

Hartlepool Reactor 1 Periodic Shutdown 2021
Consent to Start-up Reactor 1 Following Periodic Shutdown

Project Assessment Report ONR-OFD-PAR-21-012
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EXECUTIVE SUMMARY

Title

Hartlepool Reactor 1 Periodic Shutdown 2021 - Consent to Start-Up Reactor 1 Following Periodic Shutdown.

Permission Requested

EDF Energy Nuclear Generation Limited (NGL), the operator and licensee of Hartlepool nuclear power station, has written to the Office for Nuclear Regulation (ONR) requesting Consent to start-up Reactor 1 following its 2021 periodic shutdown. The request is in accordance with the licensee's arrangements made under Licence Condition (LC) 30(3).

Background

The nuclear site license requires the licensee to periodically shutdown any plant or process under LC30. This is to enable examination, inspection, maintenance and testing (EIMT) to take place. ONR has specified under LC30 (3) that the licensee is required to seek ONR's Consent before the start-up of a reactor after it is shutdown in compliance with LC30(1). At Hartlepool (HRA), reactor periodic shutdowns are every three years, as specified in the Maintenance Schedule (MS) preface, which is an approved document under LC28 (4).

ONR Consent for Reactor 1 start-up following its last periodic shutdown was given on 14 March 2018 (Licence Instrument 564). Owing to the impact of the Covid-19 pandemic, the licensee submitted a safety justification to extend the operating period of Reactor 1 until no later than 4 October 2021, which ONR agreed to (Licence Instrument 573).

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

The main requirements ONR seeks to confirm during a periodic shutdown are:

- The EIMT requirements specified in the station's maintenance schedule in support of LC30 have been complied with.
- EIMT has been carried out by Suitably Qualified and Experienced Persons (SQEP), with an appropriate level of supervision and quality assurance in place commensurate with equipment's safety function.
- Safety issues identified by the Licensee during the outage are adequately addressed with suitable and sufficient safety justification provided to allow a regulatory judgement to be made in support of re-start of the reactor and its safe operation until the next periodic shutdown.

The documentation produced by the licensee for the periodic shutdown and the EIMT of Structures, Systems and Components important to nuclear safety has been assessed by ONR specialist inspectors in: Graphite, Structural Integrity, Electrical Engineering, Control & Instrumentation, Mechanical Engineering, Civil Engineering Chemistry and Conventional Safety. Site inspections were conducted to confirm work was carried out by competent individuals and to the required quality standards.

The Environment Agency has been consulted and does not object to ONR issuing a Licence Instrument giving Consent for Reactor 1 to start-up following its periodic shutdown. Civil

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Nuclear Security has also been consulted and have no security concerns regarding the start-up of Reactor 1.

Matters arising from ONR's work

ONR's inspection and assessment activities during the periodic shutdown required consideration of a number of emergent issues:

The planned exchange and inspection of two boiler closure unit primary retention stud bolts confirmed the presence of Stress Corrosion Cracking (SCC). As a consequence, all of the stud bolts have been inspected and those with indications associated with SCC have been replaced.

The licensee identified a safety case anomaly for the 9% Chrome sections of the boiler tubes, where the severity of start-up transients was thought to be greater than is addressed in the current safety case for boiler tube failure. An ONR structural integrity inspector is of the opinion that, in response to this anomaly, the licensee has been rigorous in the provision of suitable technical justifications to support their judgement that the likelihood of boiler tube failure in the 9%Cr region is two orders of magnitude less likely during the phases of start-up up to Phase 7 than it is at-power.

The licensee's inspection of the CO₂ vaporiser tube nests revealed some corrosion in two of the vaporisers. In response the licensee performed an availability assessment to ensure the system functionality in the case of the vaporisers becoming unavailable. In addition, an audit of the Hartlepool corrosion management programme identified shortfalls against NGL's internal arrangements for corrosion management.

An ONR structural integrity specialist inspector has reviewed the evidence provided by NGL in response to these issues and is satisfied that there are no residual matters that would prevent the safe return to service of the systems covered. Consequently, ONR is satisfied that there are no implications for the return to service of Reactor 1.

There are no outstanding issues preventing the return to service of Hartlepool Reactor 1. A number of intervention findings were made by ONR specialist inspectors during the periodic shutdown which have been recorded in the respective inspection records and reported to the licensee. All matters have now been addressed to allow Consent to start-up Reactor 1 with some minor residual issues that will be followed-up through routine business.

Conclusions

ONR's inspection and assessment of the Hartlepool Reactor 1 2021 periodic shutdown confirms that the licensee has carried out EIMT in accordance with the requirements of its maintenance schedule. The work has been conducted to the required quality standards by competent personnel. No outstanding issues of significance have been identified by the licensee or ONR that prevent the start-up of Reactor 1 following its periodic shutdown.

Recommendation

I recommend that ONR issues Licence Instrument 574, giving Consent to start-up Hartlepool Reactor 1 following its 2021 periodic shutdown.

LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
APEX	Appointed Examiner
BCU	Boiler Closure Unit
BEOM	British Energy Operations Memoranda
C&I	Control and Instrumentation
CNSS	Civil Nuclear Security and Safeguards
CP	Competent Person
CTO	Central Technical Organisation
EA	Environment Agency
EC	Engineering Change
EIMT	Examination, Inspection, Maintenance and Testing
EOSR	Early Outage Safety Review
GAP	Graphite Assessment Panel
HRA	Hartlepool
INA	Independent Nuclear Assurance
INSA	Independent Nuclear Safety Assessment
JCO	Justification for Continued Operation
LC	Licence Condition
LI	Licence Instrument
MS	Maintenance Schedule
NGL	EDF Energy Nuclear Generation Limited
OAP	Outage Assessment Panel
OCC	Outage Control Centre
OID	Outage Intentions Document
OPEX	Operating Experience
ONR	Office for Nuclear Regulation
PCPV	Pre-stressed Concrete Pressure Vessel
PSSR	Pressure Systems Safety Regulations
R1	Reactor 1
RGP	Relevant Good Practice
SCC	Stress Corrosion Cracking
SQEP	Suitably Qualified and Experienced Persons

WAH Work At Height
WSE Written Scheme of Examination

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1 PERMISSION REQUESTED

1. EDF Energy Nuclear Generation Limited (NGL), the operator and licensee of Hartlepool nuclear power station, has written (Ref.1) to the Office for Nuclear Regulation (ONR) requesting Consent to start-up Reactor 1 (R1) following its periodic shutdown. The request is in accordance with the licensee's arrangements made under Licence Condition (LC) 30 (3).

2 BACKGROUND

2. The nuclear site license requires the licensee to periodically shutdown any plant or process under LC30. This is to enable examination, inspection, maintenance and testing (EIMT) to take place. ONR has specified under LC30 (3) that the licensee is required to seek ONR's Consent before the start-up of a reactor after it is shutdown in compliance with LC30 (1). At Hartlepool (HRA), reactor periodic shutdowns are every three years, as specified in the Maintenance Schedule (MS) preface, which is an approved document under LC28 (4).
3. ONR Consent for R1 start-up following its last periodic shutdown was given on 14 March 2018 (Licence Instrument (LI) 564). Owing to the impact of the Covid-19 pandemic, the licensee submitted a safety justification to extend the operating period of R1 until no later than 4 October 2021, which ONR agreed to (LI 573).
4. The licensee set out the scope of work for the HRA R1 2021 periodic shutdown in the Outage Intentions Document (OID) (Ref. 2). This set out the MS requirements, as well as identifying other work to be carried out in support of safety. It also identified the licensee's arrangements for managing safety and quality during the HRA R1 periodic shutdown.

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

5. As the outage project inspector, I have considered the licensee's request for ONR's Consent to start-up HRA R1 after its periodic shutdown. I have followed ONR guidance for LC30: Periodic shutdown, as detailed in HOW2 (Ref. 3).
6. The main requirements ONR seeks to confirm during a periodic shutdown are:
 - The EIMT requirements specified in the station's MS in support of LC30 have been complied with.
 - EIMT has been carried out by Suitably Qualified and Experienced Persons (SQEP), with an appropriate level of supervision and quality assurance in place commensurate with equipment's safety function.
 - Safety issues identified by the Licensee during the outage are adequately addressed with suitable and sufficient safety justification provided to allow a regulatory judgement to be made in support of re-start of the reactor and its safe operation until the next periodic shutdown.
7. Based on the scope of work identified in the OID, I judged it proportionate to obtain advice from the following disciplines to support my recommendation to give Consent:
 - Graphite

- Structural integrity
- Electrical engineering
- Control and instrumentation
- Mechanical engineering
- Civil engineering
- Chemistry
- Conventional safety

8. The inspections and assessments were undertaken in accordance with ONR Technical Inspection and Assessment Guidance. I provided oversight by maintaining an overview of the work undertaken by the ONR specialist inspectors, monitoring periodic shutdown activities and providing regulatory input as necessary.
9. The following sections provide summaries of the ONR specialist inspectors' inspection and assessment findings for each technical discipline supporting the HRA R1 periodic shutdown. These summaries provide the information and evidence to underpin ONR's considerations and judgement to give Consent to start-up HRA R1.

3.1 GRAPHITE

10. References 4, 5 and 6 report the findings of ONR's graphite inspection and assessment of the HRA R1 2021 periodic shutdown activities.
11. The inspector conducted an LC28 compliance inspection focused on arrangements for graphite core examination, inspection and testing and the observations made during the periodic shutdown activities. The objectives of this intervention were:
 - Inspection of the licensee's graphite inspection arrangements on site.
 - Inspection of the quality of the graphite core inspections.
 - Inspection of training records and quality control procedures of inspection staff.
12. The inspector considered that the licensee's arrangements with regards to graphite core inspection during the periodic shutdown were suitable and adequate. In the inspector's opinion, the visual records and the data sampled were of adequate quality for the licensee to form an accurate judgement and sentence the cracks.
13. The inspector also assessed the inspection results relating to the graphite core for the HRA R1 2021 periodic shutdown. The inspector compared the findings against the claims and limits in the current graphite safety case and assessed them against the expectations laid down by the relevant Safety Assessment Principles.
14. The licensee's core inspection activities during the HRA R1 2021 periodic shutdown consisted of a minimum of:
 - Inspection of 20 fuel channels both visually and dimensionally using New In-Core Inspection Equipment.
 - Trepanning of a minimum of 30 graphite specimens, with a target of 36 samples.
 - Visual inspection of one control rod channel.
 - Eddy current inspection of 6 fuel channels.

15. At the time the inspector conducted his assessment, only 8 of the 20 planned fuel inspections had been completed. Based on the information sampled, the inspector was satisfied that the inspection programme was being adequately monitored and controlled by the Graphite Assessment Panel (GAP). The inspector was content that the GAP appeared to provide adequate oversight and challenge of the periodic shutdown activities. The inspector's assessment was based on approved inspection sheets and from a verified statement provided by the licensee in advance of the EC justifying the return to service.
16. The inspector was content that the INSA clearance statement for the return to service EC would be sufficient to formally confirm that all the necessary inspections have been completed and reported prior to the return to service.
17. Based on the inspector's assessment of the HRA R1 2021 graphite core inspection results and justification for return to service, the inspector has no objection to recommending that Consent is given to return HRA R1 back to service, subject to:
 - Confirmation that all of the planned graphite inspections have been completed and that the findings do not challenge the safety case.
 - The EC summarising the findings of the graphite inspections is provided to ONR as part of the justification for the return to service and that it has been through the INSA process.
18. The licensee has completed the planned graphite inspections and the findings have been reviewed and sentenced by the GAP. The inspector observed the GAP meeting and was content that the GAP process was suitable. The inspector was content that the GAP sentencing of the defects appeared appropriate. The inspector confirmed (Ref. 7) that all of the graphite inspections have been completed and the findings do not challenge operation under the existing graphite safety case NP/SC 7570.
19. ONR has subsequently received and is content with EC 370463 (Ref. 27) summarising the findings of the graphite inspections and the associated INSA approval statement (Ref. 28).

3.2 STRUCTURAL INTEGRITY

20. References 8 and 9 report the findings of ONR's structural integrity inspection and assessment of the HRA R1 2021 periodic shutdown activities.
21. The inspector assessed the adequacy of the following, in line with LC28, and compliance with Pressure Systems Safety Regulations (PSSR) during the HRA R1 2021 periodic shutdown:
 - Inspections of welds
 - Pipework
 - Vessels
 - Metallic reactor internal structures and components
 - Main cooling water system
 - Pipe hangers and thermal movement supports
22. The assessment was conducted in three stages:

- Pre-outage review of the licensee's OID and supporting inspections specification documentation.
 - Visit to site during the periodic shutdown to assess the adequacy of the inspections in progress and how the licensee is complying with the commitments provided in the outage intents document.
 - Monitoring of the Outage Assessment Panel (OAP) minutes throughout the periodic shutdown to identify how the inspections are progressing and how any emergent issues identified are managed and resolved.
23. The inspector was not satisfied that sufficient attention was being paid to the corrosion management programme highlighted by the fact that HRA were unable to demonstrate compliance with their own arrangements, BEG/SPEC/ENG/CTS/031 (CTS/031). Consequently, the inspector raised Regulatory Issue 9068 to ensure that threats from corrosion are managed as low as reasonably practicable (ALARP) and demonstrate compliance with CTS/031. The inspector did not consider that this would prevent ONR giving Consent to return to service following the current periodic shutdown since risks from corrosion have been demonstrated to be low and can be adequately managed by the regulatory issue.
24. The inspector was content that the claim that boiler spine failure during start-up is very low has been adequately justified. Routine engagement is scheduled with regards to the licensee's long term structural integrity boiler spine safety case and its associated structural integrity work programme for which the inspector will utilise to ensure predicted frequencies remain consistent with the extant case.
25. The inspector has considered the basis of structural integrity claims and is content that adequate justification has been made that boiler tube failure predictions remain below the licensee's prescribed post-trip safety limits. Consequently, the inspector is supportive of the deferral to update EC 369159/001, which addresses post-trip boiler tube failure frequencies, until after return to service following its periodic shutdown. Revision of EC 369159/001 is scheduled for completion by the end of December 2021, consideration of which will form part of ONR's structural integrity specialism routine regulatory activities.
26. The inspector is of the opinion that the licensee has been rigorous in its approach and provided suitable technical justifications on its methods utilised to support that the likelihood of boiler tube failure in the 9%Cr region is two orders of magnitude less likely during the phases of start-up up to Phase 7 than it is at-power.
27. At the time of the inspector's assessment, the safety case, EC 370544, supporting return to service of HRA R1 following the discovery of stress corrosion cracking of Boiler Closure Unit (BCU) stud bolts was in preparation and ONR's engagement on this work was ongoing. The inspector was content that risks are considered tolerably low to allow restart of HRA R1 on the basis that all studs with indications will be replaced prior to return to service and that there are reasonable grounds to support the integrity of the remaining studs.
28. Overall, based upon the items that the inspector sampled, and the evidence presented, the inspector judged that the licensee has undertaken sufficient inspection and assessment to support the safe return to service of HRA R1. The inspector was satisfied that the inspections have been undertaken in line with the HRA R1 2021

periodic shutdown inspection documentation and that the licensee has followed corporate procedures in the selection, assessment and sentencing of component inspections and subsequent results.

29. The inspector's judgements and conclusions were based on some information that had not completed the licensee's due process at the time of the assessment. From a structural integrity perspective, the inspector supports ONR issuing Consent to start-up of HRA R1, following the 2021 periodic shutdown contingent on ONR receiving the following information:
- Confirmation of receipt of the independent Nuclear Safety Assessment (INSA) clearance statement for EC 370544.
 - Confirmation from the structural integrity inspector that there are no issues that would undermine the arguments made in EC 370544.
 - The INSA certificate for the return to service EC 367278 report should be submitted as part of the licensee's application for Consent to return to service to show satisfactory completion of the inspection programme and completion of the work of the OAP.
 - A return to service statement from the PSSR Competent Person (CP) should be submitted as part of the licensee's application for Consent to return to service to show satisfactory completion of PSSR inspections.
 - A demonstration that the inspections not covered by the Appointed Examiner (APEX) and third-party PSSR CP have been completed satisfactorily. The return to service report EC 367278 must include a statement from the licensee's second party PSSR CP supporting the fitness for return to service.
30. ONR has subsequently received EC 370544 (Ref. 32) and the associated INSA approval statement (Ref. 33). The inspector is satisfied (Ref. 34) there are no issues that would undermine the arguments made in the safety case to address the discovery of Stress Corrosion Cracking (SCC) in BCU studs.
31. ONR has subsequently received and is content with EC 367278 (Ref. 25) and the associated INSA approval statement (Ref. 26); the return to service statement from the PSSR CP supporting the fitness for return to service (Ref. 30) and a demonstration that the inspections not covered by the APEX and third-party PSSR CP have been completed satisfactorily (Ref. 38).
32. The following issues do not prevent the return to service of HRA R1 as the inspector did not consider them to be related to periodic shutdown activities.
- Regulatory Issue RI-10475 has been raised for the licensee to provide ONR with an update of EC 369159/001 for information in order for ONR to consider, as part of routine regulatory business, the long-term justification of 9%Cr boiler tube failure predictions and its implementation of Tube Wall Delay.
 - ONR structural integrity assessors should review and consider EC 370544 and the JCO which supports long-term BCU stud integrity.

3.3 ELECTRICAL ENGINEERING

33. Reference 10 reports the findings of ONR's electrical engineering inspection of the HRA R1 2021 periodic shutdown activities.
34. The inspector conducted an LC 28 compliance inspection targeting the planned electrical work being undertaken as part of the HRA R1 2021 periodic shutdown, including the planned electrical EIMT activities from the station's OID and any reactive electrical work emergent from the shutdown. The inspection covered a sample of the electrical engineering plant and equipment relevant to HRA R1, consisting of:
- Routine switchboard maintenance and testing including 11kV short break logic testing
 - Unit and unit aux transformer routines
 - Generator 1 protection relay testing
 - 11kV unit switchboard interconnector timer relays
35. The inspection was conducted on-site during the shutdown. The scope included a brief overview, explanation and demonstration of the electrical engineering aspects of the shutdown. The inspection focused on the progress of the shutdown work activities; findings of significance; resolution of findings, where appropriate; deferred activities; a sample of documentation related to the outage work and a plant walk-down to observe the work.
36. Based on the evidence sampled, the inspector was satisfied that there were no significant shortfalls with the implementation of the licensee's arrangements for LC 28 for the electrical work during the HRA R1 2021 periodic shutdown. The targeted inspection undertaken confirmed that the planned EIMT and modification activities during the shutdown were appropriate and that electrical plant and equipment was being maintained in accordance with the established arrangements.
37. From the evidence gathered during this intervention, the inspector did not identify any issues from the electrical work activities which would prevent ONR granting Consent for HRA R1 to return to service.

3.4 CONTROL AND INSTRUMENTATION

38. Reference 11 reports the findings of ONR's Control and Instrumentation (C&I) inspection during the HRA R1 2021 periodic shutdown.
39. The focus of the inspection was to verify that relevant work activities have been carried out in relation to C&I equipment and systems important to safety in order to confirm that they remain fit for their intended purpose.
40. The inspection sampled C&I related LC 28 activities associated with the following equipment and systems:
- Reactor safety circuits:
 - Guardlines.
 - Neutron flux detectors.

- Control rod control system.
 - Reactor post trip logic system.
 - Data processing and control system.
 - In-core and hot box dome thermocouples.
 - Gas circulator control system.
 - Chloride ingress protection system.
41. The inspection also involved a sample review of notable C&I related incidents and operating experience (OPEX) relevant to HRA during the last three years.
42. The inspector found that EIMT related activities referenced in the OID for C&I equipment and systems important to nuclear safety that were sampled to have been satisfactorily completed or were on schedule to be completed. The inspector was confident, based on the information provided, that the outstanding EIMT activities would be completed satisfactorily.
43. The inspector identified a small number of maintenance record keeping shortfalls which were raised with the relevant system engineers, who agreed to address them. The inspector did not consider that these shortfalls posed an immediate or significant risk to nuclear safety or needed to be addressed before R1 returns to service.
44. The inspector found that the C&I equipment and system stakeholders interviewed had a good understanding of the systems and equipment they were responsible for and that they appreciated the importance of the periodic shutdown work being undertaken. The inspector observed examples of proactive equipment performance trending and considered the safety circuits hot spare arrangements and the safety circuits and Data processing and control system equipment test facilities to be good examples of equipment sustainment relevant good practice (RGP).
45. The inspector did not identify any significant signs of age-related degradation with respect to the items of C&I equipment that were inspected. The inspector did note that a small number of post office type relays located in the R1 equipment room, were mottled inside. The inspector raised a level 4 regulatory issue to capture this issue and will also monitor its progress through to resolution as part of normal regulatory business. The inspector did not consider that this posed an immediate or significant risk to nuclear safety or needed to be addressed before R1 returns to service.
46. During the shutdown, the inspector conducted an additional inspection (Ref. 12) to establish whether HRA had undertaken appropriate activities to assess, understand and address recent gas turbine (GT) reliability issues.
47. Based on the evidence sampled, the inspector considered that HRA had adequate GT maintenance arrangements and that various GT start reliability issues that have arisen were sufficiently understood and being adequately addressed. The inspector did not identify any common links between the various start reliability issues and considered that HRA's GT health monitoring arrangements were adequate. The inspector was content that adequate recovery and health sustainment activities were being undertaken.

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48. The inspector did not identify any C&I issues that would pose an immediate or significant risk to nuclear safety and supported issuing a Consent to allow HRA R1 to return to service.

3.5 MECHANICAL ENGINEERING

49. Reference 13 reports the findings of ONR's mechanical engineering inspection of the HRA R1 2021 periodic shutdown activities.
50. The inspector conducted an on-site inspection against LC 30 to gather evidence to support ONR's permissioning decision to give Consent to restart HRA R1 following its 2021 periodic shutdown.
51. The inspector targeted the following systems, based on their importance to the safe operation of R1 from the claims set out in the Station's Safety Case:
- Gas Circulator Refurbishment and Installation.
 - Refurbishment of R1 reactor vessel CO₂ Safety Relief Valves.
 - Nitrogen Secondary Hold Down System Maintenance.
 - Mechanical Evaluation of Control Rods.
52. Based on the inspection findings, the inspector considered that HRA has complied with its periodic shutdown MS requirements for R1 with respect to mechanical engineering aspects. The inspector considered that the maintenance work sampled has been carried out in line with station's procedures by SQEP personnel, with the appropriate level of supervision and compliance with quality requirements. The inspector did not identify any matters that would challenge start-up of R1 or its safe operation until its next periodic shutdown.
53. The inspector supported ONR giving Consent for start-up of HRA R1 following completion of work set out in its MS for its 2021 periodic shutdown.

3.6 CIVIL ENGINEERING

54. On this occasion as a sampling organisation, ONR did not consider (Ref. 14) it proportionate to conduct any formal civil engineering inspection or assessment of the HRA R1 periodic shutdown activities. This is because the ageing mechanisms of the civil engineering components are well understood, gradual and predictable. Recent ONR assessments have not identified any significant issues or shortfalls when compared against relevant good practice or evidence to suggest that the safety functions provided by the pre-stressed concrete pressure vessel (PCPV) will be compromised in the immediate future.
55. The licensee has a well-developed process for ensuring the safety of the PCPV provided by the Appointed Examiner (APEX). To provide additional confidence in ONR's decision, I engaged with the APEX (Ref. 15) to discuss the progress of PCPV EIMT required under the Written Scheme of Examination (WSE). The scope of the engagement was developed with input from an ONR civil engineering specialist inspector (Ref. 16).
56. The areas covered in the APEX report (Ref. 17) include surveillances, inspections and tests of the following PCPV items:

- Concrete Surface
- Anchorages
- Tendon Loads
- Pre-stressing Strand
- Settlement and Tilt
- Embedded Strain Gauges
- Vessel Temperature
- Reactor Coolant Leakage
- Pressure Vessel Cooling Water
- Top Cap Deflection
- Boiler Closure Units (BCUs)

57. The surveillances, inspections and tests assessed were not limited to those carried out during the 2021 periodic shutdown, but also included activities undertaken since the previous R1 periodic shutdown. I did not identify any issues or areas of concern that required further engagement with the ONR civil engineering specialist inspector or that would justify withholding Consent.

3.7 CHEMISTRY

58. Reference 18 reports the findings of ONR's chemistry inspection of the HRA R1 periodic shutdown activities.

59. The chemistry specialist inspector conducted an LC 28 compliance inspection focusing on the feedwater chemistry control EIMT of plant required to maintain adequate feedwater chemistry for normal operations, start-up and shutdown. The objectives of the intervention were to review:

- Feedwater chemistry compliance and adequacy of operating rules.
- Plant ability to maintain adequate chemistry control.
- The chemistry functions SQEP capability and resilience.

60. The inspector reviewed chemistry compliance data for the previous operating period and through the shutdown. The inspector judged that chemistry control compliance with technical governance in the period immediately preceding and through the outage was adequate. The inspector identified some gaps with respect to implementing links in Living Safety Case Documents to the main chemistry operating rules and instructions contained in British Energy Operations Memoranda (BEOMs) but was content this will be addressed by separate Central Technical Organisation (CTO) actions.

61. The inspector sampled ongoing work to inspect the bulk sulphuric acid storage tank associated with the condensate polishing plant. This tank had a recently discovered penetrating defect which was in the process of being non-destructively tested to determine the extent of the underlying corrosion. The work was moving quickly on this emergent matter but was progressing diligently and no chemistry related concerns were identified.

62. The licensee has confirmed (Ref. 35) that the bulk sulphuric acid storage has been emptied and will be repaired and inspected prior to returning to service. A temporary

sulphuric acid tank has been installed, under EC370563 (Ref 36), and will be used until the repairs are complete.

63. The inspector identified that HRA chemistry function is currently below its nuclear baseline requirements. However, the inspector was content that actions were in place to address this, with the chemistry function at station now reporting to technical support and safety as opposed to operations.
64. Overall, the inspector had no findings that could undermine nuclear safety and has no objection to HRA R1 Return to Service.

3.8 CONVENTIONAL SAFETY

65. Reference 18 reports the findings of the ONR's conventional safety inspection during the HRA R1 2021 periodic shutdown.
66. The inspection targeted the management of industrial safety hazards present during the HRA R1 shutdown period, including planning of outage activities that involved work at height (WAH), and control of welding fumes. The inspectors also sought evidence on progress made to address findings from the previous outage inspection on industrial safety including machinery guarding, WAH, and workplace lighting, as well as fleet-wide issues including industrial safety capability, event categorisation, and overhead crane access.
67. The inspector was satisfied that the licensee had made sufficient improvements on WAH arrangements since the last outage industrial safety inspection and demonstrated adequate management of hazards and risks associated with WAH against relevant good practice.
68. The inspector was satisfied that the licensee demonstrated adequate management of hazards and risks associated with welding fumes against relevant good practice. The inspectors considered there was a good level of general awareness on welding fumes and controls, although some minor shortfalls around use of appropriate respiratory protective equipment were identified.
69. Two ONR Level 4 Regulatory Issues were raised on the two areas of shortfalls identified, one was the selection and use of respiratory protective equipment by a contractor partner and another was the provision of adequate workplace lighting by the licensee, which was observed to be dim in areas during the plant walkdown. An existing ONR Level 4 Regulatory Issue on machinery guarding remains open and has been updated to include the observation made during this inspection that good progress had been made, but some guards remained to be fitted. ONR planned to follow up these Regulatory Issues as part of routine engagements.
70. The inspector judged that there were no findings from the inspection that would prevent the restarting of plant and would support ONR's decision to give Consent to restart HRA R1 following its 2021 periodic shutdown.

3.9 PROJECT INSPECTION

71. In addition to the nuclear safety assessments identified, I sought the opinion of ONR's Civil Nuclear Security and Safeguards (CNSS) site security inspector, to understand if there were any aspects of the periodic shutdown that may have an impact on ONR's decision to give Consent to start-up HRA R1. The CNSS inspector confirmed (Ref. 20) that there were no objections or issues that would impact on the decision to give Consent to start-up HRA R1.
72. Throughout the periodic shutdown I engaged with licensee to maintain awareness of the progress of shutdown activities and emergent issues. In addition, I attended a weekly oversight meeting with the licensee's outage lead team. The weekly meeting covered:
- Overview of the shutdown performance
 - Review of events
 - Progress and critical path
 - Feedback on ONR intervention findings
 - Review of issues affecting start-up
 - Key outage dates and activities
73. Reference 21 reports the findings of my engagement with the licensee prior to the commencement of the periodic shutdown. The focus of the engagement was to:
- Understand the Station's arrangements for preparing for the periodic shutdown.
 - Determine the status of the station's outage preparation.
 - Identify any threats or risks to the delivery of the periodic shutdown.
74. I was satisfied that the planning and preparation for the periodic shutdown had been conducted in accordance with the licensee's arrangements. Although there were progress shortfalls against the Pre-Outage Milestone Plan, I was content that adequate recovery plans were in place and that there no significant threats to the delivery of the shutdown.
75. Reference 15 report the findings of my inspection during the HRA R1 2021 periodic shutdown. The inspection targeted:
- Compliance with the licensee's arrangements for outage management and the mitigation of operational risk.
 - Management of the shutdown through the Outage Control Centre (OCC)
 - Routine daily outage meetings
 - Delivery of pre-job briefs and shutdown related activities.
76. I judged that the licensee adequately demonstrated compliance with the requirements of LC 30. I considered the management of the shutdown to be effective and found the OCC to be running efficiently and dealing effectively with the emergent outage issues. All of the meetings I observed were well attended and I observed open discussions on the various outage activities and suitable challenge raised where required. There was evidence of good situational awareness, effective decision making, work prioritisation and appropriate contingency planning for

potential problems. I observed a range of shutdown related tasks being performed with evidence of effective control and supervision of both the licensee's staff and contract personnel.

77. I observed the licensee's internal nuclear assurance (INA) team on their early outage safety review (EOSR) inspection (Ref. 15) The early outage review looked at work area standards and working practices. The purpose of the EOSR is to:

- Assist station management in reducing or eliminating undesirable behaviours and conditions which could have an adverse impact on outage success.
- Identification of performance shortfalls in the early stages of an outage.
- Identify any Fleet issues for resolution in the longer term.

78. The inspection took the form of task-based observations in the morning and plant focused observations in the afternoon. A hot debrief was given to the station lead team at the end of each day and significant issues were followed up immediately. The EOSR focused on the following areas:

- NGL life saving rules
- Defence in depth
- Protected plant
- Confined spaces
- Lifting operations
- Working at height

79. At the end of the inspection feedback was given on positive observations, areas to watch, areas for improvement and Fleet level considerations. There were some minor issues identified which were accepted by the station lead team and commitment was given to act on them. There was positive engagement between the INA team and the station lead team.

3.10 RETURN TO SERVICE MEETING

80. The return to service meeting was held on 17 November 2021 (Ref. 22). The licensee summarised the findings of EIMT activities carried out on R1 under LC28 to confirm that the objectives for the 2021 periodic shutdown have been met and to demonstrate by reference to the current safety case, that the plant is fit to return to service for a further period of operation.

81. The licensee provided updates for each of the following safety management:

- Nuclear Safety
- Industrial Safety
- Fire Safety
- Radiological Protection
- Quality

82. Slides were also presented for each of the following outage islands:

- Reactor
- Condensate and Feed
- Turbine and Auxiliary Systems

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- Pile Cap
- Protection and Electrical
- Cooling Water
- Boiler Tops
- Boilers

83. ONR advised the licensee that the issues identified with the BCU boiler studs, corrosion management and CO₂ vaporisers would need to be resolved before Consent to start-up was given. ONR has received and is content with the licensee's availability assessment of the CO₂ vaporisers (Ref. 24) following internal inspection. The BCU boiler studs, and corrosion management are discussed in section 3.2.

3.11 ENGAGEMENT WITH OTHER GOVERNMENTAL AGENCIES

84. Before granting Consent, it is established practice to notify other competent regulatory authorities of ONR's intention to ensure there are no specific objections that may compromise other regulatory requirements. The HRA Environment Agency (EA) site inspector was informed that ONR intended to issue an LI giving its Consent to the restart of HRA R1 following the 2021 periodic shutdown and confirmed that they had no objections (Ref. 23).

4 MATTERS ARISING FROM ONR'S WORK

85. There are no outstanding matters arising from the inspection and assessment work carried out by ONR.

5 CONCLUSIONS

86. The licensee's request for ONR's Consent to start-up HRA R1 following periodic shutdown in compliance with LC 30(3) has been supported by their letter (Ref. 1) stating that all plant maintenance schedule requirements and modifications identified in the HRA R1 outage intentions document have been met. This excludes the testing of equipment that can only take place when the reactor is pressurised, and steam-raising commences. Based on the evidence from ONR's interventions and assessments, I am content that the licensee has complied with their plant maintenance schedule requirements.

87. The licensee's justification to return HRA R1 to service following the in-service inspections and associated assessments is set out in EC 367278 (Ref. 25). It confirms that, with the exception of BCU stud bolts, justified in EC 370544 (Ref. 32), the inspection programme has been successfully completed and the reactor is fit for return to service, this is supported by the INSA approval statement (Ref. 26).

88. The licensee's justification to return HRA R1 to service following the graphite core inspections is set out in EC 370463 (Ref. 27). It confirms that the observations were within the allowable bounds of the safety case and there are no issues that would prevent HRA R1 start-up, this is supported by the INSA approval statement (Ref. 28)

89. The licensee has submitted the HRA R1 APEX report (Ref. 17) following completion of the civil inspection and maintenance of the PCPV. This concludes that there are no safety issues associated with returning the vessel back to service.

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90. The licensee's findings from thorough examination of PCPV penetrations (Ref. 29) were found to be satisfactory. The claims and arguments presented in these documents are in line with their views from ONR intervention findings and assessments. The licensee supports this claim with statements from their independent third party PSSR Competent Person, Bureau Veritas (Ref. 30), who confirmed that there were no compliance issues from inspections carried out in accordance with the PSSR written schemes of examination.
91. HRA INA has provided their INA concurrence (Ref. 31, 37). Based on their R1 shutdown concurrence activities, no issues have been identified that would challenge their support for the start-up of HRA R1. Based on the evidence gathered from ONR's intervention and assessment activities for the HRA R1 2021 periodic shutdown, together with the claims, arguments and evidence presented by the licensee in its request for Consent, I judge that HRA has complied with its LC 30(1) requirements for R1 in performing the required EIMT in accordance with the station's plant maintenance schedule. The work was performed in accordance with the station's procedures by competent SQEP's working to identified quality arrangements and with appropriate supervision. Where EIMT findings were anomalous with safety case requirements, the licensee has provided adequate safety justification that relevant safety case limits and conditions are not challenged.
92. In conclusion, ONR has not identified any matters of concern that would prevent ONR giving Consent for HRA R1 to start-up following its 2021 periodic shutdown.

6 RECOMMENDATIONS

93. I recommend that ONR issues Licence Instrument 574, giving Consent to start-up Hartlepool Reactor 1 following its 2021 periodic shutdown.

7 REFERENCES

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16. Civil Engineering Inspector's advice on Civil engineering areas for considerations. ONR. E-mail dated 29 September 2021. CM9 2021/78769.
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19. Hartlepool Reactor 1 Periodic Shutdown 2021. Industrial Safety Inspection. 27-28 October 2021. ONR-OFD-IR-21-110. CM9 2021/81381.
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21. Hartlepool Reactor 1 Periodic Shutdown 2021. Pre-shutdown meeting. ONR- OFD-CR-21-482. 8 September 2021. CM9 2021/70915.
22. Hartlepool Reactor 1 Periodic Shutdown 2021. Start-up meeting. 16 November 2021. ONR-OFD-CR-21-680. CM9 2021/84108.
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