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HALES – Evaporator D

Active Commissioning

Project Assessment Report ONR-SDFW-PAR-17-046
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EXECUTIVE SUMMARY

Modification of Existing Plant: Highly Active Liquid Evaporation and Storage (HALES) Evaporator D Active Commissioning

Permission Requested

In accordance with its arrangements under Licence Condition 22(1), "Modification or experiment on existing plant", of schedule 2 of site licence 103, Sellafield Limited (SL), the licensee, has requested the Office for Nuclear Regulation's (ONR) "agreement" to commence active commissioning of Evaporator D in accordance with a Category A Plant Modification Proposal (PMP).

Background

The HALES facility supports both Thermal Oxide Reprocessing Plant (THORP) operations and Magnox reprocessing operations at Sellafield by receiving Highly Active Raffinate (HAR) and concentrating it through evaporation. The result is concentrated liquor known as Highly Active Liquor (HAL). The HAL is held in interim storage within HALES in Highly Active Storage Tanks (HASTs) prior to it being transferred to another facility, the Waste Vitrification Plant (WVP), where it is processed into glass blocks suitable for long term storage.

In the late 2000's SL identified that it would face a shortage of Highly Active (HA) evaporative capacity as Evaporators A, B and C were approaching their end of life corrosion limits. This would limit SL's reprocessing and decommissioning operations so it decided to construct a new evaporator, Evaporator D, to provide the additional evaporative capacity to secure these operations. SL started construction of Evaporator D in 2009 as an extension to its existing HALES facility which contains the other evaporators.

ONR has been regulating the licensee's design, construction and commissioning of Evaporator D. ONR implemented formal regulatory hold points associated with construction, inactive safety commissioning and active connections which have been assessed and released. There are currently two regulatory hold points remaining on Evaporator D. One is associated with the commencement of active commissioning, assessed in this Project Assessment Report (PAR), and the other is associated with the transition to full operations scheduled for late 2018.

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

ONR carried out a programme of work utilising specialist inspectors in Fault Studies, Human Factors, Chemical Engineering, Mechanical Engineering, Control and Instrumentation and Internal Hazards to assess SL's proposal and supporting safety case. In these activities we have:

- Performed assessments of SL's suite of safety case documents supporting the proposal
- Reviewed the Inactive Safety Commissioning Report (ISCR)
- Reviewed a number of the reports produced by SL's Independent Nuclear Safety Assessment (INSA) team and Internal Regulators
- Held meetings and discussions to feed back our assessment findings and allow SL to present new and/or revised evidence and proposals.
- Witnessed the licensee's emergency exercise demonstration
- Undertaken an inspection of the key interfacing facilities
- Undertaken a readiness review to confirm implementation.

Matters arising from ONR's work

The focus of ONR's assessments for this permission has been on modifications raised during the inactive commissioning phase and assessing the licensee's claims, arguments and evidence demonstrating that the safety systems, both engineered and administrative, operate

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as claimed in the safety case. ONR specialist inspectors engaged with the licensee to resolve a number of minor clarifications and apparent shortfalls. As part of their assessments the specialists identified three areas which need to be addressed prior to the completion of active commissioning:

- Human Factors (HF) Recommendation 1: SL should fully implement its training plan to address off normal/ fault conditions before the start of full operations.
- HF Recommendation 2: SL should fully implement its Human Factors Integration Plan, in particular in relation to workload and environmental aspects within the control room.
- Control & Instrumentation (C&I) Recommendation 1: SL should adequately justify the suitability of every smart device used for safety protection systems on evaporator D.

For HF Recommendation 1, the specialist inspector is satisfied that the licensee has demonstrated its current operators have been adequately trained against these aspects. New operators on Evaporator D will not have gained this experience, therefore additional training will be necessary to address this matter. HF recommendation 2 cannot be addressed until the facility starts active commissioning. The licensee's strategy and arrangements for demonstrating this are judged to be adequate and the risks are being managed appropriately. On this basis I am content that it is safe for the Licensee to commence active commissioning with these shortfalls.

C&I Recommendation 1 potentially reduces confidence in the reliability of parts of some safety systems. Notwithstanding this, ONR is satisfied that Evaporator D has been designed with sufficient redundant and diverse hardwired engineered protective systems providing adequate defence-in-depth against significant fault conditions. These systems have been comprehensively tested during the inactive commissioning phase demonstrating they function as claimed in the safety case. I am content that this does not preclude the start of active commissioning.

I have shared these recommendations with the Licensee with the clear regulatory expectation that they need to be addressed prior to release of the regulatory hold point to transition to full operations scheduled for late 2018. Following engagement with the licensee, the specialist inspectors had no remaining concerns that would prevent their support to agreeing to the licensee's proposal and all specialists support the release of the LI to enable SL to commence active commission Evaporator D.

Conclusions

I have reviewed the licensee's ISCR which demonstrates that all safety systems on Evaporator D have been fully tested and demonstrated to function as claimed in the safety case. I have sampled completed inactive safety commissioning test documents in addition to the completed test documents sampled by the ONR specialist inspectors as part of their assessments. These documents were comprehensive, fully testing the associated safety systems on the facility and completed to a good standard. On this basis I am satisfied that the licensee has adequately inactively commissioned Evaporator D.

I consider that the licensee's fault observation process is adequate and compliant with the guidance published in the ONR safety assessment principles. In addition, I am satisfied that modifications made to the plant during inactive commissioning have been managed appropriately, and that the safety significant changes are incorporated in the PACSR. I have also reviewed the licensee's safety case and arrangements for actively commissioning evaporator D. I judged that these are adequate and demonstrate that risks have been reduced as low as reasonably practicable. These views are underpinned by support from nuclear safety specialist inspectors who have assessed specific areas of the safety case.

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I have undertaken a readiness inspection where I inspected the plant, people and processes associated with actively commissioning Evaporator D and I am satisfied that the licensee is ready to start active commissioning operations.

Overall I am satisfied that the licensee's claims, arguments and evidence presented in the safety case, along with the state of plant readiness, demonstrate that the licensee has completed inactive safety commissioning, and that active commissioning of evaporator D can be safely conducted.

ONR civil nuclear security and the Environment Agency have raised no objections to ONR agreeing to the licensee's proposal. I recommend that ONR issues LI506 to release the regulatory hold point that allows SL to commence active commission of Evaporator D.

Recommendations

The project assessment report recommends that ONR issues LI506 to agree to the commencement of active commissioning of Evaporator D

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LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
C&I	Control and Instrumentation
CNS	Civil Nuclear Security (ONR)
EA	Environment Agency
Evap D	Evaporator D
FOBS	Fault Observation
HA	Highly Active
HAL	Highly Active Liquor
HALES	Highly Active Liquor Evaporation and Storage
HAR	Highly Active Raffinate
HASTs	Highly Active Storage Tank
HAZAN	Hazard Analysis
HF	Human Factors
HFIP	Human Factors Integration Plan
HOW2	(Office for Nuclear Regulation) Business Management System
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
IH	Internal Hazards
IN	Improvement Notice
INSA	Independent Nuclear Safety Assessment
ISCR	Inactive Safety Commissioning Report
LC	Licence Condition
LI	Licence Instrument
LTQR	Lifetime Quality Records
MSC	Management Safety Committee
NSC	Nuclear Safety Committee
OFI	Opportunity for Improvement
ONR	Office for Nuclear Regulation
OSA	Outstanding Actions
PACSR	Pre Active Commissioning Safety Report
PAR	Project Assessment Report (ONR)
PICSR	Pre Inactive Safety Commissioning Report
PMP	Plant Modification Proposal
POCO	Post Operational Clean Out
RGP	Relevant Good Practice
SAMS	Severe Accident Management Strategy
SAP	Safety Assessment Principle(s)

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SCIP	Safety Case Implementation Plan
SL	Sellafield Limited
TAG	Technical Assessment Guide (ONR)
TCA	Temporary Commissioning Aids
THORP	Thermal Oxide Reprocessing Plant
WVP	Waste Vitrification Plant

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1 PERMISSION REQUESTED

1. In accordance with its arrangements under Licence Condition (LC) 22(1), “Modification or experiment on existing plant”, of Schedule 2 of site licence 103, Sellafield Limited (SL), the licensee, has requested (Ref 1) the Office for Nuclear Regulation’s (ONR) “agreement” to commence active commissioning of Evaporator D in the Highly Active Liquor Evaporation and Storage (HALES) facility, in accordance with a Category A Plant Modification Proposal (PMP). The following safety case documentation was submitted for consideration by ONR:
 - HALES/██████/1531 – Plant Modification Proposal – Modification of the Highly Active Liquor Evaporation and Storage (HALES) Facility through Incorporation of Evaporator D (including Active Commissioning). (Ref 2)
 - RP_3507104_SAFE_210_A – Evaporator D Pre Active Safety Commissioning Report (Ref 3)
 - INSA Certificate 3009 (Ref 4)
 - HALES/NEW BUILD MSC Special Minutes (Ref 5)
 - HALES/NEW BUILD MSC Minutes 17-009 (Ref 6)
 - NSC 137 Minutes (Ref 7)
 - ██████ EVAPD/SCIP/1 (Ref 8)
 - Util/SCIP/EvapD/01 (Ref 9)
 - ██████ EvapD/SCIP/2.1 (Ref 10)
 - ██████ EvapD/SCIP/2.2 (Ref 11)
 - ██████ EvapD/SCIP/2.4 (Ref 12)
 - ██████ EvapD/SCIP/2.6 (Ref 13)
 - ██████ EvapD/SCIP/2.4.2 (Ref 14)
 - SC_3507104_SAFE_00005 Rev P9 - Inactive Safety Commissioning Report For HALES Evaporator D (Ref 35)
2. No existing licence instruments have been identified for amendment or revocation as a result of this agreement.
3. This Project Assessment Report (PAR) has been written to present the basis for the permissioning decision made by ONR. The rationale for regulating this permission through a PAR and Licence Instrument (LI) has been agreed with the Superintending Inspector and the scope is captured in the Sellafield Sub-Division Objective 4 task sheet (Ref 15).
4. This report has been prepared in accordance with the requirements of HOW2 (Ref 16).

2 BACKGROUND

2.1 FACILITY INFORMATION

5. The HALES facility broadly consists of two areas: Evaporation and Storage. The Evaporation element consists of three evaporators A, B and C with a fourth evaporator, D, currently completing inactive commissioning. The Storage element comprises of a number of High Activity Storage Tanks (HASTs) divided into ‘old side’ (essentially quiescent) and ‘new side’ (in active operations). Parts of the HALES facility were constructed in the 1950’s and have since been extended and modified over subsequent years and so comprise different generations of HASTs and evaporators.
6. HALES supports both Thermal Oxide Reprocessing Plant (THORP) operations and Magnox reprocessing operations by receiving Highly Active Raffinate (HAR) into buffer storage. The volume of HAR is reduced through evaporation (low temperature boiling at sub-atmospheric pressure), resulting in a concentrated liquor known as Highly Active Liquor (HAL). The HAL is held in interim storage within the HASTs prior to it

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being transferred to the Waste Vitrification Plant (WVP), where it is incorporated in glass within a high integrity welded stainless steel container suitable for long term storage and disposal.

7. In the late 2000's SL identified that it would face a shortage of Highly Active (HA) evaporative capacity as Evaporators A, B and C were approaching their end of life corrosion limits. This would limit SL's reprocessing and decommissioning operations so it decided to construct a new evaporator, Evaporator D, to provide the additional evaporative capacity to secure these operations.
8. ONR has been monitoring SL's use of Evaporators A, B and C to ensure it continues to operate them safely and is managing it's HA evaporative capacity to ensure there are no unnecessary delays to hazard and risk reduction activities on site. In 2015 ONR assessed SL's safety case to justify continued operation of Evaporator C and concluded that the licensee has an adequate safety case to continue with the strategic aim of reducing HAL stocks. ONR wrote to SL stating that we expect Evaporator C to be withdrawn from front line duty when Evaporator D becomes operational, and that SL should be doing all that is reasonably practicable to safely deliver Evaporator D into operations (Ref 17). I have been monitoring the licensee's progress through monthly regulatory engagements and I am content that licensee has taken all reasonable steps to deliver Evaporator D as soon as practicable.
9. ONR has been regulating the licensee's design, construction and commissioning of Evaporator D (Ref 16). ONR has implemented formal regulatory hold points associated with Construction (Refs 18-20), Inactive safety commissioning (Ref 21), and active connections (Ref 22) which have been assessed and released. There are currently two regulatory hold points remaining on Evaporator D. One is associated with the commencement of active commissioning which is assessed in this PAR, and the other is associated with the transition to full operations scheduled for 2018.
10. In addition to the permissioning and assessment work on Evaporator D, ONR attended monthly update meetings to review progress and provide regulatory challenge and advice. During the course of the Evaporator D project, ONR also conducted an investigation focussed on the licensee's quality assurance arrangements. The outcome of this resulted in the issue of an Improvement Notice (IN) in June 2013 (Ref 23). The required improvements were fully implemented to our satisfaction by December 2013 and the IN closed out (Ref 24).

2.2 LICENSEE'S PROPOSAL

11. SL is proposing to start active commissioning of Evaporator D. Once the evaporator D active connections have been completed, one of the first planned activities is route testing to confirm that the connections have been completed correctly. SL states that it will do this by transferring clean or low activity liquors from Evaporator D to HALES and monitoring the liquor levels in the associated tanks to confirm the integrity of transfer route. Once complete, processing active liquors in the evaporator will then commence. This will start with low activity liquors and steadily increase the radiological challenge over the first 5 batches until Evaporator D takes over all HA evaporation operations on site.
12. In support of this activity SL has submitted the safety case documentation cited in Section 1 of this report to ONR.
13. The Plant Modification Proposal (PMP) (Ref 2) identifies this as a category 'A' modification within SL's arrangements as it is a significant modification to the HALES facility with the potential for offsite radiological consequences if inadequately conceived or implemented. The PMP presents the extent of works to test the

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completed active connections, integration into the existing interfacing facilities and to actively commission Evaporator D.

14. The Pre-Active Commissioning Safety Report (PACSR) (Ref 3) is the primary document detailing the licensee's safety case for active commissioning of Evaporator D. This identifies all of the fault sequences and the safety systems installed to prevent these from occurring and/or mitigate the consequences should they occur.
15. I note that SL has subjected the suite of safety case documents to a prescribed checking and approval process in accordance with its arrangements made under the licence conditions. I have taken due note of comments from its Independent Nuclear Safety Assessment (INSA) (Ref 4) which identified minor issues in the safety case which have been adequately addressed. I am satisfied that SL's due process has been followed and that the safety case documentation was approved at the relevant Management Safety Committees (MSC) (Ref 5 & 6) and the Nuclear Safety Committee (NSC) (Ref 7).
16. The Safety Case Implementation Plans (SCIP) details the manner in which the licensee will implement the PACSR into the operational arrangements of the affected facilities (HALES, THORP, Utilities, Evaporator D, active effluents and the Waste Vitrification Plant). To confirm this process, ONR undertook an inspection of the interfacing facilities which confirmed the equipment was installed and tested in line with regulatory expectations (Ref 44 & 45).
17. The Inactive Safety Commissioning Report (ISCR) (Ref 35) provides an overview of all of the inactive safety commissioning tests undertaken on Evaporator D. This document confirms that all safety systems have fully tested and function as claimed in the PACSR.

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

18. The licensee's request for permission to actively commission Evaporator D essentially involves the controlled introduction of radioactivity into the plant for the first time and to start processing HAR. Therefore the focus of ONR's assessment is to ensure that plant, people and processes important to safety have been developed, tested and implemented correctly and demonstrated to function as claimed in the safety case.
19. In accordance with ONR's regulatory strategy and scope defined in the Sellafield Objective 4 Task Sheet (Ref 15) related to this project, ONR carried out a programme of work utilising specialist inspectors in Fault Studies, Human Factors, Chemical Engineering, Mechanical Engineering, Control and Instrumentation, and Internal Hazards to assess SL's proposal and supporting safety case. In these activities we have:
 - Performed assessments of SL's suite of safety case documents supporting the modification
 - Reviewed the Inactive Safety Commissioning Report (ISCR)
 - Reviewed a number of the reports produced by SL's INSA team and Internal Regulators
 - Held meetings and discussions to feed back our assessment findings and allow SL to present new and/or revised evidence and proposals.
 - Undertaken a review of the licensee's emergency arrangements
 - Undertaken an inspection of the key interfacing facilities
 - Undertaken a readiness inspection to confirm implementation.

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20. In line with ONR's permissioning process, further supporting documentation was requested by ONR and is referred to where appropriate within this PAR.

3.1 CONSULTATION WITH OTHER AGENCIES AND DEPARTMENTS

21. I have consulted the Environment Agency (EA), which confirmed that it has no objection to the issuing of a licence instrument in this matter (Ref 25).
22. I have consulted ONR Civil Nuclear Security (CNS), which confirmed that it has no objection to the issuing of a licence instrument in this matter (Ref 26).
23. The nature of this proposal does not relate to the transport or safeguarding of nuclear material, therefore I have not consulted with ONR's inspectors within these areas.

4 MATTERS ARISING FROM ONR'S WORK

24. As part of the Pre-Inactive Commissioning Safety Report (PICSR) permission (Ref 21) ONR assessed the licensee's as built design and safety case in detail and reviewed its strategy for commissioning the plant. This assessment concluded that the as built design was adequate and its commissioning strategy met Relevant Good Practice (RGP) (Ref 46 & 47). Therefore the focus of ONR's assessments for this permission has been any modifications raised during the inactive commissioning phase, and assessing the licensee's claims, arguments and evidence demonstrating that the safety systems, both engineered and administrative, operate as claimed in the safety case. The findings of each specialist inspector are summarised below.

4.1 FAULT STUDIES ASSESSMENT

25. The Fault Studies specialist's assessment (Ref 27) of the Evaporator D PACSR considered whether the issues (see below) identified during inactive commissioning, that resulted in changes to the safety case, have been appropriately implemented on plant and addressed by the updated PACSR. These issues were primarily associated with updates to design assumptions so they better reflected the actual conditions on plant enabling excessive conservatism to be removed. The specialist inspector also confirmed that previous fault studies specialist recommendations raised during the PICSR assessment have been appropriately addressed. The key issues considered were:

- The resolution of the licensee's issue on the integrity of pipe welds to restraint features
- The impact on the safety case of any outstanding Temporary Commissioning Aids (TCA)
- The impact on the safety case of changes to the maximum pressure within the Evaporator due to forced boiling with continued low pressure steam supply.
- Impact of reduced concentration and heat loading of HA Concentrate
- Closeout of the Fault Studies specialist's recommendations made during ONR's Assessment of the PICSR on the development of Operating Rules, segregation of control and safety systems and the potential impact of faults on interfacing facilities.

26. These aspects were assessed through review of the licensee's documentation and through an inspection on site to gather additional evidence to underpin the licensee's claims. The fault studies specialist concluded that these aspects and all the issues raised during inactive commissioning have been adequately addressed, implemented on plant, and incorporated into the licensee's operational arrangements and extant safety case in line with guidance detailed in the ONR SAPs and TAGs. The inspector is satisfied that three fault studies recommendations identified during the PICSR assessment around implementation of operating rules, segregation of control and

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safety systems and the potential impact of faults on interfacing facilities, have been fully addressed and incorporated into the licensee's arrangements and implemented on plant as necessary. Overall the Fault Studies specialist is content with the claims, arguments and evidence presented by the licensee and supports the release of the LI506 to enable the licensee to commence active commissioning of Evaporator D.

4.2 HUMAN FACTORS ASSESSMENT

27. The Human Factors (HF) Specialist's assessment (Ref 28) of the Evaporator D PACSR has considered the extent to which HF aspects of the 'as built' design are compliant with RGP. This considered the important human actions and administrative controls claimed in the safety case and the appropriate substantiation of these measures. The key aspects considered were:
- The extent to which HF aspects of the 'as built' design are compliant with RGP and HF standards and guidance
 - Important human actions and administrative controls claimed in the safety case, with particular reference to any new or modified claims from the PICSR and supporting Hazard Analysis (HAZAN)
 - Training and Competence Assurance (including consideration of normal, off normal and fault recovery conditions as well as control handover and handback when moving between automatic, manual and emergency mode)
 - Assessment of maintenance error
 - Staffing and work organisation (including workload, team structure, interactions with other plants, cultural aspects)
 - Learning from experience (including trials and commissioning activities) and closeout of HF related Opportunities for Improvements (OFIs) and Outstanding Actions (OSA's)
28. These aspects were assessed through review of the licensee's documentation and through an inspection on site to gather additional evidence to underpin the licensee's claims. The HF specialist identified two shortfalls; the first associated with operator training for off normal and fault conditions, and the second on the Human Factors Integration Plan (HFIP) around operator workload and environmental conditions. The licensee has developed two action plans to address the shortfalls before the plant transitions to full operations in late 2018 and agreed these with the HF specialist. To ensure the timely closeout of these plans the HF specialist has raised the following recommendations:
- **HF Recommendation 1:** SL should fully implement its training plan to address off normal/ fault conditions before the start of full operations.
 - **HF Recommendation 2:** SL should fully implement its Human Factors Integration Plan, in particular in relation to workload and environmental aspects within the control room.
29. I am content that HF recommendation 1 does not need to delay the start of active commissioning as the current Evaporator D operators have been in place since 2015/16, they have been involved in commissioning and maintenance activities on plant and as a result of this they have built up a strong understanding of the facility and how it operates in fault and off normal conditions. The HF specialist notes this and some additional training given by the Evaporator D safety case manager and is content that this mitigates the shortfall for the current cohort of operators. However, once the plant goes active gaining this 'hands on' experience will not be possible and the training will need to be improved to reflect this shortfall to ensure new operators have this broad understanding. I have raised a Level 4 Regulatory Issue (RI5840) to track this recommendation and ensure it is completed before the consent to operate permission in 2018.

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30. For HF recommendation 2, the inspector notes that it is difficult to fully demonstrate these aspects on the plant before operations commence, and accepts the licensee's claim that this must be addressed in the active commissioning phase. The HF specialist has reviewed the licensee's strategy and arrangements for demonstrating this and is content that they are adequate and risks are being managed appropriately. On this basis I am content that it is safe for SL to start active commissioning operations with this shortfall. I have raised a Level 4 Regulatory Issue (RI5841) to track this recommendation and ensure it is completed before the consent to operate permission in 2018.
31. Overall the HF specialist considers that SL has taken a structured and systematic approach to consideration of HF in relation to the Evaporator D PACSR. This gives confidence that the plant will support reliable operations, that the operational contribution to safety is understood and that the operator claims are reasonable and justifiable. On this basis, and noting the recommendations, the HF inspector is content that from a human factors perspective, the evidence presented by SL supports the granting of permission to progress to active commissioning.

4.3 CHEMICAL ENGINEERING ASSESSMENT

32. The Chemical Engineering specialist's assessment (Ref 29) of the Evaporator D PACSR builds upon ONR assessments of the Evaporator D Pre-Construction Safety Report and PICSR, which concluded that the process design met regulatory expectations as detailed in the SAPs and TAGs. Therefore the inspector focussed the PACSR assessment on modifications made to the plant that affect the process design intent or process safety systems since the PICSR assessment was completed. The inspector also reviewed the commissioning test processes to confirm the safety systems have been adequately demonstrated to meet the claims made in the safety case. These aspects were assessed through review of the licensee's documentation, inspection on site and through technical discussions with the licensee to gather evidence to underpin the key claims.
33. The Chemical Engineering specialist inspector is satisfied, based on the evidence sampled, that SL has performed adequate inactive commissioning of Evaporator D in line with the guidance in the ONR SAPs. The specialist considers that inactive commissioning has been sufficient to identify where the plant did not meet expectations and that where modifications have been made to address identified shortfalls, they have not adversely affected the safety, functionality or design intent.
34. The specialist inspector is satisfied with the claims, arguments and evidence laid down within SL's PACSR and supporting documents. They agree with SL's claim that inactive safety commissioning has been adequately completed and that the risks associated with the transition to active commissioning are reduced As Low As Reasonably Practicable (ALARP). The Chemical Engineering specialist therefore supports ONR granting SL permission to commence active commissioning on Evaporator D.

4.4 CONTROL AND INSTRUMENTATION ASSESSMENT

35. The Control and Instrumentation (C&I) assessment (Ref 30) of the Evaporator D PACSR builds upon the ONR C&I assessment undertaken of the PICSR and focussed on the following aspects:
 - Assurance that C&I equipment functionality has been adequately demonstrated during inactive safety commissioning
 - Any design changes made since the PICSR
 - Any issues encountered or shortfalls identified, and

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- The resolution of recommendations from ONR's previous assessment relating to work not complete in the PICSR.
36. These aspects were assessed through review of the licensee's safety case documentation and through technical discussions to gather additional evidence to underpin the licensee's claims. The C&I specialist sampled completed inactive safety commissioning tests, reviewed the proof test instructions and the resolution of C&I related FOBs on Evaporator D. The inspector is satisfied that these met regulatory expectations detailed in the SAPs and have been adequately captured in the PACSR.
37. However the inspector considers that there are shortfalls associated with the justification of smart (i.e. computer-based) devices used in safety protection systems and the execution of design changes. To ensure the timely closeout of these shortfalls the C&I specialist recommends that:
- **C&I Recommendation 1** - SL should adequately justify the suitability of every smart device used for safety protection systems on evaporator D.
 - **C&I Recommendation 2** - SL should demonstrate that the protection systems have been adequately tested following design modifications.
38. The shortfall identified in C&I recommendation 1 potentially reduces confidence in the reliability of part of the safety systems on Evaporator D, and on this basis I support the C&I inspector's recommendation and have raised a L3 regulatory issue (RI5838) to ensure this is completed in advance of the transition to full operations permission in 2018. I have reviewed the potential impact of this shortfall against the requirements of active commissioning and note that Evaporator D has nevertheless been designed with sufficient redundant and diverse hardwired engineered protective systems providing adequate means stopping fault conditions from progressing. Therefore, development of a dangerous condition on plant would require failure of multiple engineered protective systems alongside a coincident failure of the plant control system. All of these systems have been comprehensively tested during inactive commissioning (Ref 35) which provides confidence that the affected equipment operates as required. In the event that these failed, all radioactive materials would be retained within the primary shielded containment meaning there would be no direct impact on the operators or public, although this would delay the plant entering full operations as the situation was recovered. In addition to this, during active commissioning SL has implemented enhanced administrative controls and reviews to ensure all systems operate as intended with specialist commissioning resources retained to support early active commissioning operations. The ONR HF specialist reviewed SL's arrangements for using this resource as part of the assessment. The inspector is satisfied that this additional resource provides further assurance on fault identification and recovery during early active commissioning operations. Therefore I am content that it is safe for the licensee to commence active commissioning with this shortfall.
39. I have reviewed C&I recommendation 2 and agree with the C&I inspector that there is a potential shortfall in the licensee's arrangements on control and supervision of works by specialist contractors on systems linked to the one being modified. The shortfall was identified by SL when a specialist contractor was modifying the circuitry on a safety system which affected the power supply to other alarms and was only noted when power was restored. The licensee has revised its arrangements and provided additional evidence regarding modifications made to C&I based safety systems, confirming that these have been adequately tested and function as claimed in the safety case. The C&I specialist inspector has assessed this and is now satisfied that the licensee has fully addressed C&I recommendation 2 (Ref 43).
40. The C&I specialist believes that it would take SL a minimum of several months to address recommendation 1, and by considering the strategic importance of Evaporator

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D, and the reduction in risk in operating it compared to Evaporators A, B and C, has judged that it would be disproportionate to withhold agreement to active commissioning until this shortfall is resolved. On this basis the C&I inspector supports the release of LI506 to enable the licensee to commence the active commissioning of Evaporator D.

4.5 INTERNAL HAZARDS ASSESSMENT

41. The main focus of the Internal Hazards (IH) specialist's assessment (Ref 31) was to reach a conclusion as to whether, from an IH perspective, the PACSR meets the relevant standards and criteria and whether any obstacles remain which may preclude the plant from progressing to the active commissioning phase.
42. Throughout the assessment the IH inspector concentrated on determining the adequacy of the Evaporator D PACSR and supporting documents when measured against relevant ONR Safety Assessment Principles (SAPs), relevant ONR Technical Assessment Guides (TAGs), and other RGP, specifically that:
- The 'as-built' design of the facility meets relevant safety criteria and is capable of ensuring that the plant is robust to the effects of:
 - a fire, in particular that fire protection measures identified in the PICSR and during commissioning have been adequately installed and tested where appropriate;
 - an explosion or catastrophic failure of existing and new air receivers and key compressed gas system components;
 - The measures identified during inactive commissioning as required to protect against other IH are adequate;
 - Learning from Regulatory Issue 4587 around the implementation of the THORP Nuclear Fire Safety Case, has been noted and applied where appropriate;
 - Learning from the Grenfell Tower Fire has been applied to the review of Evaporator D.
43. These aspects were assessed through review of the licensee's documentation and through an inspection on site to gather additional evidence to underpin the licensee's claims. Overall, considering the robust concrete construction, low level of combustible material, active and passive safety measures (including use of fire retardant materials/ablatives paint) the IH specialist inspector is content that SL has implemented suitable fire protection measures. In addition to this the inspector is content that the arrangements for examination, maintenance, inspection and testing of fire systems are adequate and that wider learning from other facilities on site, in line with RI4587, has occurred resulting in enhancements to the maintenance and inspection arrangements for nuclear fire dampers. The IH specialist inspector has not identified any significant shortfalls and supports the release of LI506 to allow SL to commence the active commissioning of Evaporator D.

4.6 MECHANICAL ENGINEERING ASSESSMENT

44. The Mechanical Engineering Specialist's assessment (Ref 32) targeted the mechanical engineering related items giving potential rise to the greatest risks to nuclear safety (diesel generator, containment of HA liquors and the cooling water systems). The main objective for their assessment was to determine that SL is ready from a mechanical engineering perspective to commence active commissioning. The key aspects considered by the mechanical specialist inspector were to:
- Follow up recommendations from ONR's mechanical assessment of the PICSR on the adequacy of operating rules for mechanical equipment and the testing of the emergency diesel generators.

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- Determine the adequacy of mechanical process equipment' particularly in areas where significant quality issues had arisen
 - Determine the adequacy and effect of changes made as a result of inactive commissioning.
 - Gain confidence that the licensee's has given adequate consideration to limits and conditions (Operating Rules) in conjunction with the Fault Studies and HF Specialist Inspectors.
 - Determine the adequacy of pre-active commissioning activities.
45. These aspects were assessed through review of the licensee's documentation and through an inspection on site to gather additional evidence to underpin the licensee's claims. The inspector undertook a sampled assessment of completed commissioning tests and was satisfied that SL has undertaken adequate commissioning of the plant to demonstrate it functioned as claimed in the safety case. The inspector is also satisfied that SL has adequately identified and managed areas requiring change through its FOB process and resolved issues found during inactive commissioning, ensuring that nuclear safety functions and plant performance has not been adversely affected.
46. The mechanical specialist reviewed all the significant quality issues raised by the licensee that related to primary containment. The key issues considered were: primary weld integrity, process pipework staining, the distillate take nozzle alignment and a concession raised during manufacturing of the main evaporator dished end. The inspector reviewed SL's resolution and did not find any significant issues which would affect nuclear safety. The inspector is satisfied that residual risks are acceptable; the equipment is fit for purpose and meets the expectations detailed in the ONR SAPs.
47. The mechanical specialist inspector concludes that SL's mechanical engineering arrangements on plant and within the safety case are appropriate for permission to be granted. The inspector supports ONR granting permission for SL progressing into active commissioning, and judges there to be no significant risk to nuclear safety as a result of these activities from a mechanical engineering perspective.

4.7 PROJECT INSPECTOR ASSESSMENT

48. In addition to the assessments undertaken by the specialist inspectors, I have undertaken my own review as project inspector through routine regulatory engagements and undertaking a readiness inspection (Ref 33). This review covered a wide cross-section of systems, people and processes that have been modified to enable the integration of Evaporator D into the HALES facility.
49. The key findings of the readiness review (Ref 33) were that the HALES and Evap D management, operations and control of work systems have been adequately integrated and are working effectively together. I requested a copy of the method statement (Ref 34) describing the process for removal of the welded end stops on the HALES diverters. This was reviewed by the HF specialist inspector who is satisfied that the method statement describing and controlling the process for removal of the welded end stops met RGP and is adequate (Ref 48).
50. The Life Time Quality Records (LTQR) that I sampled were accessible and complete. However, I noted on the licensee's LTQR tracker that a number of outstanding records existed. The licensee stated these related to systems to be tested/finalised as part of active commissioning and the works associated with active connections. The SL internal regulator has since reviewed the LTQRs associated with the active connections work and is content these are adequate to support starting active commissioning (Ref 49). I am satisfied with this evidence.
51. I consider that LTQRs do not impact on day to day safe operations of the plant; instead they record the baseline data to aid future modifications and decommissioning of the

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facility. On this basis I am content that it is safe for the licensee to start active commissioning without all LTQRs in place. I reviewed the system that the licensee has in place to ensure LTQRs are completed. I judge that this is adequate as it has identified all outstanding records and SL has a plan in place for addressing each of these. I reviewed some outstanding LTQRs and I am content that the system has been adequately implemented. The records were mostly complete with only a few parts missing for which the licensee could demonstrate how and when the records would be completed. I advised SL that I expected all LTQRs to be in completed prior to release of the hold point for transition to full operations in 2018.

52. I reviewed the licensee's management of Fault Observations (FOBS) and noted that there were 82 outstanding from a total of 1863. SL stated that it has reviewed the outstanding FOBS and that none were associated with safety systems on the plant. I reviewed the Inactive Safety Commissioning Report (ISCR) (Ref 35) which confirms all safety systems have been tested and function as required in the safety case. I also reviewed the outstanding FOBs (Ref 36) and judge that none of these impact on the operation of the safety systems; they reflect minor process improvements all of which can be addressed during the active commissioning phase with no significant increase in risk when compared to the inactive phases. I am content that these outstanding FOBs should not preclude active commissioning from commencing.
53. I reviewed the licensee's strategy (Ref 37 & 38) for the route testing and operational ramp up of Evaporator D. I support its proposals to steadily increase the challenge, as this should identify any residual shortfalls in the system with lower risk than progressing straight to higher activity liquors. SL has confirmed that the active connections work is now complete and all 22 high and medium active connections have been subject to non-destructive examination which confirms their integrity (Ref 42). I also note that SL has retained one of the commissioning teams to provide technical support throughout these early batches of liquor feed to ensure any issues are resolved efficiently and effectively.
54. I am satisfied that the licensee has adequately tested the performance of Evaporator D with its safety commissioning tests and the water throughput trials which ONR witnessed earlier this year (Ref 39). During these trials, SL simulated running a batch using water instead of reprocessing liquors; this demonstrated SL can efficiently and effectively operate evaporator D. This gives regulatory confidence that the evaporator is capable of performing as required to meet its strategic requirements to support reprocessing operations to completion, and enable timely Post Operational Clean Out (POCO) of spent fuel management high active facilities.
55. I witnessed an emergency exercise demonstration (Ref 40) whereby the licensee simulated an acid spillage resulting in the shutdown, evacuation, remote monitoring, and recovery operations of the facility. In addition to this, I have reviewed the Severe Accident Management Strategy (SAMS) papers for Evaporator D and the ongoing training and emergency exercise drills (Ref 33). I am satisfied that the licensee has suitable and sufficient arrangements in place for emergency operations.
56. I have also reviewed the licensee's internal process for starting active commissioning and note that this is subject to a detailed review of the status of all aspects of Evaporator D operations. This process has been split into three phases: A1, A2 and A3. The A1 review was used to lift SL's internal hold point to remove the temporary commissioning equipment from the facility, the A2 review assessed if SL is ready to start active connections, and the A3 review to assess if SL is ready to commence active commissioning. I also examined associated arrangements (Ref 33) and I am satisfied these are adequate and that appropriate diligence has been applied tracking and addressing issues and shortfalls identified within these reviews.

5 CONCLUSIONS

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57. This report presents the findings of ONR's assessment of the safety case associated with the licensee's request to commence active commissioning of Evaporator D in the HALES facility on the Sellafield site.
58. I have reviewed the licensee's ISCR which demonstrates that all safety systems on Evaporator D have been fully tested and demonstrated to function as claimed in the safety case. I sampled completed inactive safety commissioning test documents in addition to the completed test documents sampled by the ONR specialist inspectors as part of their assessments. These documents were comprehensive, fully testing the associated safety systems on the facility and completed to a good standard. On this basis I am satisfied that the licensee has adequately inactively commissioned Evaporator D.
59. I am content that licensee's FOBS process is adequate and meets the expectations set out within the guidance published in the ONR safety assessment principles. In addition, I consider that modifications made to the plant during inactive commissioning have been managed appropriately and that the safety significant changes have incorporated in the PACSR.
60. I reviewed the licensee's safety case and arrangements for actively commissioning Evaporator D, and judge that these are adequate and demonstrate that risks have been reduced to as low as reasonably practicable. These views are underpinned by support from nuclear safety specialist inspectors who have assessed specific areas of the safety case.
61. I carried out a readiness inspection of the plant, people and processes associated with actively commissioning Evaporator D, and am satisfied that the licensee is ready to start active commissioning.
62. On the basis of ONR's assessment and inspections, I am content that the licensee's claims, arguments and evidence presented in its safety case adequately demonstrate that the licensee has completed inactive safety commissioning, and that active commissioning of evaporator D can be safely conducted.
63. I consulted ONR civil nuclear security and the Environment Agency who have raised no objections to ONR agreeing to the licensee's proposal. I recommend that ONR issues LI506 to release the regulatory hold point that allows SL to commence active commission of Evaporator D.

6 RECOMMENDATIONS

64. The project assessment report recommends that ONR issues LI506 to agree to the commencement of active commissioning of Evaporator D

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