tests and commissions new capabilities as they are required. The approach also improves management and control of modifications, and incorporate learning from experience, where appropriate. The programme is an integral part of the Sellafield site high hazard risk reduction (HHRR) plan. Retrieval of bulk waste is currently planned to be completed in 2045-50.

12. In outline, SEP caves will mechanically retrieve waste (grabbing and raking) from compartments. The retrieved waste will be placed into a skip and

exported from the cave and MSSS in a shielded transport package for transfer by road to the on-site storage facility. At the storage facility the skip will be transferred into a storage container for interim storage pending availability of the final disposal route.

13. MSSS has been extensively modified [6] to facilitate retrievals, enhance civil structural integrity and reduce risks associated with loss of containment from hydrogen deflagration (chronic hydrogen hazard). To support retrievals a number of enabling facilities have been built and are at various stages of readiness. For example the silo maintenance facility (SMF) which is operational and is necessary to store and maintain SEP tooling and to maintain the SEP package. The new silo waste storage facilities are still undergoing construction and commissioning. These will not be available for start of retrievals, so Sellafield Ltd. has modified an existing waste route and storage facility, EPS/WTR, to accept unconditioned MSSS waste. ONR has permissioned into service SMF [7] and EPS/WTR, [8] which were pre-requisites to ONR's Agreement to release HP41b.

14. ONR has implemented a strategy for permissioning key activities associated with MSSS retrievals programme. This permissioning activity forms part of that strategy.

2.1.1 RETRIEVAL OF MBGW FROM COMPARTMENT 10 (HP41B)

15. The phased approach to MSSS waste retrieval, commences with retrieval MBGW from C10 [5]. C10 compartment is unique in that there is a distinct layer of MBGW approximately nine metres depth on the top of mixed MBGW/sludge, sludge waste. The company has judged this top layer can be safely retrieved using a C10-specific ventilation system rather than delaying until the full RVS is available.

16. Sellafield Ltd. identified [9] compartment 10 as favourable for commencing retrieval operations as the acute hydrogen hazard is restricted to waste disturbance activities only, that is, there is no significant enhanced residual risk following cessation of waste disturbance. Additionally, the chronic hydrogen generation rate from MBGW is low.

17. Sellafield Ltd.'s strategy is to commence retrieving MBGW from C10 in four phases:

    Phase 1 - modify the extract ventilation system in preparation for waste retrieval. Phase 1 activities did not attract ONR assessment and permissioning due to the low radiological safety significance.
    Phase 2 - to introduce reactive passive vents (RPV) on C10 and carry out retrievals vents system (RVS) commissioning activities (nitrogen inerting) with a) the silo roof plug installed and b) auxiliary shield plug (ASP) installed in the C10 chargehole. The SEP2 machine remained

sited over C4 and did not form part of this phase commissioning activities.
Phase 3 - SEP2 was moved onto compartment 10 and connect this via the ASP. This enabled further RVS commissioning, taking account of the SEP cave and compartment ullage.
Phase 4 - to commence active commissioning and waste retrieval activities of MBGW from C10 and transfer the waste to an external storage facility. On completion of phase 4 commissioning, MSSS retrievals will transition into routine normal operations.

18. Given the safety significance of the activities, complexity and novel nature, ONR permissioned implementation of phases 2 and 3. Permissioning phase 4, known as hold point (HP) 41b, is the subject of this PAR.

19. Waste retrieval from C10 will utilise SEP2 to undertake mechanical retrieval (grabbing and raking) of the top five-metre depth of MBGW from C10. Waste retrieval and in-compartment waste disturbance will take place under a nitrogen atmosphere to control the acute hydrogen hazard. The waste is placed into a skip within the SEP cave, when filled is exported in a shielded transport package for transfer by road to EPS/WTR for receipt and interim storage pending availability of a final disposal route.

20. Initial HP41b retrievals will form what is regarded by Sellafield Ltd. as stage E commissioning, where the remaining commissioning work to support MBGW retrievals from C10 will be completed. This includes undertaking waste grabbing and raking operations. Stage E anticipated to require approximately 25-30 skips to complete. On successful completion of stage E commissioning, Sellafield Ltd. plans to transition into normal operations where management transfers from projects to plant operations.

21. In practice the transition from stage E commissioning has little operational impact as operators, maintainers, supervisors, governance and oversight etcetera are consistent throughout. The transition will be controlled by appropriate internal governance and approval. Completion of HP41b MBGW campaign is anticipated to require between 200-300 skips, but could require up to 500 skips, depending on the achieved skip filling densities.

22. After retrieval of MBGW from C10, the Sellafield Ltd. phased approach will progress to retrieving bulk waste from original building (OB) and first extension (FE) compartments (C1-12) using SEP 1 and 2, and from the second and third extensions using SEP 3. All waste retrieval operations will be undertaken in oxygen-depleted atmospheres, which are achieved using nitrogen inerting of the silos' ullages and SEP cave interiors, to control the acute hydrogen hazard arising from waste disturbance.

23. Retrieval of bulk waste will require further plant modifications. This includes bringing into service the full retrievals ventilation system (RVS), FE and OB

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liquor level management (LLM) (including provision of liquor buffer capacity in the 3rd extension) and availability of storage in the Box Encapsulation Plant (BEP) currently under construction on site. The full RVS system includes a new nitrogen generation and storage plant (NGSP), which will provide greater defence in depth (and partial diverse supply) for nitrogen gas supplies needed for full retrievals. Implementation of the phased modifications will, where appropriate, be subject to ONR permissioning in accordance with our regulatory strategy for the Sellafield site.

2.1.2 HAZARDS INTRODUCED AT HP41B

24. The hazards introduced by retrieving MBGW from C10 and the mechanisms by which Sellafield Ltd. controls the risks SFARIP are outlined in the C10 MBGW retrievals safety summary report [2] and supporting documents. The key hazards and protective measures introduced at HP41b are:

- Acute hydrogen [10]: Disturbance of waste during retrievals is expected to result in releases of hydrogen and generation of a new acute hydrogen release hazard. The acute hydrogen hazard has the potential to lead to a faster release of hydrogen into the compartment atmosphere on short timescales than the chronic hydrogen hazard. Sellafield Ltd. claims that the risk of an acute release of hydrogen would cease when disturbances to the waste bed are halted.

- Sellafield Ltd. considers that the unmitigated radiological consequences arising from faults associated with the acute hydrogen hazards are in the range 20-1000 mSv and 1-100 µSv for workers and public respectively. The acute hydrogen hazard is controlled by engineered and operational protective measures that have mainly been introduced in previous commissioning phases. These [11] include:

  - A nitrogen (oxygen reduced) atmosphere will be maintained in the compartment and SEP2 ullage during retrievals to manage [12] the hydrogen hazard associated with waste disturbance. This will be provided by an interim system that uses the existing liquid nitrogen (LIN) tanks and delivery system to provide nitrogen ventilation to C10 only. This will be available in advance of the full nitrogen ventilation, which will be introduced at a subsequent commissioning phase.
  - Sellafield Ltd. considers that the acute hydrogen hazard will only occur when waste is disturbed. On cessation of retrievals this acute hazard also ceases, and the compartment and cave can transition to an air atmosphere if required.
  - Control of the chronic hydrogen hazard [13].

- Liquor level management [11]: The SEP caves will be washed down periodically to control surface contamination and build-up of waste on

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operational components. There are also occasional water additions to maintain the ASP water seal and to maintain cover water within the operating limits. The wash water drains into C10 increasing the level of cover water in the compartment. Compartments' liquor levels are controlled by batch transfer of liquor for treatment elsewhere on site. The treated wate is then discharged to sea, provided that the water complies with environmental discharge limits. Sellafield Ltd. considers that unmitigated radiological consequences arising from faults associated with LLM are in the range 20-1000 mSv and 1-10 mSv for workers and public respectively.

- Compartment liquor levels are controlled by existing operational and engineered protective measures. These are supplemented by new operational safety measures introduced at HP41b. Sellafield Ltd. has identified an engineering protective measure and justified implementation as soon as possible after commencement of retrievals.

- Radiological shielding and containment [14]. There are new requirements for shielding of retrieved waste by SEP2 and the waste package. The skip provides primary containment for liquid and solid waste, with secondary containment and shielding provided by the SEP2 cave and the waste package.

  - Sellafield Ltd. will introduce engineered and operational protective measures to ensure radiological shielding and containment are maintained in accordance with safety case requirements. This includes introducing a new operating rule (OR), OR19, [15]. The company identified that the worker consequence threshold for dose update of 500mSv was met by the fault condition concerned with waste transfer. The fault involves opening of the gamma gate without the package present with a skip (with an atypical waste content) in the transfer tunnel. There are engineered protective measures to terminate or mitigate this fault.

- Nuclear lifting operations [12]: MSSS packages will be imported and exported using one of two electric overhead travelling cranes (EOTC). The two high-integrity cranes are designated as the West End Crane (WEC) and the East End Crane (EEC). The packages are used to move either waste or retrieval equipment, such as grabs, rakes and maintenance equipment. Uncontrolled lowering or dropped nuclear lifts could result in loss of package containment and/or damage to structures or components that fulfil a nuclear safety function. The latter risks have been considered at earlier commissioning phases, including installation and inactive commissioning of SEP1 and 2, which ONR permissioned. Sellafield Ltd. identified faults associated with

uncontrolled lowering or dropping of the package leading to loss of waste containment could result in unmitigated radiological consequences in the range 20-1000 mSv and <0.001mSv for workers and public respectively. The radiological consequences arise from loss of containment from either the SEP package (uncontrolled lowering incident in the central hoistwell) or from impact of lift loads on vulnerable systems and structures, specifically the first extension liquor activity reduction (FELAR) pipework and the Mark V cooler.

- The main hoist load path, the crane support structure and the physical end-stops and buffers are considered to be deterministic safety features, failure of which Sellafield Ltd. consider is incredible, but which in theory could initiate a dropped load/uncontrolled lower if they did fail.
- In outline, Sellafield Ltd. is controlling the risks associated by MSSS nuclear lifting operations during HP41b by appropriately designated and substantiated structures and components which will be operated and maintained by suitably qualified and experienced persons (SQEP). There are existing operational protective measures to prevent or mitigate fault progression.
- The EEC meets modern standards and is considered to generally comply with relevant good practice (RGP). The WEC does not meet RGP per-se, but Sellafield Ltd. considers that its use is adequately justified, and for transit package lifting operation performs in an equivalent safe manner to the EEC.
- Two additional safety measures, designated as safety features (SF), have been identified to control the risk. These are the SEP ILW transit package (SP/0255) and SEP 2. In both cases the feature is to provide shielding.

25. Sellafield Ltd. judges that the other hazards introduced at HP41b (nuclear fire, external hazards, cross-site transfer) present lower radiological consequences should the associated faults be realised.

26. Sellafield Ltd.'s radiological safety assessments informing start of retrievals focus on the immediate radiological consequences. The company understands that recovery from a significant radiological fault would be expected to greatly impact on MSSS retrievals operations over an extended period.

2.1.3 EMERGENT ISSUES

27. In February 2022, Sellafield Ltd. notified ONR that it had identified shortfalls with low-temperature operations [16] and acute hydrogen hazards associated with lowering of C10 liquor level [17]. ONR's position on these emergent issues is discussed later in the report in Section 3.

Low temperature operations.

28. Sellafield Ltd. identified that the HP41b submission did not identify direct procedural control via formal Limits and Conditions in the interest of safety that operation of the SEP mobile cave or SEP package does not occur at temperatures lower than the design basis for the operation of equipment.

29. The performance of operations using the SEP mobile cave and/or SEP package at a temperature below the operational design basis has the potential for the following effects.

30. Structural dynamic loading of the SEP equipment at temperatures outside of the substantiated temperature range (inclusive of park stands for the SEP package, SEP package lifting beam, auxiliary seal plug and chargehole plug).

    - There is an existing limit and condition prohibiting use of the building cranes below 0°C, implementation of which prevents the hazard. The extant engineered (MSSS steelwork temperature monitoring system) and operational (rOI- WEC and EEC movements must not be undertaken when the crane support steelwork temperatures are below minus 2°C) protective measures.
    - Sellafield Ltd. has made two additional substantiated claims on the extant steelwork temperature monitoring system and one new operational protective measure (rOI) to protect against these dynamic risks associated with low temperature operation.

31. Inability for water-based systems to correctly function if the water in these systems has frozen (e.g., overcome the thermal inertia of the system).

    - Sellafield Ltd. has made two additional substantiated claims on the extant steelwork temperature monitoring system and one new operational protective measure (OA) to protect against the water-based system risks associated with low temperature operation.

32. Operation of CE&I equipment outside of the manufacturer's specified temperature range.

    - No further limits and conditions required.

Acute hydrogen hazards associated with lowering of C10 liquor level:

33. Sellafield Ltd.'s fault sequence analysis identified excessive lowering of the C 10 liquor level could lead to exposure of air ingress routes (hydraulic links) to the compartment ullage, thus undermining the inert C10 environment. Commissioning testing confirmed that the fault could be realised in that the bottom of the C12 liquor dip leg was lower than the upper hydraulic links.

34. Liquor level management is controlled by existing engineered and operational protective measures. Sellafield Ltd. will implement two operational protective measures, both rOIs.

- The first rOI identifies operational controls to ensure that a specific valve de-energised, the electrical distribution panel locked, and the keys required to unlock the panel are placed under management control during periods of C10 waste bed disturbance. This will prevent silo liquor removal via the C12 dip leg.
- The second rOI is already designated and ensures waste bed disturbance operations stop should a high oxygen alarm occur within the SEP 2 operator bulge.
- Sellafield Ltd. has identified an engineering modification to C12 pump suction dip leg that will eliminate the risk. The company has justified the implementation of the modification at the next appropriate opportunity.

MSSS nuclear fire protection

35. PMP 0696 required phase one of MSSS nuclear fire protection improvement modification to be completed before implementation. In March 2022, Sellafield Ltd. informed ONR [18] that phase one would not be completed prior to commencement of retrievals. The omission was due to installation of some of the passive fire protection in the central hoistwell being more difficult than envisaged. The company judged that the risks arising from the omission and completing phase 1 modifications after implementation of the proposal remained ALARP. Phase 1 work is now planned to be completed soon after commencement of retrievals operations. ONR's position on the emergent issues is discussed in Section 3.

2.1.4 ALARP JUSTIFICATION FOR HP41B

36. Sellafield Ltd.'s overarching claim is that the MSSS programme and stream strategy is compliant with Best Available Techniques (BAT) and reduces the risks ALARP [19]. The strategy is to commence a sustainable retrievals campaign as soon as it is safe to do so. The company identified that safely retrieving MBGW from C10 at the earliest opportunity aligned with the MSSS and hence the site HHRR strategy.

37. The company considered delaying C10 MBGW retrieval until the nitrogen generation and storage plant (NGSP) was available but concluded that commencing using the existing liquid nitrogen (LIN) system was safe and justifiable. The NGSP was to become operational as part of bringing the fill RVS into service. By implementing the phased approach, the plan is now to separately bring the NGSP into service earlier towards the end of 2022 i.e., soon after start of C10 MBGW retrievals.

38. The company judges that the on and off-site radiological risks arising from MSSS retrievals are dominated by chronic hydrogen and LLM hazards. The additional risks introduced by commencing C10 MBGW retrievals remain bounded by chronic hydrogen and LLM, control of which were implemented at earlier phases. Therefore, HP41b does not result in a further significantly increased radiological risk from MSSS.

39. Sellafield Ltd. considers that the other risks introduced by HP41b, such as asphyxiation (use of nitrogen gas), Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) and cyber security are understood and have been reduced ALARP. Overall, the company considers that it is safe to start C10 MBGW retrievals, including utilising the LIN before transitioning to NGSP after retrievals have started.

2.1.5 INTERNAL AND INDEPENDENT OVERSIGHT

40. PMP 0929, supporting safety case and associated documentation, commissioning activities etc. have been subject to Sellafield Ltd.'s governance, oversight, challenge, and approval. The internal and internal independent bodies involved include:

- MSSS Management Safety Committee (MSC). The committee approves the key safety case documents, the safety commissioning report and confirms and approves the PMP category.
- Commissioning safety committee: The committee agrees the commissioning schedule, ensuring that the safety case requirements are confirmed by the commissioning tests and considers the safety commissioning report prior to approval at MSC.
- Independent Nuclear Safety Assessment (INSA). INSA undertakes independent assessment of key safety case documents.
- Sellafield Ltd. Nuclear safety Committee (SLNSC): Sellafield Ltd. has presented the PMP for consideration and advice [1], as it has done for other MSSS retrievals significant safety proposals.

41. At the 169th meeting of the SLNSC [20], the committee provided formal advice to the MSSS retrieval programme. The SLNSC was broadly satisfied with the quality and comprehensiveness of the paper. Therefore, subject to satisfactory completion of the hazardous activity readiness review (HARR) (including review of outcome by Chief Operations Officer, Chief Nuclear Officer and SLNSC Chair), and close out of requirements identified within the paper, that the project can move forward against the endorsement for active commissioning.

2.2 IMPACT OF MSSS RETRIEVALS ON MSSS LEAKAGE

42. Recommencement of the MSSS OB leak was an anticipated risk from waste retrieval programme works. As part of the preparations for retrievals Sellafield Ltd. developed the MSSS leak to ground risk management plan [21]. The plan and supporting assessments provided the company with an understanding on the likelihood and nature of the threat posed to people and the environment in the event of further significant leakage to ground. This included characterising anticipated leakage behaviour. The plan also identified appropriate measures for detection of the leak and control of its impact.

43. In November 2019, Sellafield Ltd. notified regulators [22] that the MSSS OB liquor balance model (LBM) results for the preceding three months had exceeded the trigger level of (loss of more than 5m^3 /month) for investigation. The LBM from July 2019 to April 2020 gave the OB liquor loss rates of around 1.6-1.8 m^3/day. In April 2020 the company reported an increase in liquor loss rate to around 2.2m^3/day; the rate increasing slowly to around 2.5m^3/day by December 2020. The leakage rate has been relatively constant at around 2.3-2.5m^3/day since February 2021.

44. The LBM is used by Sellafield Ltd. to monitor cover liquor losses from MSSS silos and takes account of variation in seasonal temperature, atmospheric conditions on changes in liquor levels from evaporative losses and bulk waste volume. The model also takes account of deliberate water additions to maintain liquor level within safety case limits and conditions and from SEP 2 washing. The LBM is a lagging indicator as the model requires details on atmospheric conditions (temperature and barometric pressure), and liquor additions (water top ups), some of which are available weeks later. Sellafield Ltd. has since implemented additional monitoring protocols which provide rapid identification of changes in leakage rate.

45. The company's investigation concluded that the increased loss was due to a leak of radioactive liquor to ground. The leakage was assessed against the International Nuclear and Radiological Scale (INES) as a category two (incident) event.

46. Sellafield Ltd. has instigated an extensive programme of work, principally to provide responses to regulatory concerns and provide evidence to support the claim that risks arising from the MSSS leakage remain ALARP and utilise [2] BAT.

47. Sellafield Ltd. considers that to date the MSSS leakage to ground behaviour is well within the envelope identified in the leak management plan. The company judges that the risks arising from the in-ground leakage to workers and people off site are orders of magnitude lower than the risks posed by

above-ground loss of bulk containment. Overall, Sellafield Ltd. is confident that the risks from the MSSS facility remain demonstrably ALARP.

48. In December 2021, Sellafield Ltd. notified regulators that it had identified a damp patch on the MSSS OB wall. Sellafield Ltd. adopted a conservative approach, assuming that the patch was the result of an above ground leakage. The company has investigated the patch, including inspections and sampling, to determine the origin and possible safety and environmental consequences. The work to date indicates that it is unlikely that the damp patch is the result of silo liquor leakage. The ONR Sellafield Compliance, Inspection and Enforcement legacy silos inspector is leading ONR's engagement on this matter.

49. Sellafield Ltd. considered possible effects of commencing retrievals operations on OB leakage [23]. The review provided confidence from the safety and environmental perspective that the commencement of C10 MBGW retrievals will not preclude any viable option for stopping or mitigating the leak which has restarted from the OB. Further the re-commencement of the OB Leak adds to the imperative of beginning and sustaining retrievals of waste from MSSS on the earliest practicable timescale as the route to progressive high hazard risk reduction in MSSS.

50. Sellafield Ltd. concluded that, given the structural and hydraulic separation between the OB and FE, there is a high level of confidence that the commencement of MBGW Retrievals on C10 will neither preclude action to mitigate or stop the OB leak, nor will it cause a significant increase in OB leak rate.

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

51. Reference [24] presents ONR's strategy for regulating Sellafield site, a key outcome of which is accelerated hazard and risk reduction across the site. Successful implementation of the strategy will help secure this key outcome, including for the risk posed by MSSS. For MSSS, risk reduction centres on timely safe retrieval of bulk waste, starting with MBGW from C10.

52. I judged that it was proportionate to obtain specialist inspector advice from the following specialisms:

- Criticality
- Nuclear Liabilities Regulation
- Fault Studies
- Chemical / Process Engineering
- Human Factors
- Internal Hazards
- Mechanical Engineering
- Control and Instrumentation

- Radiological Protection
- Conventional Health and Safety.
- External Hazards/Civil and Structural Engineering

53. I chose not to obtain electrical engineering advice on SEP 2 cave electrical power supply because installation of the permanent electrical supply to the cave had been completed prior to engagement. Initially, I had been seeking a view on the adequacy of the temporary system.

54. In conjunction with the specialist inspectors, I have produced the permissioning strategy [25] for Sellafield Ltd.'s proposal to commence retrieval of MBGW from C10 and transport the waste for interim storage in EPS3. The strategy identifies the key areas of focus. The strategy has been approved by the Sellafield projects sub-division delivery lead.

3.1 ONR ASSESSMENT

55. I have assessed Sellafield Ltd.'s request for ONR Agreement under its arrangements for LC 22. I have followed ONR's permissioning guidance [26] and permissioning strategy. I have utilised specialist ONR inspectors to assess the adequacy of Sellafield Ltd.'s proposal and deliver the permissioning strategy. I am also cognisant of the findings of the company's governance, the work undertaken by their Nuclear Intelligence and Independent Oversight (NI&IO) function, and the consideration and advice provided by the Sellafield site NSC.

56. Inspectors have assessed Sellafield Ltd.'s proposal, safety case summary report, and relevant supporting references. Inspectors met with Sellafield Ltd. to obtain further evidence and discuss technical issues to inform their assessments. Where necessary, inspectors have liaised with colleagues from within their specialism and with other specialisms to form their judgements.

57. Where inspectors identified shortfalls against regulatory expectations or made recommendations, these have been incorporated as actions in ONR regulatory issues. Where the inspectors judged that Sellafield Ltd. needed to address the issues prior to commencement of retrievals, I have recorded inspectors' satisfaction with the company's responses within this report.

58. Where inspectors, considered that the nature and magnitude of the shortfalls and recommendations were such that they do not foreclose commencing MBGW retrieval from C10 they were content for these be addressed by Sellafield Ltd. after Licence Instrument 540 has been issued. Inspectors will manage regulatory issues in accordance with ONR guidance [27].

59. Inspectors have utilised ONR guidance, mainly the Safety Assessment Principles [28] and relevant Technical Assessment Guides, in forming their judgements on the adequacy of Sellafield Ltd.'s proposal. Where necessary,

the inspectors have also referred to appropriate national/international standards and other relevant good practice.

60. The documentation supporting ONR permissioning are filed at CM9 4.4.2.25541. This includes Sellafield Ltd.'s request letter, PMP, safety case summary report and key supporting reports, contact records, intervention records (also filed at 4.5.10373.), and correspondence between ONR and Sellafield Ltd.

61. LC 11, emergency arrangements, requires the licensee to make and implement adequate arrangements for dealing with any accident or emergency arising on the site and their effects. In February 2022, ONR observed Sellafield Ltd.'s demonstration of the emergency response to a radiological event on MSSS. The scenario was based on a fault sequence introduced at HP41b of an uncontrolled/dropped SEP package in the central hoistwell that resulted in a loss of liquor containment.

62. In addition to the above and to support the permissioning decision, I judged that it was proportionate for ONR to undertake a readiness inspection. The purpose of this was to give ONR confidence that the physical installation and operating instructions were complete and reflected the requirements of the safety case. The inspection also sought evidence that sufficient people are suitably qualified and experienced, including completion of all relevant training, to operate and maintain structures systems and components important to nuclear safety that are introduced by this proposal.

63. To inform the permissioning decision, the ONR Sellafield projects sub-division delivery lead judged it proportionate to undertake a pre-commencement inspection. The purpose of the inspection was to gain assurance that Sellafield Ltd. was ready to implement PMP 0929 safely, securely and in compliance with the law.

3.2 CRITICALITY

64. The fissile material stored in MSSS (excluding C22) consists of natural or very low enriched uranium (and small amounts of plutonium) carryover on swarf, generated through the process of de-cladding of Magnox spent fuel. MSSS MBGW includes a range of operational (e.g., sources, contaminated items of equipment) and post irradiation examination nuclear fuel solid waste, which at the time of disposal into MSSS were too radioactive for disposal at the Low-Level Waste Repository. MBGW of most significance to criticality safety are classed by Sellafield Ltd. as Enriched Fissile Tippings (EFT), which are enriched uranium items from various prototype and experimental nuclear reactor fuels.

65. The ONR criticality specialist inspector's assessment [29] encompassed retrieval of MBGW waste from C10 into SEP packages, transport across site and interim storage on site in the identified facilities (EPS3 or BEPPS). The

inspector's lines of enquiry focused on MSSS waste inventory (including fissile material); criticality safety criterion; normal/fault conditions; fault identification; safety measures; operating rules (limits and conditions); criticality warning system.

66. The inspector assessed the adequacy of Sellafield Ltd.'s consideration of the lines of enquiry to form their judgement on the adequacy of the criticality-related aspects of the MSSS HP41b submission.

67. Overall, the inspector judges that:

- Sellafield Ltd. has used and reviewed a wide range of data sources to determine the MSSS inventory used as the basis for the criticality safety case, in particular the fissile inventory and EFT stored in MSSS. Sellafield Ltd. identified uncertainties in the available information but has mitigated against these by conservative and bounding material modelling assumptions within the criticality calculations. At the request of ONR, Sellafield Ltd. has agreed to attempt to identify waste as it is retrieved from the MSSS (e.g., operator observation and camera images) and to add this information to the waste records. This includes observation of potential EFT containers is recorded.
- An appropriate criticality safety criterion has been used within Sellafield Ltd.'s criticality calculations.
- Sellafield Ltd. has demonstrated criticality safety for all proposed normal operations. Sellafield Ltd. considers that the only credible route to a criticality would be via either many unrecorded fissile tips having been made to the MSSS, or for a smaller number of large mass fissile tips to have been made and to be unrecorded.
- Sellafield Ltd. has undertaken an adequate fault identification process to identify those faults with a potential to lead to the occurrence of criticality, and criticality safety has been demonstrated for each of these faults.
- For both normal and fault conditions, a large margin of criticality safety has been demonstrated, for conservative models of the fissile materials to be retrieved from MSSS. It has not been necessary for Sellafield Ltd. to identify safety measures to protect against criticality.
- A Criticality Warning System is not necessary, although at the request of ONR and in the interest of reducing risks as low as reasonably practicable (ALARP), Sellafield Ltd. has undertaken work considering how the MSSS would respond in the unlikely event of a criticality. This has included an analysis of the installed gamma detectors and alarm response.

68. Based upon the sample assessment performed, the inspector judged from a criticality perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The

inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

3.3 NUCLEAR LIABILITIES REGULATION.

69. The nuclear liabilities regulation (NLR) specialist inspector's assessment [30] focused on focused on the characterisation of the silo waste during retrievals and the records generated to support future management decisions and ensure that future options for management of the waste are not foreclosed. The assessment has also considered the generation and management of secondary waste arisings during the retrievals process, the interfaces between MSSS and the proposed storage facilities, and the waste disposability in terms of the options being considered for future waste conditioning, and how Sellafield Ltd will assure itself that options for future waste management are not foreclosed by the retrievals programme.

70. Characterisation of waste during retrievals will be by means of observations made by SQEP operators in the SEP machine. Based on the evidence sampled, the inspector considered that the characterisation information to be recorded by Sellafield Ltd during retrievals is sufficient to demonstrate that the Condition for Acceptance (CfA) for the receiving facilities will be met. This enables decisions to be made regarding the subsequent safe management of the waste in the storage facilities, consistent with ONR's expectations on the characterisation and segregation of radioactive waste.

71. The inspector was content that Sellafield Ltd. has a process in place to generate waste characterisation records during retrievals and that this process is embedded in the operating instructions (OI) for skip filling and skip import/export. However, these documents have not been finalised, so the inspector recommended that they are implemented prior to the start of retrievals.

72. The inspector considered that Sellafield Ltd. has appropriate arrangements to enable quality assurance checks to be conducted on the waste packages to confirm that the CfA have been met, and arrangements to identify, categorise and address non-conforming waste packages. The inspector recommended that the finalised OI for the consignment of waste packages and records to the receiving facilities is provided to ONR prior to the commencement of retrievals.

73. Based on the evidence sampled on disposability, the inspector was satisfied that Sellafield Ltd.'s strategy to store the waste in an unconditioned state does not foreclose future options for waste processing and disposal. The inspector judged that the company's plan to further characterise the waste to support conditioning in a future finishing plant was acceptable in the light of the

current priority to retrieve the waste from MSSS as soon as reasonably practicable to support high hazard and risk reduction.

74. The inspector considered that Sellafield Ltd. has an adequate understanding of the amount and type of solid secondary wastes anticipated to be generated during retrievals and that these wastes can be managed safely by means of their existing arrangements for radioactive waste management. The inspector judged the company's approach is reasonable for to minimising secondary waste arisings by utilising the SMF, where possible, to maintain equipment and prevent it requiring disposal met with regulatory expectations for minimising the generation of radioactive waste.

75. The inspector's two recommendations were captured in a Level 4 regulatory issue relating to the production of detailed arrangements and operating instructions. This requires Sellafield Ltd.to address prior to the commencement of retrievals from C10. The closure statement is provided in Section 4 of this report.

76. Based upon the sample assessment performed, the inspector judged from a NLR perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The basis of this decision is subject to resolution of the recommendations identified which require Sellafield Ltd. to address prior to first retrievals of MBGW from C10. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

3.4 FAULT STUDIES

77. The fault studies specialist inspector's assessment [31] of Sellafield Ltd.'s proposal to commence retrieval of MBGW from MSSS C10 focussed on the hazards presented by the production of acute hydrogen during retrieval operations, and on the potential faults arising from the retrieval operations. This encompassed the following topics:

- Liquor level management
- Acute hydrogen management
- Grabbing and raking operations-waste retrieval / normal operations
- Nuclear Lifting

78. The inspector identified that no new faults relating to liquor level management are introduced in the submission. So the inspector's assessment in this area has been limited to the consideration of the findings of a previous fault studies assessment [32] on this project.

79. The assessment identified the potential for common cause failure to compromise the first claimed line of protection or Basket Safety Measure (BSM) and that consequently there is the potential for a single failure to compromise the BSM.

80. ONR regulatory issue 8159 action 1 sought improvements the 2nd BSM which is claimed against the fault such that the BSM comprises an engineered protection system rather than an alarm supported by operator action as currently. This would resolve the single failure shortfall and close the most significant gap to the deterministic design criteria. Sellafield Ltd. has committed to implement the modification in advance of bulk waste retrievals. The inspector therefore considered the findings of the previous fault studies assessment note in this regard have been satisfactorily addressed.

81. The inspector judged that through the provision of an additional BSM Sellafield Ltd. demonstrated that the risks have been reduced to below the numerical targets BSO, and that the improvements planned in resolution to issue 8159 demonstrate that the risks are being managed to ALARP.

82. Following consideration of the findings of a previous fault studies assessment note, the inspector concluded that the shortfalls identified by the assessment note have either been resolved or are being managed such that resolution is achieved in a suitable timeframe within the on-going retrievals programme. The inspector identified no impediment to permissioning HP41b outstanding from this discussion.

83. For acute hydrogen, the inspector sampled the associated hazard and operability (HAZOP) studies, the fault analysis of the design basis faults identified and assignment of protective measures. For the latter, the inspector focused on the two lines of protection they viewed as the most significant protection measures presented to protect against the acute hydrogen hazard. Together with the supporting safety mechanisms the lines of protection are comprised of required Operating Instructions (rOI), which under Sellafield Ltd.'s arrangements are the 2nd tier of Limits and Conditions of Operation (LCO).

84. Based on the arguments and evidence sampled, the inspector concluded that the risks presented by the acute hydrogen hazard are acceptable when compared to ONR risk targets, and that Sellafield Ltd. has conducted adequate fault analysis. The inspector had some outstanding questions as to whether all reasonably practicable measures have been taken to reduce risk with respect to the provision of an engineered response to a loss of inerted atmosphere. The inspector progressing resolution to these questions post implementation through regulatory issue 10671.

85. For waste retrieval and normal operations, the inspector sampled the relevant HAZOP studies, focusing on the two fault sequence groups outlined in the

grabbing and raking radiological safety assessment. The faults were dropping or uncontrolled decent of skip from the package hoist during import to/export from the SP/0255 package and loss of containment of skip liquor from SP/0255 package owing to incorrect skip/package preparation. The inspector concluded that adequate fault analysis has been performed and suitable and sufficient safety measures have been provided. Therefore, they judge that the risks associated with the faults have been demonstrated to be ALARP.

86. For lifting operations, the inspector focused on the potential to drop a package containing a skip filled with MBGW down the main hoist well. The inspector concluded that the safety function categorisation and safety system classification were appropriate for that fault, and that the controls required to mitigate the consequences of a dropped package are ensured through application of the required controls for compliance with lifting regulations.

87. Based on the evidence sampled the concluded that Sellafield Ltd. had adequately demonstrated that the risks associated with a dropped package down the main hoist well have been reduced ALARP.

88. Based upon the sample assessment performed, the inspector judged from a fault studies perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

3.5 CHEMICAL / PROCESS ENGINEERING

89. The chemical engineering specialist inspector’s assessment [33] focused on relevant hazards and risks introduced at HP41b, these being:

- Management of chronic hydrogen within C10 and SEP2.
- Management of acute hydrogen within C10 and SEP2.
- Management of Liquor within the FE related to the management of Acute hydrogen.

90. For chronic hydrogen risk management, the inspector focused on waste heat management because of recent problems relating to this area in MSSS third extension silo compartments. The inspector sampled Sellafield Ltd.’s argument that FE waste does not require active cooling.

91. The inspector concluded that, when C10 is in quiescent mode i.e., (a) prior to retrievals, (b) during periods where retrievals are halted and (c) when retrievals are completed, Sellafield Ltd. has provided sufficient evidence that chronic hydrogen hazard has been addressed and all reasonably practicable measures to manage it have been implemented.

92. For acute hydrogen risk management, the inspector sampled the relevant key factors and assumptions within the submission. These are addressed throughout the fault sequence groups identified within the acute hydrogen radiological safety assessment:

- An adequate understanding of the potential source terms.
- There are no changes to hydrogen generation when the compartment is in the quiescent state during the period of C10 MBGW retrievals.
- The risk of acute hydrogen generation stops when waste disturbance stops.
- Acute hydrogen generation can be detected effectively when C10 is in retrievals and under a nitrogen ullage.
- Oxygen ingress can be detected accurately and effectively when C10 is under a nitrogen ullage.
- The nitrogen ullage can be effectively maintained.
- Retrieval operations can be stopped when high levels of oxygen and hydrogen are detected.
- The import and export of Skips does not impact of the risk of a deflagration.

93. The inspector reached the following conclusions on the lines of enquiry.

- An adequate understanding of the potential source terms. The inspector judged that Sellafield Ltd. had adequately identified potential sources of acute hydrogen within the C10 MBGW that could be experienced during C10 retrievals and adequately established the bounding volume of a hydrogen release, excluding the potential, though unlikely, presence of swarf bins.
- There are no changes to hydrogen generation when the compartment is in the quiescent state during the period of C10 MBGW retrievals. The inspector judged that Sellafield Ltd. had identified all reasonably practicable measures to address the challenge of hydrogen being released by the incorrect retrieval of bulk sludge and of the bulk sludge bed being disturbed such that the chronic hydrogen rate within C10 is changed.
- The risk of acute hydrogen generation stops when waste disturbance stops. The inspector judged that the argument, that the risk of acute hydrogen release stops when retrievals stop, is adequately underpinned except for the scenario of an upturned swarf bin close to the sludge / MBGW interface.
- Acute hydrogen generation can be detected effectively when C10 is in retrievals and under a nitrogen ullage. The inspector judged that Sellafield Ltd. had taken reasonable account of the impact of the change in atmosphere from air to nitrogen on hydrogen monitoring within C10 and the need to adopt strict control of the changeover from air to nitrogen-based operation for C10.

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- Oxygen ingress can be detected accurately and effectively when C10 is under a nitrogen ullage. The rate of hydrogen generation within C10 is an unknown variable during retrievals and uncontrolled. Therefore, the inspector considered that Sellafield Ltd.'s approach of controlling the oxygen level, which can be influenced, below that which can ignite a hydrogen release and generate a deflagration, is justified, and meets with the expectations of ONR's Safety Assessment Principles (SAPs). The inspector judged that Sellafield Ltd. had put in place all reasonably practicable measures to ensure that there is effective and accurate oxygen ingress detection within C10 and SEP2.
- The nitrogen ullage can be effectively maintained. The inspector considered that the nitrogen ullage can be effectively maintained with the existing liquid nitrogen tank system until the full retrievals ventilation system is available.
- Sellafield Ltd. provided sufficient evidence that from a chemical engineering perspective retrieval operations can be stopped when high levels of oxygen and hydrogen are detected.
- The import and export of Skips does not impact of the risk of a deflagration. The inspector judges that Sellafield Ltd. has demonstrated through test rig trials and commissioning that the import and export of skips does not impact on the risk of a deflagration within either SEP2 or C10 ullage and that the maximum operational air in leakage of 40m3/hr is a suitable alarm value.

94. The inspector examined FE liquor management with respect to acute hydrogen hazards. The inspector judged that Sellafield Ltd. had adequately addressed the potential for the ingress of air through the hydraulic links. The inspector also judged that the company had provided sufficient evidence to justify that it had reduced the risks for the generation of a flammable mixture during retrievals operations from this route as low as reasonably practicable.

95. The inspector was satisfied from a chemical engineering perspective that Sellafield Ltd. had provided sufficient evidence to support the claim that risks associated with the proposal are reduced ALARP.

96. The inspector made seven recommendations which are incorporated in a regulatory issue that can be addressed after commencing retrievals.

97. Based upon the sample assessment performed, the inspector judged from a chemical engineering perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

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3.6 HUMAN FACTORS

98. Retrieval of MBGW from C10 places considerable reliance upon the operator with a relatively small number of engineered protection measures introduced at HP41b. The human factors (HF) specialist inspector's assessment [34] focused on the differences or changes to the design and safety case since the previous phase. Acute hydrogen was a key focus of the inspector's assessment as it will be the first time that the waste bed will be disturbed with the potential to generate hydrogen.

99. The inspector extended their inspection scope to include the two emergent work operational safety memorandum (OSMs include operational designations and an additional NFR was produced documenting the HF substantiation). The inspector reviewed the substantiation to determine that a full suite of HF substantiation was in place to underpin the submission.

100. The assessment builds on ONR's HF assessments at previous phases and takes cognisance of relevant assessments completed by ONR inspectors in other disciplines.

101. The inspector provided HF advice to other ONR inspectors on MSSS lifting operations, nuclear fire safety, operator alarm response and conditions for acceptance. The latter area was concerned with the use of a paper-based system for waste consignment prior to the introduction of the electronic system (known as Historian) soon after commencement of MBGW retrieval operations.

102. The inspector's main lines of enquiry for the areas of focus were:
- HF integration.
- HF aspects of the design including the extent to which HF aspects of the design 'as built' are compliant with RGP.
- Important human actions and administrative controls claimed in the safety case; in particular any new or modified claims for Phase 4 and those relating to the compliance with the CfA for other interfacing facilities (SMF and EPS-WTR).
- Assessment of maintenance error.
- Training and Competence Assurance.
- Development and validation of operator & maintenance instructions including the interface between the OIs and the EOIs.
- Staffing and work organisation.

103. For HF integration, the inspector expected that a systematic approach should be taken to integrating HF requirements within the MSSS Phase 4 activities. Retrieval of MBGW from C10 places considerable reliance upon the operator with a relatively small number of engineered protection measures. Sellafield Ltd. recognises this significant operator contribution to safety and the

importance of providing HF SQEP resource (specialist contractor) across the lifetime of the project.

104. The inspector identified that due to the limited timescales to address a large amount of work, the Sellafield Ltd. HF SQEP has prioritised the substantiation of the operational designations. The inspector notes that whilst this resulted in the HF SQEP not being involved in all activities they ideally would have been, the completed work has focused on ensuring that operational designations introduced during Phase 4 can be completed safely and reliably taking into account factors affecting human reliability. The inspector judges the approach taken by the Sellafield Ltd. HF SQEP to be acceptable and appropriate given the stage of the project and the HF work completed at previous phases of the project.

105. The inspector identified numerous examples of improvements to task and equipment design due to the HF SQEP's involvement. The inspector's opinion was that the work completed by the HF SQEP was of a high quality. The HF SQEP had produced an intelligent, proportionate substantiation that reflects the complexity/novelty and significance of the tasks. There was, however, a significant amount of work to complete prior to commencing retrievals.

106. Overall, the inspector considered that there had not been full demonstration that HF had been systematically integrated into the project and some work was outstanding. The inspector raised two regulatory issue actions arising from HF integration, one of which needed to be addressed prior to Agreement. This regulatory action is related to closure of the safety important issues raised by the Sellafield Ltd. HF SQEP. The closure statement is provided in Section 4 of this report.

107. The inspector considered confirmation that the design 'as built' meets HF design standards is a key activity at this stage of the life cycle. The inspector expected Sellafield Ltd. to demonstrate that the design supports reliable operations and task performance across a representative range of activities. Also, that learning from activities and commissioning at previous phases has been appropriately incorporated.

108. The inspector identified appropriate involvement from Sellafield Ltd. HF resource, with assessment building on previous significant detailed HF design work. The inspector challenged the mainly task base approach adopted, which was acknowledged by Sellafield Ltd. However, the inspector took confidence that the approach did include consideration of the design, which resulted in some of the design changes. Overall, the inspector considered there was sufficient evidence that the design of tools and equipment had adequately considered.

109. The inspector expected provision of proportionate substantiation of safety important tasks and in particular, operational designations. The inspector

reviewed the evidence provided in support of the rOIs and key OAs, sampling claims and underpinning analysis associated with several specific fault groups. This was to gain confidence that any important human actions and administrative controls claimed in the safety case were suitably substantiated. The sample covered acute hydrogen, LLM and cross-stream waste behaviour (including compliance with CfA).

110. In summary, the inspector considered the HF substantiation reports provided a good level of analysis in support of the key human-based safety claims. The inspector judged this was particularly important given the reliance on operator action and administrative controls to protect and prevent faults with significant consequences. The inspector considered that the HF SQEP has produced an intelligent, proportionate substantiation that reflects the complexity/novelty and significance of the tasks.

111. The inspector considered that the HF substantiations were generally consistent with the company's HF arrangements and provided a good level of evidence, giving confidence that the safety significant tasks can be achieved reliably. The inspector raised one regulatory issue action that needed to be addressed prior to Agreement. The action was concerned with the adequate justification for use of a paper-based alternative approach to the Historian software. The closure statement is provided in Section 4 of this report.

112. The inspector expected Sellafield Ltd.to provide adequate evidence that safety important maintenance activities have been analysed from a HF perspective to minimise the potential for human error (latent errors). The inspector focused on maintenance, recognising that such significant activities are expected to take place after start of retrievals.

113. Overall, the inspector was content with the company's approach to minimising the potential for maintenance error. Although the consideration of maintenance error has focused on the claims on the operator, the inspector considered the task-based approach adopted by the Sellafield Ltd. HF SQEP resulted in a wider consideration of maintenance related errors.

114. The inspector expected safety important procedures to support reliable human performance should be accurate and designed and presented so that they; meet the needs of all intended users; facilitate the safe and effective completion of tasks important to safety.

115. The inspector identified that Sellafield Ltd. had undertaken a variety of work to support the development of instruction. The inspector drew confidence from the considerable involvement of operators in procedure development, including extensive use of the training rig to improve the procedures. Another good point was the involvement of safety case authors in checking operational designations in their safety case documents had been appropriately included.

116. In summary, the inspector considered that an appropriate approach has been taken to the development of procedures and instructions. However, not all the range of operational documentation the inspector chose to sample, including transition from normal to emergency operations, was available. The inspector raised a regulatory issue action for provision of these approved documents that needed to be addressed prior to Agreement. The closure statement is provided in Section 4 of this report.

117. For staffing and work organisation, the inspector expected that there should be sufficient competent personnel available to operate the facility in all operational states. The inspector identified that Sellafield Ltd. was introducing additional supervision with appointment of retrievals team leaders (RLT), which they considered was a positive improvement. The inspector advised that RLT around the importance of maintaining this independence specifically in relation to the paper-based Historian approach.

118. The inspector was content with the approach taken by Sellafield Ltd. in identifying appropriate manning levels and putting in place a suitable team structure and organisational arrangements to support effective transition to Stage E active commissioning and operations. Although the retrievals team will be small at the start of retrievals, the inspector was content that there are appropriate controls in place to only undertake retrievals when the necessary staff are available and that there is no safety implication of retrievals operations not being completed if there are insufficient staff numbers.

119. Based upon the sample assessment performed, the inspector judged from a human factors perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The basis of this decision is subject to resolution of the recommendations identified which require Sellafield Ltd. to address prior to first retrievals of MBGW from C10. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

3.7 INTERNAL HAZARDS

120. The internal hazards specialist inspector’s assessment [35] focused on the internal hazards aspects of hazards introduced by commencing retrieval of MBGW from MSSS C10. The report builds on a separate assessment [36] undertaken for the waste transfer and interim storage of the compartment 10 MBGW following these retrieval operations.

121. The inspector sampled the internal hazards aspects of the proposal in the following areas:

- Hydrogen - Consideration of the potential for acute hydrogen to be generated during waste retrieval operations. The inspector considered the potential for packages containing hydrogen sources to be transported to interim storage (in EPS3-WTR).
- Nuclear Fire – The inspector's assessment considered whether recommendations from the previous ONR MSSS nuclear fire assessment have been suitably addressed and consideration of specific nuclear fire hazards associated with MSSS retrievals operations.
- Dropped Loads and Impacts – The inspector's assessment considered the potential for dropped loads and impacts to result in nuclear safety consequences, specifically focussing on the potential to damage structures, systems, and components (SSC)s.

122. For hydrogen, the inspector focused on consideration of the hydrogen hazards associated with the waste package and skip as these have the potential for significant radiological consequences both within MSSS and during downstream operations in EPS3-WTR.

123. An important element in mitigating the amount of hydrogen generated is associated with ensuring the waste received into EPS3-WTR meets the CfA acceptance, which relies on actions undertaken by MSSS retrievals operations with no further control measures available. The inspector's EPS3-WTR assessment identified that the licensee's hazard management strategy relies on ensuring that significant quantities of sludge and pressurised cans are not present in the waste retrieved during MSSS compartment 10 MBGW retrieval operations. The inspector therefore sampled controls introduced for HP41b for embargoing Winfrith cans (potential to contain significant quantities of hydrogen) not adding water to skips and limiting the volume of retrieved sludge.

124. The inspector raised a regulatory issue associated with controlling risks arising from acute hydrogen release from retrieved bulk waste i.e., post C10 MBGW retrieval. The issue can be addressed by Sellafield Ltd. post Agreement.

125. Overall, the inspector judged that Sellafield Ltd. demonstrated that the risks associated with acute hydrogen during MSSS retrieval operations have been minimised.

126. The inspector noted that ONR had previously assessed [36] nuclear fire in the MSSS retrievals programme. The inspector therefore focused on changes to Sellafield Ltd.'s MSSS nuclear fire safety assessment (NFSA), these being:

- Unmitigated radiological consequences are identified for all fault sequence progressions that are more specific to the transporter fire

scenario, rather than high level bounding estimates of consequence bands.

- The package has now been substantiated to withstand the transporter fire scenario. New safety functions are placed upon the package in the NFSA.
- Confirming if the SEP package transporter tugs' engine fire suppression systems have been installed in all Sellafield Ltd. transporter tugs.
- Fire protection modifications to MSSS central hoistwell structural steelwork.

127. The inspector identified that most of the changes to the MSSS NFSA relate to package transporter fires. The inspector sampled Sellafield Ltd.'s identification and frequency of initiating events, the associated unmitigated radiological consequences and the protective measures the company has or will implement.

128. Overall, the inspector was satisfied that the consequences of a fire induced containment failure involving a single vehicle have been appropriately calculated in a conservative manner and have led to the specification of suitable safety measures including the installation of fire suppression systems on the tugs for use by trained operators. The inspector judged that the company has demonstrated that, because of these safety measures, the risk of fire from the single transporter impacting the package has been suitably reduced ALARP.

129. Previous revisions of the MSSS lifting operations assessment have been subjected to ONR assessment, although no specific internal hazards assessment has been undertaken considering dropped loads and impacts to SSCs. MSSS lifting operations has been a key line of enquiry within the ONR mechanical engineering, fault studies and human factors, and so the inspector has liaised with these inspectors in forming their view on the adequacy of the internal hazards aspects of MSSS lifting operations.

130. As previously discussed in Section 2.1.3. Emergent Issues, Sellafield Ltd. informed ONR that phase one of the MSSS nuclear fire protection improvement would not be completed prior to commencement of retrievals. The inspector, supported by an ONR nuclear fire safety specialist inspector assessed Sellafield Ltd.'s safety justification for commencing retrieval operations without MSSS central hoist well passive fire protection phase 1 being completed. ONR undertook a series of engagements to gain further evidence to determine the adequacy of Sellafield Ltd.'s proposal. The engagements and further evidence gained are referenced in the inspector's assessment.

131. The inspector judged that the risk gap introduced by the shortfall can be adequately addressed for the release of HP41B subject to Sellafield Ltd.

providing confirmation of the verbal evidence of suitable risk assessment and implementation of options, together with the timescale for competing phase 1 work. The inspector raised a regulatory issue against this issue that Sellafield Ltd. needed to address prior to ONR Agreement being granted. The inspector raised an action associated with fire protection Examination, Inspection, Maintenance, and Testing (EIMT) in the regulatory issue, which can be addressed post Agreement.

132. The inspector also considered the consequences arising from lifted loads impacting on vulnerable SSC, specifically the first extension liquor activity reduction (FELAR) transfer pipework and the Mk V first extension silo liquor cooler system.

133. Sellafield Ltd. controls the risks associated with lifting operations using engineered and operational protective measures. The inspector sampled the operational protective measures (OPM), specifically the two implemented lifting operation rOIs to protect vulnerable SSCs.

- rOI4.20 requires there must be no lifting operations above, or within 0.5m horizontally of any compartment cooling containment, unless the cooler in the vicinity of the load has been shut down.
- rOI4.62 requires there must be no lifting operations above, or within 0.5m horizontally of the 1st Extension Liquor Transfer system, unless the 1st Extension liquor transfer system has been shut down

134. The inspector was content that Sellafield Ltd had designated OPMs to prevent lifting operations in the vicinity of the LAR pipework and compartment coolers when these are operational. The inspector was satisfied that the company had adequate evidence to support the claim that potential damage to the LAR pipework and compartment coolers will not result in significant radiological consequences and disruptions to retrieval operations can be minimised. The inspector raised an action associated with review of the lifting safety assessment to ensure it includes extant protective measures in the regulatory issue, which can be addressed post ONR Agreement.

135. Based on the sample performed from an internal hazards perspective, the inspector considers that Sellafield Ltd. has adequately considered the nuclear safety risks associated with internal hazards during the MSSS compartment 10 MBGW retrieval and cross site transport operations.

136. Based upon the sample assessment performed, the inspector judged from an internal hazards perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The basis of this decision was subject to resolution of the recommendations identified which require Sellafield Ltd. to address prior to first retrievals of MBGW from C10, which has since been provided and is

captured within Section 4. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

3.8 MECHANICAL ENGINEERING

137. The mechanical engineering specialist inspector's assessment [37] focused on MSSS lifting operations. The inspector focused on the adequacy of:
- the West End and East End cranes to support retrievals.
  - the ability of components to withstand a dropped load.
  - asset maintenance and condition.
  - categorisation and classification arrangements.
- cross site transfer risks.

138. The inspector concluded that Sellafield Ltd. had provided sufficient evidence to justify that:

- Both the West End and East End cranes can be used to support the start of retrievals.
- The cross-site transfer risks have been demonstrated to be ALARP.

139. The inspector made 7 recommendations, which will be aggregated into a single Regulatory Issue to be addressed post ONR agreement.

140. Based upon the sample assessment performed, the inspector judged from a mechanical engineering perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

3.9 CONTROL AND INSTRUMENTATION

141. The control and instrumentation (C&I) specialist inspector's assessment [38] focused on the adequacy of the following:
- The new C&I safety measure in place to detect an abnormal nitrogen flow rate to the SEP 2 ullage, due to either failure of the nitrogen delivery system or an incorrect configuration of the nitrogen supply requiring cessation of MBGW disturbance within C10.
- The new C&I safety measure to detect high oxygen concentration in the C10 ullage requiring cessation of MBGW disturbance within C10.
- The new C&I safety measures to prevent the gamma gate opening if there is no package present at the SEP 2 import / export station.
- Sellafield Ltd.'s proposal to address regulatory issue 8159 raised during previous permissioning due to an inadequate safety measure to

prevent overfilling the first extension compartments from a significant water source supplied by the SEP 2 mobile cave wash system.

- The new C&I safety measure to prevent waste bed disturbance, specifically when C10 is in an air-based configuration.

142. The inspector reviewed Sellafield Ltd.'s proposal for proof testing the radar used to detect high compartment liquor level in the first extension compartments. The inspector also sampled the arrangements in place to address safety consequences of cyber security risks.

143. Against the areas of focus, the inspector assessed C&I aspects of acute hydrogen management (including limiting grab depth), liquor level management, SEP 2 gamma gate interlock and the SEP 2 closed circuit television system. The inspector also assessed the safety consequences of cyber security risks, liaising with the ONR cyber security specialist on this matter.

144. Previous C&I assessment have identified that SEP 2 cave nitrogen supply flow instrument (SSC 0506) needed to be adequately claimed in the safety case. This assessment examined further the adequacy of substantiation against the claims made on this system and the C10 ventilation extract oxygen analyser (SSC 0574).

145. The C&I specialist inspector judged that the evidence provided by Sellafield Ltd. adequately demonstrated that the C&I safety measures for detecting low nitrogen flow to the C10 ullage and abnormal nitrogen flow to SEP 2 cave ullage (SSC 0517 and SSC 0506 respectively) and high oxygen content in the C10 ventilation extract (SSC 0574) meet the requirements for the safety designation claimed. Notwithstanding this, they judge the three safety measures are not appropriately classified based on the hazard consequence and their contribution to the delivery of the safety functions. However, when considered holistically, the C&I specialist inspector considers design of the three independent safety mechanisms are adequate for their claimed contribution to the MSSS hydrogen hazard management strategy, as documented in the safety case.

146. The inspector's assessment included sampling C&I systems and components' safety classification, design for reliability, reliability claims, EIMT, commissioning and demonstration of ALARP.

147. Regulatory issue 8159 is concerned with a shortfall with Sellafield Ltd.'s protective measures for liquor level management. Sellafield Ltd. has identified an EPM to replace an existing OPM to protect against overfilling FE compartments. Sellafield Ltd. has provided adequate justification as to why risks are reduced ALARP for HP41b utilising the OPM. ONR has accepted the company's commitment to install the EPM at the earliest opportunity after

commencement of retrievals operations and has been captured as a regulatory issue (10674) for addressing post ONR Agreement.

148. The inspector was content that the risk is sufficiently low of a cyber vulnerability associated with the smart devices used to protect against the sampled fault sequences described in the safety case.

149. Based upon the sample assessment performed, the inspector judged from a control and instrumentation engineering perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

3.10 RADIOLOGICAL PROTECTION

150. The radiological protection (RP) specialist inspector's assessment [39] focused on the adequacy of Sellafield Ltd.'s assessment of dose exposures specifically associated with MGBW retrievals from C10 in relation to:

- RP for retrievals and maintenance operations
- RP-related aspects of the training strategy
- Emergency arrangements

151. RP for retrievals and maintenance operations: The inspector focused on the adequacy of Sellafield Ltd.'s assessment for minimising operator/maintainer dose arising from background radiation, contamination and task-specific dose. This included consideration of worst -case exposure and measures to reduce exposure ALARP and avoid unexpected exposures during maintenance operations.

152. The inspector considered that worker doses will be dominated by the background doses within the MSSS facility, with limited opportunities to reduce these further. The inspector accepted Sellafield Ltd.'s assessment that operator doses may increase as waste is retrieved from C10. The inspector considered there are appropriate measures in place to monitor worker dose and react accordingly to ensure doses remain ALARP.

153. The inspector sampled training requirements including emergency operation (escalation from normal, abnormal to emergency and interactions with other facilities/equipment) and off-normal conditions and recovery during retrievals operations (skip filing). The inspector was content that ONR had observed a relevant emergency exercise in MSSS and that the inspection was rated green.

154. The inspector was content that:

- Sellafield Ltd. had made an adequate whole-body dose assessment for the worker groups that will undertake routine operations and maintenance of silo emptying plant and have has considered means to reduce background dose rates where possible demonstrating that doses have been reduced ALARP.
- Sellafield Ltd. had adequate methods to monitor operator doses to ensure these remain ALARP and do not challenge company or legal dose limits.
- Sellafield Ltd. had adequate emergency procedures from a radiological perspective in place to address a dropped silo emptying plant waste package.

155. Based upon the sample assessment performed, the inspector judged from a radiological protection perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

3.11 CONVENTIONAL HEALTH AND SAFETY

156. The conventional health and safety specialist inspector [40] focused on Sellafield Ltd.'s arrangements for complying with the Lifting Operations and Lifting Equipment Regulations (LOLER) 1998, Regulation 8: Organisation of lifting operations. The regulation is supported by an Approved Code of Practice (ACOP) and guidance. Further guidance is provided by BS7121 – Code of practice for safe use of cranes.

157. Regulation 8 of LOLER requires all lifting operations to be:

- Properly planned by a competent (SQEP) person.
- Appropriately supervised.
- Carried out in a safe manner.

158. Sellafield Ltd.'s process requires the facility Lifting Operations Appointed Person (LOAP) to carry out a risk assessment as part of the lift planning process and for the risk assessment to be used to develop a method statement detailing the safe system of work for the lifting operation. The risk assessment, method statement and relevant drawings form the lift plan which is managed as an OI. The inspector's main line of enquiry focused on Sellafield Ltd.'s lift plan for movement of the SEP package within MSSS, which is included in an operator instruction.

159. The inspector identified that on MSSS Sellafield Ltd. had not fully implemented the company extant lifting operation arrangements. The inspector required Sellafield Ltd. to review the lifting operating instruction against the company's extant relevant procedures and guidance and ensure compliance thereof. The inspector confirmed [41] that Sellafield Ltd. had provided adequate evidence that the extant company arrangements had been incorporated in the MSSS lifting operating instructions.

160. The inspector also sampled [42] MSSS lifting operations operator training. They were satisfied, based on the sample taken that Sellafield Ltd. was providing training to their employees as required by the general duties under Section 2 of the Health and Safety at Work etc Act 1974.

161. From discussion with the inspector, they confirmed satisfaction that Sellafield Ltd. had provided sufficient evidence to support the claim that, from a CH&S aspect, the risks arising from MSSS lifting operations were controlled SFAIRP.

3.12 EXTERNAL HAZARDS/CIVIL AND STRUCTURAL ENGINEERING

162. The civil and structural engineering (C&SE) specialist inspector carried out a high-level over-view of the safety case documentation and identified key aspects for inclusion in their assessment [43]. In addition, to respond to queries from the fault studies specialist inspector, the inspector also included consideration of deflagration and dropped load hazards. The following aspects have been included in the scope of this assessment:

- External hazards assessments in relation to the existing gantries under seismic and extreme low temperature conditions.
- Shortfall in the fire protection to the CHW steelwork.
- Effects of dropped loads on the first extension silo compartments.
- Effects of a deflagration of acute hydrogen on the first extension primary and secondary containment.
- Adequacy of the confidence statements provided in relation to the impact of the leak in the OB on retrieval operations in C10.
- The extent to which outstanding C&SE /external hazards-related actions and recommendations in relation to the previous ONR assessment had been addressed.

163. Due to a significant previous C&SE assessment carried out by ONR in preparation for retrievals, the scope of the inspector's assessment was limited to modifications to the safety case made since 2019, including the impact of the new leak identified in the OB. The scope also included a review of progress with outstanding matters raised during the earlier assessment.

164. The inspector was satisfied that Sellafield Ltd.'s external hazards assessment has adequately considered the effects of extreme temperatures and seismic loads on the high and low-level gantries, which could pose a risk to the

passive ventilation if they were to collapse. The inspector was satisfied that there are suitable mitigations within the safety case to address the identified shortfall with respect to the risk of brittle fracture of the gantry steelwork at extreme low temperatures. Overall, the inspector judged the risk of blockage of the passive ventilation due to this hazard to have been reduced ALARP.

165. The inspector was content that adequate progress is being made in addressing an identified shortfall with respect to the fire protection of structural steelwork in the central hoist well. The inspector am satisfied that the Licensee has put in place adequate arrangements to progress remediation works in a prioritised manner, so that retrievals will not commence until the most important steelwork has been protected. Given the significant potential impact on the retrievals programme of a fire in this area, the inspector recommended that seek confirmation of Sellafield Ltd.'s intentions for completing the subsequent phases of this work after the start of retrievals.

166. The inspector was satisfied that Sellafield Ltd.'s dropped load assessments confirm that the primary containment structures can meet their safety functional requirements with adequate confidence.

167. Although no explicit claims have been made on the primary containment structures with respect to the deflagration hazard, the inspector was satisfied that the structures have adequate robustness to maintain bulk containment under the maximum predicted overpressure, with no cliff edge effects at slightly higher pressures. The inspector judged that some damage may occur to the structures, which may result in seepage from the containment. The potential for such damage has been acknowledged by the Licensee and is taken into consideration in the MSSS severe accident response plan.

168. The inspector judged that the current OB leakage does not have any impact on the start of retrievals from C10 and that viable options for stopping or mitigating the leak will not be precluded.

169. The inspector was satisfied that there are suitable operating instructions in place to control the east end crane parking location, to minimise the risks due to seismic events.

170. The inspector was satisfied that adequate progress is being made to address identified defects due to concrete degradation in the OB primary containment structure, and that these defects do not currently have any impact on the start of retrievals from Compartment C10.

171. The inspector reiterated one recommendation from the previous ONR assessment, so that it is not over-looked, and so that the Licensee can make the appropriate arrangements to carry out an inspection inside the secondary containment prior to future retrieval operations.

172. The inspector raised two recommendations for Sellafield Ltd. relating to fire protection of key steelwork structures in central hoistwell and inspection of secondary containment, neither of which require completion prior to the start of retrieval operations from C10.

173. Based upon the sample assessment performed, the inspector judged from a civil and structural engineering/ external hazards perspective that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. The inspector therefore recommends that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10

3.13 PROJECT INSPECTION

174. In addition to assessing Sellafield Ltd.'s submission, I have undertaken inspections of the MSSS facility to inform my consideration of the request to commence retrieval of MBGW from MSSS C10. The inspections consisted of:

- Demonstration of emergency arrangements.
- Readiness inspection.
- Confirmation of readiness to commence retrievals.

Demonstration of emergency arrangements

175. ONR observed a demonstration of MSSS emergency arrangements [44] and undertook a readiness inspection [45] of the MSSS programme to support retrievals. The purpose of the observation and readiness inspection was to gain confidence that Sellafield Ltd. would be ready to implement the revised safety case for commencement of C10 MBGW retrievals and inform ONR's permissioning decision for HP41b.

176. LC 11 requires the licensee to make and implement adequate arrangements for dealing with any accident or emergency arising on the site and their effects. The scenario for the MSSS emergency arrangements demonstration involved an uncontrolled lowered/dropped SEP package in the central hoistwell resulting in loss of liquor containment. The scenario was based on a fault sequence introduced at HP41b.

177. ONR considered that the exercise demonstrated Sellafield Ltd. had effectively implemented its arrangements for compliance with LC 11. There were a number of areas where Sellafield Ltd. demonstrated good practice. ONR provided some observations regarding some areas for minor improvement. ONR rated the inspection rating green (no formal action).

Readiness inspection

178. Mechanical engineering and chemical engineering specialist inspectors and I undertook a readiness inspection [45] against LC 22. We focused on the hazards introduced by retrieving MBGW from C10 and the measures by which Sellafield Ltd. ensures that the associated risks are reduced so far as is reasonably practicable. The areas of focus were hydrogen management, silo radioactive liquor level management, and lifting operations.

179. From the evidence sampled we identified no shortfalls requiring regulatory attention. I gained confidence on Sellafield Ltd.'s ability to safely implement the proposal to commence retrieval of MBGW from compartment 10 in the near future. We identified several areas of good practice and some minor observations on areas for improvement. We provided non-formal regulatory advice. I consider that minor observations did not warrant raising a regulatory issue. ONR rated the inspection rating green (no formal action).

Confirmation of readiness to commence retrievals

180. The ONR HP41b Agreement decision maker, nominated Sellafield project inspector, retrievals enabling facilities project inspector and I met [46] with Sellafield Ltd. legacy silos value stream leadership to gain confidence that the company is ready to safely commence retrievals and associated risks are reduced SFAIRP.

181. The inspection consisted of a facility walkdown and meeting operators to determine if they were ready to commence retrievals. This was followed by a Level 3 regulatory meeting is for Sellafield Ltd senior leadership and decision makers to demonstrate to ONR that the facilities have:

- Adequately implemented the safety cases within the facilities, by suitable progression of plant and equipment modifications and implementation of procedural arrangements.
- Adequately progressing with emergent issues and/or regulatory queries to support the permission.

182. We were shown the MSSS central hoistwell and the phase 1 fire protection. Operators clearly articulated the shortfall in completion of phase 1 work and the operational protective measures in place to control risk.

183. We met with MSSS and EPS/WTR plant and retrievals operators, all of whom articulated good understandings of setting to work arrangements, limits and conditions, identification and responses to off-normal operation.

184. We met with Sellafield Ltd. senior leadership and independent oversight. The topics covered were:

- ONR provision of hot feedback from facility walkdowns.
- Position from Sellafield Ltd. on state of readiness.
- Position from NIIO on Facility readiness.

- Closing statement.

185. The Site Director as custodian of the nuclear site licence confirmed they were content with the work that has been done in relation to ensuring that retrievals can be undertaken safely. Also, the Site Director confirmed that retrieval of Miscellaneous Beta Gamma Waste from Compartment 10 as defined within HP41B can be undertaken safely, securely and in compliance with the law.

186. NI&IO confirmed [46] that the MSSS HARR had not identified any significant issue or concern that challenged start of retrievals. The high category reservations (required to be resolved before commencement of the activity) will all be addressed as part of Sellafield Ltd.'s due process.

3.13.1 EMERGENT ISSUES

Low temperature operation and acute hydrogen hazards arising from lowering FE liquor levels

187. In February 2022, Sellafield Ltd. notified ONR that it had identified two shortfalls associated with MSSS low temperature operations and acute hydrogen hazards arising from lowering FE liquor levels. The company subsequently provided assessments [16] [17].

188. I reviewed the assessments to determine if ONR should extend the HP41b assessment lines of enquiry to include the two shortfalls and the adequacy of Sellafield Ltd.'s response thereof. I obtained advice from the human factors, fault studies, C&I and chemical engineering specialist inspectors to inform my judgement on the adequacy of the submissions.

189. The chemical engineering and human factors specialist inspectors included acute hydrogen hazards arising from lowering FE liquor levels within their assessment scopes [33] [47]. Both inspectors were content that Sellafield Ltd. had adequately addressed the potential for air ingress through the hydraulic links.

190. The C&I and fault studies specialist inspectors reviewed [48] the acute hydrogen submission. The fault studies inspector concluded that there was no need for fault studies to assess the detail of the changes outlined in the OSM or to prevent permissioning of HP41b.

191. ONR had sampled low temperature withstand and associated limits and conditions of SEP 2 cave and package park stands as part of previous permissioning assessments [49] [50]. The ONR fault studies inspector reviewed [51] the justification and provided an opinion on Sellafield Ltd.'s control measures. Overall, the inspector considered the control measures were reasonable. The inspector raised four questions for clarification relating to SEP cave withstand to low temperature faults. I have raised the four

questions [52] as technical queries to be added to the MSSS TQ tracker. The questions can be addressed post ONR Agreement.

192. Based upon the sample assessment performed, I judged that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated low temperature operation and acute hydrogen hazards arising from lowering FE liquor levels to ALARP.

Nuclear fire safety

193. In March 2022, Sellafield Ltd. notified ONR that phase 1 of the MSSS central hoistwell fire protection modifications that should have been completed prior to implementation of PMP 0929 had not been completed. Sellafield Ltd. judged that the risks of commencing retrievals without completing phase 1 remained ALARP.

194. ONR internal hazards and nuclear fire safety specialist inspectors and I engaged with Sellafield Ltd. [18] [53] to determine the adequacy of the ALARP claim. From the initial engagement, inspectors considered that the company had not provided sufficient evidence to support the ALARP claim and provided advice and guidance on their expectations. Sellafield Ltd. subsequently provided additional evidence [54].

195. ONR's review [55] concluded that whilst Sellafield Ltd. had not completed installation of phase 1, it will implement adequate protective measures to mitigate the risk. The company committed to complete phase 1 work as soon as possible. Inspectors considered, therefore, that it would be disproportionate to require Sellafield Ltd. to complete phase 1 prior to commencement of retrievals. Overall, ONR considered that Sellafield Ltd. had provided adequate evidence to support the ALARP claim. ONR will raise a regulatory issue to ensure timely completion of phase 1 modifications.

3.14 CROSS-SITE WASTE TRANSFER

196. Consideration of cross-site transport of SEP packages was included specifically in ONR's internal hazards [35] and mechanical engineering assessment [37] scopes. The fault studies [31] assessment included consideration of package transfers between building cranes and road transporter within the MSSS central hoistwell. I consider that NLR [30], chemical engineering [33] and criticality [29] assessments also contribute to forming ONR's judgement on the adequacy of Sellafield Ltd.'s control of the associated risks.

197. The internal hazards assessment of cross-site transport focused on nuclear fire safety. Overall, the inspector was satisfied with the internal hazards aspects of cross-site transport of MSSS packages. The inspector did identify improvements that Sellafield Ltd. could make after commencement of MBGW retrievals which were captured in a regulatory issue.

198. The mechanical engineering assessment focused on the transporter impacting with another vehicle and this resulting in a fire. The inspector was content that Sellafield Ltd.'s assessment was suitably conservative. This included consideration of fuel loading from the involved vehicles and the frequency of transporter movements.

199. Overall, the inspector was satisfied with the company's response and considered that the evidence supported the claim that the risks associated with the cross-site transfer have been reduced ALARP from a mechanical engineering perspective.

200. In my opinion, ensuring the risks arising from the transported waste, particularly hydrogen generation or criticality, are known and appropriately controlled is central to safe cross-site transport of MSSS waste. ONR NLR and chemical engineering inspectors considered waste characteristic, including hydrogen generation and waste conditions for acceptance. The criticality specialist inspector considered the criticality risks arising from retrieving waste. The inspectors did not identify any regulatory shortfalls.

201. Overall, in my opinion, based on the samples taken, Sellafield Ltd. has provided sufficient evidence to support the claim that the risks associated with cross-site transport of SEP packages for HP41b are ALARP.

3.15 MSSS OB LEAKAGE

202. ONR, together with the Environment Agency, has engaged with Sellafield Ltd. on the MSSS OB leak since first notified in November 2019. We responded initially with two joint regulatory letters [56] [57] outlining our regulatory expectations and initiated investigations. For ONR, this was supported by a Level two regulatory issue, 8145, a significant issue that merits oversight by the Divisional Director. The ten actions associated with issue 8145 are presented in Table 1. ONR's investigation concluded with issue of an Enforcement Letter [58] to Sellafield Ltd. for shortfalls in compliance with Licence Condition 34 (leakage and escape of radioactive material and radioactive waste). We judged the company had failed to ensure, so far as is reasonably practicable, that the radioactive material contained within MSSS is adequately controlled or contained to prevent leakage.

203. ONR has engaged with Sellafield Ltd. to gain assurance that the company is working to address regulatory concerns and ensure that the risks to people on and off site continue to be reduced SFAIRP. Ensuring that the risks posed by MSSS leakage remain reduced SFAIRP is a key enabler for high hazard and risk reduction retrievals operations. Throughout, I have been advised by ONR inspectors from the following specialisms: NLR, civil and structural engineering (C&SE), chemical engineering, chemistry, radiological protection (RP), and fault studies.

204. Assessment of the NLR aspects [59] of the MSSS safety case (MSSS leak to ground management plan) is key to informing ONR's judgement on the adequacy of the leak management plan. The assessment focused on in-ground characterisation, monitoring and assessment analysis and decision making to ensure appropriate response; and arrangements enabling appropriate minimisation and mitigation.

205. ONR's overall judgement from the NLR perspective is that, to date, Sellafield Ltd. has adequately demonstrated its arrangements for management of a leak to ground from MSSS OB. This included control and mitigation of the consequences such that the risks arising from ground contamination are managed to be as low as reasonably practicable, and that continued retrieval of the waste stored in MSSS should remain Sellafield Ltd.'s priority. The inspector raised a level three regulatory issue requiring SL to address seven recommendations arising from the assessment. The recommendations were associated with leak activity, mitigation and oversight. The leak activity and mitigation recommendations complement issue 8145 actions 2, 3 and 5, and the remaining recommendations focus on improvements in Sellafield Ltd.'s oversight and challenge of MSSS OB leakage to ground.

206. The C&SE assessment [60] focused on the civil structural integrity to very large leakage scenarios and ageing management. Overall, the civil engineering specialist inspector was satisfied that Sellafield Ltd.'s review has adequately demonstrated that the OB will retain it structural integrity, even under liquor loss rates significantly greater than those currently being experienced. Based on the evidence presented, the inspector was satisfied that the risk of a disproportionate change in behaviour, or cliff-edge effect, due to increased leakage, was as low as is reasonably practicable.

207. Overall, the inspector was satisfied that Sellafield Ltd. is adequately managing the OB silo structure ageing and that an adequate programme of repairs and corrosion mitigation activities has been developed to address active degradation mechanisms. The inspector judged that this work should extend the life of the containment structure and, subject to an adequate programme of examination, inspection, maintenance and testing, enable the structure to continue to meet its safety functional requirements until decommissioning is complete.

208. The inspector identified potential improvements to the inspection, testing and maintenance regime for the OB silo structure, that should be considered by Sellafield Ltd. These improvements have been detailed in three recommendations, and it is intended that progress will be monitored using Regulatory Issue 8145, Action 9.

209. The inspector was satisfied with the overall adequacy of Sellafield Ltd.'s safety case review, and judged that, despite the renewed leakage, supports the judgement that risks are being reduced as low as reasonably practicable.

The inspector judged that neither the identified defects, nor the current leakage levels, prevent the start of retrievals from C10.

210. Chemical engineering and chemistry specialism engagements have focused on chemical interactions between demineralised water used to replace water lost to evaporation or leakage and the ILW, civil structure and leakage point(s). Sellafield Ltd.'s work to address the chemical engineering /chemistry aspects of the leak are planned for delivery in mid-2022. The engagements have given ONR confidence that Sellafield Ltd. will provide suitable and sufficient responses.

211. The fault studies assessment will focus on the adequacy of the OB leakage management on the associated Severe Accident Analysis and Severe Accident Management. The assessment will be informed by the findings of the C&SE and nuclear liabilities assessments.

212. The RP assessment focuses on the adequacy of Sellafield Ltd.'s assessment of the radiological aspects of the management of leakage to ground. The RP assessment to be informed by the findings of the C&SE and nuclear liabilities assessments. In January 2022, Sellafield Ltd. responded to the radiological protection action. ONR is currently assessing the response.

213. ONR advised Sellafield Ltd. to consider the validity of the current International Nuclear and Radiological Event Scale (INES) rating of the MSSS leak as the leak has continued since SL's initial rating of the event. Sellafield Ltd.'s review has concluded that INES Level two criteria is unlikely to be exceeded until after commencement of waste retrievals operations from OB silo compartments. Overall, the UK INES Officer was content [61] that the current INES rating is valid and is unlikely to increase in the near term based upon current leak rates.

214. Overall, ONR considers that Sellafield Ltd. has provided sufficient evidence to give us confidence that our regulatory concerns will be adequately addressed, as detailed in the two joint regulatory letters, the enforcement letter and ONR Issue 8145 actions. ONR's assessment of Sellafield Ltd.'s responses to the concerns will form the basis ONR's regulatory position statement on the MSSS OB leak.

215. In respect of HP41b, I consider that Sellafield Ltd.'s high confidence that commencement of MBGW Retrievals on C10 will neither preclude action to mitigate or stop the OB leak, nor will it cause a significant increase in OB leak rate is reasonable.

3.16 CONSULTATION WITH RESPECT TO NUCLEAR SECURITY, SAFEGUARDS AND ENVIRONMENT

216. To inform this permissioning decision I have consulted with ONR Civil Nuclear Security - cyber security [62], ONR Safeguards [63] and the Environment

Agency [64]. Cyber security specialist raised two actions that are captured in regulatory issue10679 which can be addressed after issue of the ONR Agreement. All parties have confirmed that they support ONR agreeing to Sellafield Ltd. commencing retrieval of MBGW from MSSS C10.

4 MATTERS ARISING FROM ONR'S WORK

217. ONR's assessment identified a number of shortfalls in Sellafield Ltd.'s proposal to commence retrieval of MBGW from MSSS C10. During engagement, the shortfalls were raised as technical queries on the MSSS technical query tracker or at technical meetings recorded in contact records.

218. Inspectors captured outstanding safety significant shortfalls as assessment recommendations that were included as actions in regulatory issues. Where inspectors judged that Sellafield Ltd. needed to provide adequate responses to issues prior to commencement of HP41b, the inspectors' confirmation of responses acceptability are recorded in this report. Where inspectors judged that Sellafield Ltd. could address the issues after commencement of retrievals, the inspectors will engage with the company as appropriate to achieve resolution in accordance with ONR guidance [27].

219. The internal hazards, nuclear liabilities regulation and human factors specialist inspectors all made recommendations in their assessment reports that needed to be adequately addressed by Sellafield Ltd. prior to ONR issuing Agreement.

220. The two recommendations raised by the nuclear liabilities regulation specialist inspector related to production of detailed arrangements and operating instructions. In response, Sellafield Ltd has provided finalised guidance of waste characterisation of silo waste and the procedures/ instructions for consigning waste packages. The inspector confirmed [65]that they are satisfied with the responses provided by Sellafield Ltd.

221. A recommendation raised by the internal hazards specialist inspector related justification of safety measures for acute hydrogen. In response, Sellafield Ltd has provided a note for the record justifying the safety measures including the limits and conditions. The inspector confirmed [55] that they are satisfied with the responses provided by Sellafield Ltd.

222. The recommendations raised by the human factors specialist inspector related to HF integration, justification of the paper-based system Historian and final versions of operating procedures. The inspector confirmed [66]that they are satisfied with the responses provided by Sellafield Ltd.

5 CONCLUSIONS

223. ONR has assessed the adequacy of Sellafield Ltd.'s proposal justifying commencement of retrieval of MBGW from MSSS C10. Assessments focused

on the hazards introduced by the submission, in particular acute hydrogen, silo liquor level management, nuclear lifting operations and radiological shielding.

224. Based on the safety case evidence ONR has sampled during this assessment process, it is my opinion that for the proposed modification Sellafield Ltd. has provided adequate arguments and evidence to demonstrate that:

- The company has done all that is reasonably practicable within the conduct of its undertaking, such that for the proposed activity it has reduced the risks to the public and workers so far as is reasonably practicable.
- Suitable and sufficient safety measures have been designed and implemented to provide adequate control of the hazards.
- The company has adequately implemented its safety case under Licence Condition 22 such that there are no safety shortfalls that would prevent ONR agreeing to the request for Agreement under their relevant arrangements.
- The proposal has been subject to an adequate level of independent internal challenge and governance in accordance with the company's established arrangements.

225. Where ONR identified shortfalls, these have been captured in regulatory issues which state the actions Sellafield Ltd. needs to take to address our concerns. Sellafield Ltd. has provided satisfactory responses to issues ONR required to be addressed prior to granting the Licence Instrument (Agreement). ONR is satisfied that Sellafield Ltd. can address the remaining issues further to granting the Licence Instrument on a timeframe agreed with the respective ONR Specialist Inspector.

226. Based upon the sample assessments performed, the specialist inspectors judged that Sellafield Ltd. had provided appropriate claims and arguments underpinned by adequate evidence demonstrating that the risks associated with the permission requested have been reduced to ALARP. All the inspectors therefore recommend that ONR should grant a Licence Instrument (Agreement) to Sellafield Ltd. for implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10 and support ONR issuing Agreement within Licence Instrument 540.

6 RECOMMENDATIONS

227. I recommend that ONR issues Licence Instrument 540, Agreement to Sellafield Ltd.'s request to Implementation of PMP B*Stream/B*/* – Issue 1 B*.MSC/*/* Miscellaneous Beta Gamma Waste Retrieval Operations from Compartment 10.

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CM9 Ref: 2022/11048

Table 1
ONR Level two Regulatory Issue 8145
Management of MSSS Original Building leakage to ground of silo radioactive liquor

Action	Requirements
1	Sellafield Ltd. to review and analyse the MSSS environment/safety case for leak to ground to ensure that risks from leakage remain ALARP.
2	Sellafield Ltd to demonstrate that it has adequately characterised the current leak in terms of radiological species, activity and probable source(s) to substantiate the consequence assessment.
3	Sellafield Ltd to demonstrate that it adequately understands the potential migration pathways from leaks at MSSS and identifies outline mitigation response plans for each pathway. The outline mitigation response plans should take account of the realistic timescales to develop and implement detailed solutions verses the credible leak rates such that risk to workers, public and environment is reduced ALARP.
4	Sellafield Ltd to demonstrate that it has adequately assessed the potential effects of the leak on receptors.
5	Sellafield Ltd to demonstrate that it has adequate, substantiated, arrangements for the ongoing monitoring of the OB leak. This should include evaluation of enhanced detection and monitoring systems.
6	Sellafield Ltd to demonstrate that it has evaluated, and where appropriate made arrangements to implement options to prevent, minimise, mitigate or remediate the consequences of leaks from MSSS. SL to implement adequate arrangements for the periodic review of options to prevent, minimise, mitigate or remediate the consequences of leaks from MSSS, and in response to significant changes in the leak characteristics.
7	Sellafield Ltd to demonstrate that the retrieval choreography adequately takes account of ensuring that the risks arising from OB liquor leakage remains ALARP and that retrievals remain achievable.
8	Sellafield Ltd to demonstrate that it has adequately assessed the structural integrity of the OB civils structure to high liquor loss rates.
9	Sellafield Ltd to demonstrate that it is adequately managing aging of the MSSS OB reinforced concrete containment.
10	Sellafield Ltd to demonstrate that the company has a resourced programme for undertaking and completing the tasks the company has identified in addressing the above actions.
