Office for Nuclear Regulation

Hunterston B Reactor 3 Periodic Shutdown 2019

EDF Energy Nuclear Generation Limited (NGL) – Hunterston B – Consent under Licence Condition 30(3) to start-up Hunterston B Reactor 3 following periodic shutdown

Project Assessment Report ONR-OFD-PAR-18-031
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EXECUTIVE SUMMARY

Title

EDF Energy Nuclear Generation Limited – Hunterston B – Consent under Licence Condition 30(3) to start-up Hunterston B Reactor 3 following periodic shutdown.

Permission Requested

EDF Energy Nuclear Generation Limited (EDF NGL), the licensee of Hunterston B power station, has requested that the Office for Nuclear Regulation, grants Consent to start-up Reactor 3 following its periodic shutdown as required under Licence Condition 30(3) of nuclear site licence number Sc.13.

Background

NGL is licensed to operate two advanced gas-cooled reactors (AGRs), known as Reactor 3 and Reactor 4 at Hunterston B Power Station.

To continue to operate safely and reliably, systems, structures and components important to safety require regular and systematic examination, inspection, maintenance and testing. Whilst some of these activities can take place when the reactor is at power, many of them require it to be shut down. In addition, the licensee also undertakes plant safety improvements to be implemented where these are deemed to be reasonably practicable. The licensee's arrangements require that periodic shutdowns, as required by Licence Condition 30(1), are carried out every three years on each reactor at Hunterston B. The previous start-up Consent for Reactor 3 was granted on 30 November 2015 via Licence Instrument 549.

Inspection of the Hunterston B Reactor 3 graphite core in March 2018 identified cracking which was in excess of the operational allowance of 350 axially cracked bricks but well within the upper safety case limit of 700 axially cracked bricks. As a result, Hunterston B Reactor 3 has remained shut-down while the licensee has prepared a revised graphite safety case to justify a return to service of Reactor 3.

In parallel, the licensee has completed the routine outage maintenance requirements which are the focus of this Project Assessment Report (PAR). The statutory outage for Reactor 3 was originally due to commence by 30 November 2018. Prior to this date, EDF NGL requested from ONR an extension to the plant's operating period to 30 November 2019 which ONR agreed to under LI 559. EDF NGL subsequently completed the outage work during the period between February and April 2019.

A separate PAR has been produced by ONR which assesses the suitability of the graphite core safety case for Reactor 3 and, together with this PAR, represents the view of ONR on issuing Consent for Reactor 3 to return to service. The graphite PAR concluded that the operation of Hunterston B Reactor 3 to a core burn up of 16.425 TWd has been adequately justified by EDF NGL (roughly six months continued operation at power).

The length of time elapsed since the statutory outage work took place has meant that the routine process that ONR would follow for a statutory outage has been modified. This was to ensure that, before issuing Consent to restart, ONR has had a greater level of oversight of the completion of maintenance activities and also considered the capability and readiness of station personnel to safely operate Reactor 3 after so long shutdown.

During the Reactor 3 periodic shutdown 2019 the licensee conducted:

- Examinations, inspections, maintenance and testing activities in accordance with the maintenance schedule,

- Inspections to support the station safety case,
- Work to comply with statutory requirements,
- Remedial work to rectify plant defects,
- Plant safety improvements where these are deemed to be reasonably practicable.

In addition to the routine outage related work the licensee implemented its equipment preservation procedures to ensure that all equipment was suitably ready for return to service after being shut down for significantly longer than during routine outages. ONR inspected these arrangements during the oversight of outage activities.

Where inspection work revealed the potential for an adverse plant condition, the licensee has assessed the inspection results in accordance with its arrangements and taken appropriate remedial action as necessary prior to reactor start-up.

The Hunterston B Station Director has written to ONR requesting Consent to start-up Reactor 3. In that letter, the Station Director confirmed that all maintenance required for start-up had been completed, with the exception of those items which can only be completed during the return to service. Completion of these items will be reported to ONR post start-up.

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

ONR inspectors have inspected a sample of the licensee's arrangements for controlling and completing the examination, inspection, maintenance and testing requirements of the maintenance schedule, and other plant modifications of nuclear safety significance, as identified within the licensee's outage intentions report. This has included attending the significant outage planning and progress meetings and visiting site where necessary to examine aspects of the implementation of the licensee's arrangements.

The regulatory interventions carried out by ONR have not identified any issues of safety significance which remain unresolved in relation to the licensee's safety case for the start-up of Reactor 3. The graphite safety case has a limit of operation of 16.425 TWd which is roughly six months continued operation at power. Operation beyond a core burn up 16.425 TWd will need to be justified in a further safety case submission to ONR. Details of this decision are given in a separate PAR as noted above.

The Scottish Environment Protection Agency (SEPA) has been consulted and raised no objections to ONR issuing Consent to start-up of Reactor 3.

Matters arising from ONR's work

No matters preventing the granting of Consent to start-up arose from the work undertaken by ONR inspectors in relation to the Hunterston B Reactor 3 periodic shutdown 2019.

Conclusions

Following assessment and inspection of matters arising in relation to the Hunterston B Reactor 3 periodic shutdown carried out in 2019, ONR was satisfied that the licensee's justification to start-up Reactor 3 and operate for a further period was adequate.

Recommendation

It was recommended that, in accordance with the request from the licensee, ONR should grant Consent under LC 30(3) attached to Nuclear Site Licence Sc.13 for Reactor 3 at Hunterston B nuclear power station to start-up following the 2019 periodic shutdown, and Licence Instrument 566 be issued to the licensee.

LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
APEX	Appointed Examiner
BOP	Boiler Oversight Panel
BTFSC	Boiler Tube Failure Safety Case
C&I	Control & Instrumentation
CCR	Central Control Room
DHS	Decay Heat System
DR	Decision Record
DMG	Delivery Management Group
EAL	Effective Anchorage Load
EC	Engineering Change
ECIT	Eddy Current Inspection Tool
EIMT	Examination, Inspection, Maintenance and Testing
EOR	Early Outage Review
FAC	Flow Assisted Corrosion
FME	Foreign Material Exclusion
GAP	Graphite Assessment Panel
GC	Gas Circulator
HNB	EDF NGL Hunterston B Power Station
IGV	Inlet Guide Vanes
INA	Independent Nuclear Assurance
IoGF	Incredibility of Guillotine Failure
IR	Intervention Record
JCO	Justification for Continued Operation
LI	Licence Instrument
MDL	Minimum Design Load
MS	Maintenance Schedule
MITS	Maintenance Inspection and Test Schedule [EDF]
MGRV	Main Gas Relief Valve
NGL	EDF Energy Nuclear Generation Limited
NICIE2	New In-Core Inspection Equipment Mark 2
NISR 2003	Nuclear Industries Security Regulations 2003
OAP	Outage Assessment Panel
OFI	Opportunities for Improvement
OIR	Outage Intentions Report
ONR	Office for Nuclear Regulation

OSRC	Operational Safety Review Committee
PAR	Project Assessment Report
PCPV	Pre-stressed Concrete Pressure Vessel
PRV	Pressure Relief Valve
PSSR	Pressure Safety Systems Regulations 2000
PVCW	Pressure Vessel Colling Water
RSSE	Reactor Shutdown Sequencing Equipment
RTR	Rapid Trending Review
RTS	Return to Service
RP	Radiological Protection
SEPA	Scottish Environment Protection Agency
SUM	Start-Up Meeting
TWd	Terra-Watt Days
VWSG	Vibrating Wire Strain Gauge
WOC	Work Order Card

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1 PERMISSION REQUESTED

1. EDF Energy Nuclear Generation Limited (EDF NGL), the operator and licensee of Hunterston B (HNB) nuclear power station, has written [1] to the Office for Nuclear Regulation (ONR) requesting Consent under Licence Condition (LC) 30(3) to start-up Reactor 3 (R3) on completion of its periodic shutdown (also known as its statutory outage).

2. This Project Assessment Report (PAR) presents ONR's consideration of this request and recommends that Consent is granted to start-up R3 through issuing Licence Instrument (LI) 566.

3. A separate ONR PAR [2] has assessed the graphite core safety case (NP/SC 7766) and recommended issuing LI 565 which Agrees to R3 operating until a core burn up of 16.425 TWd (roughly six months continued operation at power).

2 BACKGROUND

2.1 GENERAL

4. The nuclear site licence requires the licensee to periodically shut down plant under LC30: 'Periodic Shutdown'. This is to enable examination, inspection, maintenance and testing (EIMT) to take place in accordance with the requirements of HNB's plant Maintenance Schedule (MS) under LC28: 'Examination, inspection, maintenance and testing'. At HNB, reactor periodic shutdowns are undertaken every three years as specified in the MS Preface, which is an Approved document under LC28(4).

5. Requirements of the MS are derived from claims made in the station's safety case (required under LC23: 'Operating Rules'), along with other regulatory requirements, such as Pressure System Safety Regulations (PSSR), and maintenance and inspection requirements from equipment manufacturers.

6. ONR has previously specified [3] that the licensee requires Consent from ONR under LC30(3) to start-up R3 following a periodic shutdown. The previous Consent to start-up R3, LI 549 [4], was issued on 30 November 2015.

7. Inspection of the HNB R3 graphite core in March 2018 identified cracking which was in excess of the operational allowance of 350 axially cracked bricks but well within the upper safety case limit of 700 axially cracked bricks. As a result, HNB R3 has remained shut down while the licensee has prepared a revised graphite safety case to justify a return to service (RTS) of R3.

8. In parallel, the licensee has completed the routine outage maintenance requirements which are the focus of this PAR. The statutory outage for R3 was originally due to commence by 30 November 2018. Prior to this date EDF NGL requested from ONR an extension to the plant's operating period to 30 November 2019 which ONR Agreed to under LI 559 [5]. EDF NGL subsequently completed the outage work during the period between February and April 2019.

9. A separate PAR [2] has been produced by ONR which assesses the suitability of the graphite core safety case for R3 and together with this PAR represents the view of ONR on issuing Consent for R3 to return to service. The graphite PAR concluded that the operation of HNB R3 to a core burn up of 16.425 TWd has been adequately justified by EDF NGL (roughly six months continued operation at power). Operation beyond a core burn up 16.425 TWd will need to be justified in a further safety case submission to ONR.

10. The length of time elapsed since the statutory outage work took place has meant that the routine process that ONR would follow for a statutory outage has been modified. This was to ensure that, before issuing Consent to restart, ONR has had a greater level of oversight

of the completion of maintenance activities and also considered the capability and readiness of station personnel to safely operate Reactor 3 after so long shutdown.

11. Due to the ongoing COVID-19 (coronavirus) pandemic, EDF NGL has entered phase D of their company pandemic plan [6]. EDF NGL state within their guidance that Phase D is enacted when "the pandemic has or has the potential to have a significant impact upon business continuity including security of supply (i.e. widespread cases of the virus in the UK and / or inside the Company)". The ONR site inspector has considered the station's response to managing the necessary social distancing arrangements onsite due to COVID-19 and was content that appropriate measures had been put in place to safeguard the workforce while still being able to effectively manage the safety of the reactor (see section 3.4.2).

2.2 OUTAGE PLANNING AND MANAGEMENT

2.2.1 Outage Intentions

12. EDF NGL's planned outage work programme was outlined in the HNB Outage Intentions Report (OIR) [7]. The OIR is a routine report prepared by the licensee's engineering department to provide ONR with the detailed work packages for each system or major maintenance activity. This planned work package was reviewed by ONR specialist inspectors, the outage inspector and the nominated site inspector in preparation for the outage intentions meeting held on 30 January 2019 [8].

13. During the R3 2019 periodic shutdown EDF NGL planned to conduct:

- Examinations, inspections, maintenance and testing activities in accordance with the MS,
- Inspections to support the station safety case,
- Work to comply with statutory requirements,
- Remedial work to rectify plant adverse conditions,
- Plant safety improvements where these are deemed to be reasonably practicable.

14. The R3 outage was originally due to commence by 30 November 2018 but at the request of NGL [9] ONR Agreed [5] to extend the operating period until 30 November 2019. EDF NGL subsequently commenced the outage during February 2019.

15. Due to the extended period of shutdown of R3 the totality of work undertaken during this period has resulted in the outage being conducted in various stages. The main outage period commenced 15 February 2019, however due to R3 already being shutdown the licensee took the opportunity to execute various work packages prior to this that would de-risk the outage period. Additional graphite inspections also took place in April 2020 to provide greater assurance to the graphite safety case [2].

16. The notable packages of work completed during the shutdown period include:

- 68 fuel channels of New In-Core Inspection Equipment Mark 2 (NICIE2) inspections in 2019,
- Ten additional channels of NICIE2 inspections in April 2020,
- 36 fuel channel graphite samples in air,
- Ten Channels of Eddy Current Inspection Tool (ECIT) inspections in air,
- Eleven Control Rod Channel inspections,
- One Gas Circulator Exchange,
- Gas Circulator lub oil maintenance,
- Pipe Hanger Inspections,
- Boiler Maintenance, Inspections and repairs,
- Condensate System Outage,
- Turbine Generator work scope,

- CW System workscope,
- Control & Protection System Maintenance,
- Guard line & Gas Circulator Testing,
- Gas Bypass plant work.

2.2.2 Licensee's Outage Management

17. The outage has been managed in accordance with the requirements of NGL's integrated company practice BEG/ICP/OPS/009 'Outage Management Process'.

18. In line with EDF NGL's arrangements, a team of Independent Nuclear Assurance (INA) inspectors (EDF NGL's own internal regulator) conducted an Early Outage Review (EOR, previously called the Rapid Trending Review) during the second week of the outage [10]. The purpose of the EOR is to provide an independent and early view of outage practices across a number of areas to ensure the licensee could take early action to improve safety where required. The EOR identified points of positive feedback as well as highlighting Opportunities For Improvement (OFI), none of which impacted on the return to service.

2.2.3 ONR's Intervention Management

19. The purpose of ONR's inspection and assessment activities during statutory outages is to ensure that all MS work is being carried out and that the reactor is safe to restart.

20. The scope of the assessment work was based on the following criteria:

- Scope of work for the outage as indicated by the OIR,
- Previous outage reports and actions,
- Recent regulatory attention,
- Operational experience and outstanding issues recorded in the regulatory issues database,
- Specialism-specific areas of interest,
- Other areas of interest which could only be assessed during an outage period.

21. Based on the safety significance of the intended outage work the following ONR specialisms were assigned to the project:

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

22. ONR's process for delivering a permissioning project requires preparation of a PAR to support the permissioning decision by a senior inspector with Delegated Authority, in this case, the Deputy Chief Inspector and Director of ONR's Operating Facilities Division. The PAR is informed by the intervention findings of the specialist inspectors assigned to the project to allow the Delegated Authority to consider granting Consent for the start-up of the reactor.

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

23. The following sections provide a summary of the ONR specialist inspectors' inspection and assessment findings for each of the technical discipline areas evaluated during the HNB R3 outage. The assessments provide the information and evidence for ONR's considerations and judgment to Consent start-up of HNB R3.

3.1 ENGINEERING ASSESSMENTS

3.1.1 Graphite Core Integrity Assessment

24. The ONR assessment of the graphite safety case for return to service is considered in PAR 20-004 [2] and concludes that the operation of HNB R3 to a core burn up of 16.425 TWd (roughly six months operation at power) has been adequately justified by EDF NGL. Operation beyond a core burn up 16.425 TWd will need to be justified in a further safety case submission to ONR.

3.1.2 Civil Engineering Assessment

25. Reference [11] provides the findings of the ONR Civil Engineering assessment of the statutory examination of the pre-stressed concrete pressure vessel (PCPV) of R3 and other supporting documentation provided by EDF NGL.

26. The focus of the specialist inspector's assessment was based on the Statutory Examination Report of the PCPV produced by the Appointed Examiner (APEX). The APEX is NGL's nominated suitably qualified and experienced person responsible for ensuring the provision of in-service inspection and surveillance activities relating to the PCPV. The Statutory Examination Report records EDF NGL's progress with the statutory surveillances, inspections and tests on the PCPV as prescribed in the station Maintenance Inspection and Test Schedule (MITS).

27. The ONR specialist inspector reviewed each of the areas identified within the APEX's assessment which included:

- Visual inspection of concrete surface condition,
- Visual inspection of pre-stressing anchorages,
- Tendon residual load tests,
- Assessment of pre-stressing strand condition,
- Strand tensile testing,
- Settlement and tilt survey,
- Review of embedded strain gauge readings,
- Review of vessel concrete temperatures,
- Review of reactor coolant loss,
- Review of pressure vessel cooling water leaks,
- Top cap deflection survey.

28. **Concrete surface cracking and cooling water leakage search:** The APEX has reported that the visual examination of the accessible external surfaces of the PCPV was completed in June 2018 whilst the reactor was off-load. According to the APEX, the accessible PCPV and support structure concrete surfaces were in good condition and comparable with previous inspections, with no evidence of any significant crack development that was of concern.

29. Regular moisture monitoring surveys have been carried out on the vessel outer surface and lower stressing gallery, with the objective of detecting pressure vessel cooling water (PVCW) leakage and any resulting degradation. The APEX has confirmed that no signs of active water leakage have been reported since the last periodic shutdown. Based on the information presented, the specialist civil engineering inspector judged that the PCPV concrete is in an acceptable structural condition.

30. **Tendon Anchorages:** The APEX reports that the visual examination of tendon anchorages was completed in 2018 and that the anchorages are in a satisfactory condition, with no signs of mechanical damage or significant corrosion. Based on the anchorage condition examinations and the absence of significant active PVCW leaks, the specialist civil engineering inspector judged that the tendon anchorages are in an acceptable condition to enable them to fulfil their safety function.

31. **Tendon Load Checking:** The tendon pre-stress anchorage load was measured on a sample of 32 tendons, (approximately 1.1% of the population of 2812). The APEX selects tendons for test, based on obtaining a broadly even spread of tendons around the vessel and avoiding those tendons that have been previously tested.

32. The APEX has reported an average effective anchorage load (EAL) of 170.6 tons (1700 kN), which incorporates 5% friction losses at the anchorages and is an average of the loads measured at the upper and lower anchorages. The overall EAL (as measured in April 2018) thus incorporates a margin of 6.6% above the Minimum Design load (MDL) specified in the safety case (160 tons, equivalent to 1594.2 kN).

33. The trend analysis undertaken by the APEX shows that the best-fit linear regression curve for mean tendon load continues to fall with time but at a reducing rate, which is in accordance with expectations. The analysis indicates that there will still be adequate margin above the MDL during the next planned inspection and beyond. Based on the tendon load test results presented, together with the trend analysis undertaken by the APEX, the specialist civil engineering inspector judged that the pre-stressing tendons in the PCPV will continue to provide the required level of pre-stress for the period to the next statutory outage.

34. **Strand Withdrawal:** The MITS requires that the central strand is withdrawn from a minimum of five tendons selected by the APEX. The withdrawn strands are subject to a visual inspection and sample lengths are selected for metallurgical examination and mechanical testing. The examinations found that there was no evidence of service-related corrosion on any of the five strand samples examined.

35. Mechanical testing was undertaken for each of the five tendons where the strand was removed. Strands from two tendons showed a shortfall in breaking load of less than 0.2%. The civil engineering specialist inspector judged that the identified shortfalls in breaking load have an insignificant effect on the integrity of the PCPV. The specialist inspector was satisfied that the pre-stressing tendons are in an adequate condition and will continue to provide the necessary level of pre-stress for the next period of operation.

36. **Settlement and tilt:** Settlement and tilt surveys are carried out at four-yearly intervals in accordance with the MITS with the previous survey for R3 completed in May 2015. A further settlement and tilt survey was completed in July 2019, after the ONR civil engineering specialist had conducted his assessment report. However EDF NGL has stated that the results of this survey align with previous surveys and no issues were identified and it is content that there are no issues with regards to restart. The ONR civil engineering specialist inspector was supportive of this view [12].

37. **Strain Gauge Monitoring:** The APEX records that in general the vibrating wire strain gauge (VWSG) data shows that the strain behaviour of the PCPV remains unchanged since the previous assessment in 2015, with most gauges showing either no strain change or a slow increase in compressive strain due to creep of the concrete. Strain transients between on-load and off-load pressure cycles of the vessel remain consistent with prior trends. Based on the number of working VWSGs and the interim results presented, the civil engineering specialist inspector was content that the number of reliable gauges provides sufficient coverage throughout the vessel to indicate the global strain behaviour and that the readings indicate that the PCPV remains in a stable or increasing compressive (i.e. safe) state. Based on the evidence presented, the specialist inspector was satisfied that the temperatures recorded by the gauges demonstrate a stable trend and are within acceptable limits.

38. **Vessel Temperature:** The APEX reports that in the period from June 2015 to June 2018 there was no significant change in the average bulk concrete temperature thermocouple readings. No thermocouples recorded temperatures within 5°C of the Limiting Condition of Operation (LCO) value. The specialist inspector reviewed the temperature survey report

and judged that the bulk concrete temperature trends as recorded by the thermocouples are stable and those temperatures have been within acceptable limits.

39. **Main Reactor Coolant losses:** The APEX reports that the results of the most recent on-load MITS examination for CO_2 losses at tendon anchorage blocks (done in February 2018) showed that no CO_2 was detected at any of the anchorages checked. The specialist inspector was content with the results presented by the APEX.

40. **Pressure Vessel Cooling Water:** The APEX has confirmed that no active PVCW leaks were observed in the last operating period, based on an examination of the concrete surfaces, and in particular the sites of historic leaks. No new leaks have been reported in the last operating period, as confirmed by the current leaks database. The APEX has concluded that over the reporting period the system leak rate was satisfactory and that the results were acceptable with no adverse trend. The specialist inspector considered that the absence of observed leaks, the adequate temperature monitoring results reported by the thermocouples and the VWSG, and the most recent two-yearly PVCW flow surveys provide adequate assurance that the PVCW system is operating in an acceptable manner without significant detriment to the integrity of the PCPV.

41. **PCPV Top Cap Deflection Survey:** The APEX has reported that neither the on-load or the off-load surveys were carried out at the time that the current Statutory Examination Report was written. The APEX has justified the absence of top cap deflection survey results with reference to the consistency of long-term trends in this parameter. The APEX notes that deflection of the top cap in the period 2000 to 2015 has been within an approximate range of 2.3mm to 2.8mm. Additionally, it is noted that the previous APEX conclusions on top cap deflection surveys indicate that the top cap is still responding elastically between off-load and on-load pressure cycles of the PCPV. As the survey will not be completed until after return to service, the APEX has based his judgements on the results of previous surveys, which have demonstrated a stable trend. The ONR specialist inspector considered this is an acceptable interim position given the consistency of previous deflection results.

42. Based on the sampled evidence presented the ONR specialist inspector had no objection to the return to service of HNB R3.

43. Due to the timeframe between the ONR civil engineering assessment and the request for HNB R3 to return to service, the civil engineering specialist has recently confirmed he still has no objection to the return to service of R3 [12].

3.1.3 Structural Integrity Assessment

44. Reference [13] provides the findings of the ONR structural integrity inspector's assessment of NGL's examination, inspection, maintenance, and testing (EIMT) of systems, structures and components on R3 that fulfilled a nuclear safety function.

45. The ONR structural integrity specialist focused on the following areas during his assessment:

- Pressure Systems Safety Regulation (PSSR) compliance,
- Gas By-Pass Plant,
- Flow Assisted Corrosion (FAC) inspections,
- Corrosion Management update,
- Steam and Feed Systems inspections, including pipe hangers,
- In-service Inspection / Non-destructive testing,
- Seawater & Essential Cooling Water Systems,
- CO_2 System,
- Gas Circulator (GC) Inspections.

46. For each of these areas, the ONR structural integrity specialist inspector discussed the scope, progress and outcome of EIMT activities with responsible personnel and was provided with evidence of compliance against LC28.

47. **PSSR:** The specialist inspector maintained communications during the outage to discuss progress on examinations and inspections undertaken during the periodic shutdown, as required by the PSSR. It was confirmed that PSSR examinations had proceeded as planned and that no significant issues were identified as a result of the PSSR examinations.

48. **Gas Bypass Plant:** The gas bypass plant system engineer confirmed that inspection and maintenance work had progressed well and that no unexpected issues had been identified.

49. **Flow Assisted Corrosion:** A number of FAC inspections were conducted during this outage. No major issues were identified.

50. **Corrosion Management:** The specialist inspector confirmed that the corrosion management programme was satisfactory and that major components are free from major corrosion issues.

51. **In Service inspections:** The specialist inspector monitored the sentencing of defects by the Outage Assessment panel (OAP) and was content that they have been sentenced appropriately and was satisfied that the OAP provides a suitable forum for sentencing of inspection results.

52. **Seawater and Essential Cooling Water Systems:** Essential cooling water plant inspections included 7A and 7B drum screens and chambers, main cooling water pump volutes, pipework and valves, inlet and outlet culverts, Turbine Generator 7 (TG7) waterboxes and reactor cooling water pipework, valves and strainers. Corrosion causing misalignment of a drumscreen was identified and rectified during the outage period.

53. **CO_2 System:** The CO2 systems outage work included replacement of the five Main Gas Relief Valves (MGRV), overhaul of isolating valves, non-destructive testing of welds in the MGRV manifold and visual inspection of the MGRV discharge covers. Remedial work consisted mainly of repair to one weather hood and corrosion protection of external MGRV pipework.

54. **Gas Circulator Inspections:** GC inspections included PSSR inspections of 3A1, 3A2, 3B2 and 3D1 shutter tubes and inspection of welds 7 and 8 of GC shutter tube 3B2. No significant issues or defects were identified.

55. The specialist inspector considered the ongoing actions from the fleet-wide decay heat system regulatory issue which is discussed at section 3.3.1.

56. The specialist inspector considered the ongoing actions from the commitments made in the Boiler Tube Failure Safety Case which is discussed at section 3.3.3.

57. Based on the sampled evidence presented, and the issues discussed at section 3.3.1 and 3.3.3, the ONR structural integrity specialist inspector had no objection to the return to service of HNB R3.

3.1.4 Mechanical Engineering Assessment

58. Reference [14] provides the findings of the ONR mechanical engineering inspection conducted during the outage. The inspection focused on the EIMT of systems, structures and components important to safety in accordance with the requirements of LC28.

59. The inspection sampled and examined the following planned shutdown activities:

- Gas Circulator 3B2 exchange and 3A2 end plate close off.

- Results of Control Rod Drop Tests,
- Relief valve R3/G/R143B exchange and Isolating valve R3/G/R141C exchange.

60. **Gas Circulator Exchange:** To confirm compliance with LC28 with regard the planned GC exchange and inspection activities, the specialist inspector examined a sample of the licensee's arrangements and work order cards (WOC) and was content that these were being completed appropriately. The inspector also examined the signed off quality plans for the work package. From the evidence presented the inspector judged that the work to replace the GC was being conducted appropriately.

61. **Control Rod Drop Tests:** The inspector examined the results of the control rod drop times recorded from the shutdown. In addition, they inspected the duty-holder's arrangements for the examination, inspection, maintenance and testing of the control rods. The inspector was satisfied with the evidence from the licensee that the control rods had functioned in a satisfactory manner. The inspector considered from their sample of evidence that the licensee had adequately demonstrated that suitable and sufficient arrangements were in place to ensure appropriate examination, inspection maintenance of the reactor control rods.

62. A subsequent ONR Systems Based Inspection [15] of the reactor shutdown systems was conducted in April 2020. The inspection found that the safety case defining the control rod drive rate (10 mms-1) was unclear, as it failed to specify whether the control rod drive rate was a safety limit and condition. As a result it was unclear if the operating rule had been demonstrably complied with. Control rod drive rates are measured and therefore this represents an administrative contravention of the safety case; ONR has no concerns regarding the actual insertion of the control rods, with all control rods continuing to function as expected. An Enforcement letter was issued to station that required the safety case requirements to be clarified and all required control rod insertion characteristics to be measured and complied with by January 2021.

63. **Relief Valve Exchange:** The inspector also considered the planned replacement of the reactor pressure relief valves during the outage. Although at the time of inspection the work hadn't been undertaken on the valves the specialist inspector sampled the maintenance inspection and test schedule, quality plan and a sample of relevant WOCs. The specialist inspector was content that the evidence presented provided confidence in the workscope. All relief valve exchanges were subsequently confirmed as complete at the SUM to ONR [16].

64. Based on the sampled evidence presented the ONR mechanical engineering specialist inspector had no objection to the return to service of HNB R3.

65. Due to the extended timeframe between the ONR mechanical engineering assessment and the request for HNB R3 to return to service, the mechanical Engineering specialist has confirmed they still have no objection to the return to service of HNB R3 [17].

3.1.5 Electrical Engineering Assessment

66. Reference [18] provides the findings of the ONR electrical engineering inspection conducted during the outage.

67. The electrical engineering specialist inspector observed a sample of the outage activities to demonstrate compliance with the requirements of LC 28 arrangements. A plant walk down was conducted which sampled work in the following areas:

- Station Turbine Hall,
- 11 kV R3 Unit Transformer,
- R3 Generator Transformer,
- 11 kV Switch room,

- Central Control Room.

68. No issues relating to the outage work were identified during the inspection. The electrical specialist inspector was satisfied that the electrical work package was of a routine nature and that the electrical maintenance activities were undertaken at the appropriate periodicity.

69. The specialist inspector reviewed a number of WOC, maintenance instructions and completed check sheets for the shutdown related electrical activities referred to within the OIR and the maintenance schedule that had been completed to date.

70. The specialist inspector considered that the licensee had suitable and sufficient arrangements in place to ensure appropriate examination, inspection and maintenance of the electrical related work packages during the outage. The specialist inspector was satisfied that there were no electrical issues identified that would prevent ONR granting Consent to return R3 to service.

71. Due to the extended timeframe between the ONR electrical engineering assessment and the request for HNB R3 to return to service, the electrical engineering specialist has confirmed he still has no objection to the return to service of HNB R3 [19].

3.1.6 Control and Instrumentation Assessment

72. Reference [20] provides the findings of the ONR control and instrumentation inspection conducted during the outage. The main focus of this inspection was to inspect work activities carried out in relation to control and instrumentation (C&I) equipment and systems important to safety in order to confirm that they remain fit for their intended purpose.

73. This inspection sampled engineering procedures and records for the outage, including maintenance inspections of C&I equipment and safety systems, as well as a walk down of relevant plant. The C&I specialist inspector found the work sampled to be adequate.

74. During the outage inspection the following plant areas were inspected:

- Central control room,
- Data processing room,
- Data logger room,
- Diverse guard line room (R3),
- Instrument room (R3),
- R3 Distributed Computer System (DCS) (auto control) room,
- R3 safety room,
- Marshalling and monitoring and rod control room (R3),
- R3 Reactor shutdown sequencing equipment (RSSE).

75. During the inspection the specialist inspector reviewed progress on outage related work related to the GC system including the replacement of Inlet Guide Vane (IGV) Selsyns which were confirmed to now all be replaced for HNB R3. The progress on ageing management work on the IGVs was also discussed which was confirmed to be ongoing. Several WOCs were also sampled for ongoing maintenance work for the GC instrumentation under the MITS.

76. The progress regarding pressure vessel thermocouples was reviewed. This covered calibration of thermocouples as well as the Engineering Change (EC) covering installation of new GC mounted thermocouples. The specialist inspector also considered the laddic waveform checks which includes a functionality test and waveform check that is completed shortly after return to service. The specialist inspector also reviewed the reactor protection systems including neutron flux detectors, diverse guardlines, and also the RSSE.

77. The inspector considered that based on the evidence presented the C&I safety systems at HNB R3 have undergone suitable and sufficient examination, inspection, maintenance and testing.

78. Based on the sampled evidence presented the ONR C&I specialist inspector had no objection to the return to service of HNB R3.

79. Due to the extended timeframe between the ONR C&I engineering assessment and the request for HNB R3 to return to service, the C&I specialist confirmed he still had no objection to the return to service of HNB R3 [21].

3.2 SAFETY MANAGEMENT

3.2.1 Conventional Health and Safety Assessment

80. Reference [22] provides the findings of the ONR conventional health and safety (CHS) inspection conducted during the outage. The purpose of this intervention was to provide regulatory confidence in the management of conventional health and safety hazards during the outage.

81. Regulatory judgement was based on determining compliance with Sections 2 & 3 of the Health & Safety at Work etc. Act 1974 and the relevant statutory provisions and Approved Code of Practices (ACOP) made under the Act, namely: Management of Health & Safety at Work Regulations 1999, Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) and the Work at Height Regulations 2005.

82. During the inspection several key outage work areas were inspected:

- Pile Cap,
- R3 Circulator Hall,
- Turbine Hall,
- Cooling Water Pump House,
- Contractor Village.

83. The inspection sampled outage activities underway and the management arrangements in place, focussing on the plant and hazard control. The inspection did not reveal any safety issues which would prevent ONR issuing Consent to allow R3 to start-up.

84. Due to the timeframe between the ONR CHS assessment and the request for HNB R3 to return to service the CHS specialist confirmed he still had no objection to the return to service of HNB R3 [23].

3.2.2 LC26 Compliance Inspection

85. Reference [24] provides the findings of the LC26 (control and supervision of operations) inspection conducted during the outage by the HNB nominated site inspector. The inspection considered the implementation of 'Management of contractors performing work on power station sites (Field supervision)', BEG/SPEC/MNT/009, during the outage with the following scope:

- Outage organisation and work control,
- Interview with contract partner – working party leader,
- Attendance at contractor start of shift and pre-job briefs,
- Inspection of contract partner work activities,
- Training and authorisation records,
- EDF NGL monitoring of quality of supervision.

86. The inspection sampled the station outage organisation and management arrangements for control and supervision of contractor performed works, involved interviews with and observation of contractors performing supervisory and working party leader roles and sampled the EDF NGL training and authorisation records of persons appointed as field supervisors.

87. From the sample of the procedures and practices applied to the control and supervision of operations during the R3 outage at HNB, the site inspector judged that the station was ensuring a good standard of oversight of contractor performed works. There were no findings from this inspection that could undermine confidence in the work being completed during the R3 outage.

3.3 EMERGENT ISSUES

3.3.1 Decay Heat System

88. During the 2018 graphite inspection outage, a through wall defect was discovered on a weld on the Decay Heat System outlet line to the flash vessel. This weld is classified as Incredibility of Guillotine Failure (IOGF). A Justification for return to service was produced and assessed by ONR. A fleet-wide regulatory issue (6428) was raised to address the implications of the Decay Heat System failure.

89. The structural integrity specialist inspector was content that safety-related issues with the R3 Decay Heat System were being adequately addressed and that no further significant issues had been identified with the pipework. After the inspection, further assurance was sought [25] from the ONR structural integrity specialists to ensure adequate progress had been made with preparing a revised safety case for the system prior to return to service of R3. ONR specialists confirmed that HNB has introduced a number of mitigating measures for the system including; monitoring pipe movement, on-line radiography, pro-active reinforcement of pipework thickness in several areas and the introduction of the Boiler Oversight Panel all of which have been considered appropriate by the specialist inspectors. A valid Justification for Continued Operation (JCO) is currently in place and the specialist inspectors had no objection to the return to service of R3.

3.3.2 Gas Circulators

90. EDF NGL had reported that the operating temperatures of the HNB GCs were higher than was assumed when the motor design was originally substantiated. An analysis of the impact of running at higher temperatures in normal operation and during outages has shown that ageing of some of the GC motor stator windings has accelerated and could exceed the substantiated thermal life limit. In addressing this, EDF NGL initiated a monitoring regime to allow the analysis and management of the remaining thermal life of the GC stator windings.

91. The higher running temperatures and accelerated ageing could pose a threat to the functional capability of the GCs during a specific set of faults, most notably during a depressurisation of the pressure vessel and a concurrent boiler tube failure fault.

92. A further anomaly related to the GC impellers where a larger population of second generation forged impellers were in use at HNB than was originally considered in the existing safety case. This challenged the existing safety case assumptions, regarding the number of forged versus cast impellers likely to be used in an operating reactor.

93. EDF NGL has prepared a justification (Engineering change EC No. 366501), to substantiate the continued operation of the GCs at HNB based upon further testing and also claims that the identification of additional forged impellers in operation at HNB does not lead to an appreciable increase in operating risk and that continued operation is As Low As Reasonably Practicable (ALARP). The justification for continued operation covers all modes of operation of R3 until end of generation.

94. ONR electrical and structural integrity specialist inspectors have reviewed the claims and evidence presented in EC No. 366501 and produced a Decision Record (DR) [26]. The DR records the ONR view that the R3 GCs remain within the revised winding life safety justification and that the increased number of forged impellers in use does not increase the operating risk. The specialist inspectors have no objection to the return to service of R3.

3.3.3 Boiler Tube Failure Safety Case

95. As part of the commitments from the HNB Boiler Tube Failure Safety Case (BTFSC) (NP/SC 7703) EDF NGL has progressed enhancements to the seismic resilience of the gas circulator pipework and have installed a control and monitoring panel in the Central Control Room (CCR). Although this work is not tied to return to service of R3, the station has confirmed that the majority of the work to install seismically enhanced pipework and to install Central Control Room (CCR) controls has been completed. ONR inspectors are content that the majority of this work is now complete [27]. At the time of return to service, only one valve actuator will require installation, however this can be completed at power. ONR has inspected the valve and confirmed it can be operated manually if required, and is therefore not considered to be a return to service issue [28]. During the readiness inspection (section 3.4.2), ONR inspectors confirmed that the majority of the site enhancement work had been completed with the exception of the valve actuator mentioned above.

3.4 RETURN TO SERVICE

3.4.1 Start Up Meeting

96. The formal Start-Up Meeting (SUM) was held on 8th November 2019. ONR was represented by the Head of Operating Reactors, the nominated site inspector, the site security inspector as well as the outage project inspector. This meeting is part of EDF NGL's process to demonstrate to ONR that it has adequately completed the requirements of the Maintenance Schedule, dealt with emergent issues (to the extent that they do not impact on returning R3 to service safely), identified any additional actions to be completed, and demonstrated the safety of R3 for the operational period to the next statutory outage, subject to there being regular inspection of the graphite core and an adequate graphite safety case in place at all times. EDF NGL presented a comprehensive review [16] of the outage activities that covered all work island areas, a site inspection of the main outage related work areas and an overview by the licensee's internal regulator (INA) of the outage progress.

97. The ONR inspection team were satisfied from the evidence presented during the Start-Up Meeting and site inspection that the licensee had satisfactorily completed the necessary work scope for the R3 2019 statutory outage.

98. During the Start-Up Meeting, ONR confirmed that there were several ongoing safety case work packages, including the graphite core safety case and those discussed in section 3.3 that would need to be adequately assessed by ONR prior to granting consent to return to service. No regulatory issues had been identified during the outage that would preclude the restart of R3 [29].

99. Following ONR granting Consent to allow HNB R3 to return to service, a number of work activities and tests are carried out during the reactor start-up and raising to full power. The results of these, and other inspections conducted during the shutdown which require further analysis, will be collated after return to at power operations in a document known as the '28 day report' which will be provided to ONR for review.

3.4.2 ONR Readiness Inspections

100. Due to the non-routine nature of the outage and subsequent shut down period, ONR maintained a greater level of oversight on station activities and preparatory work for return to service. ONR conducted several site readiness inspections and carried out weekly

meetings with the station outage manager to monitor progress. This was in addition to the ongoing routine engagements expected of the nominated site inspector.

101. **Readiness Inspection March 2020:** A readiness inspection was conducted in March 2020 [30] by the nominated site inspector and the outage project inspector to ensure that since the Start-Up Meeting all ongoing work packages had progressed and to inspect the material readiness of the plant.

102. The inspection primarily focused on the plant preservation and recommissioning processes. The purpose of the preservation process is to ensure that the plant is placed into a state such that there is minimal degradation during a prolonged shutdown period, to enable the plant to be subject to an appropriate surveillance regime and to be returned to service in accordance with an additional re-commissioning plan.

103. The inspection sampled a number of key areas including; main boilers, turbines, cooling water systems as well as reviewing various pre-recommissioning walkdown check sheets.

104. The ONR inspectors were satisfied that both the plant preservation and associated recommissioning plans were robust and that personnel readiness at HNB was sufficiently demonstrated during the inspection.

105. **Readiness Inspection July 2020:** a further readiness inspection was conducted in July 2020 [31] by the nominated site inspector just prior to the station request to return to service. This readiness inspection scope considered:

- Observation of a CCR simulator exercise,
- Progress of the Operational Safety Review Committee (OSRC),
- Plant inspection of the gas circulator and turbine generator halls,
- Progress of the 'Match fit' improvement programme and staff training records,
- Learning from recent events and ONR inspection findings,
- Station arrangements to control the risk from Covid-19.

106. The inspection confirmed that:

- The R3 plant has being thoroughly checked and re-commissioned to place it in the best state for return to service. The inspector was confident that the OSRC process ensures all required checks will be carried out prior to making a recommendation that R3 may return to service.

- Morale at station has been low and this has contributed to number of recent safety events. This has been recognised and recovery plans are in progress. The learning from the Reactor 4 outage has been re-applied to R3. The Operations 'Match fit' improvement process has been extended to all departments and quality assurance audits are being carried out to independently confirm that re-commissioning quality plans are adhered to.

- All staff have been thoroughly trained and the CCR team has demonstrated a robust response to a challenging emergency exercise scenario.

- Adequate Covid-19 control measures are in place and staffing levels are returning to normal to support return to service.

3.4.3 From the sample of the governance and oversight applied to the return to service of R3 at HNB, the site inspector judged that the station is robustly applying its OSRC processes and that no matters were identified that could impact nuclear safety. Accordingly, the nominated site inspector confirmed he had no objection to the return to service of HNB R3.

3.4.4 Station Application to Restart Letter

107. On 14 August 2020, the HNB Station Director wrote to ONR requesting Consent to start-up R3 on completion of the periodic shutdown [1]. EDF NGL will convene an OSRC prior to start-up to confirm the readiness for service of the plant and endorse return to service.

3.4.5 INA

108. INA independently supported the request to start-up the reactor following the outage when it was satisfied that the reactor was in a fit state to be restarted and that the associated risks were both tolerable and ALARP.

109. INA sought assurance that the material state of the plant was acceptable to support safe operation and that activities undertaken during the outage were conducted with due regard for nuclear safety through a series of assessment activities detailed in their Concurrence Part A. INA stated its support to start up R3 in their Concurrence Part B [32], in-line with EDF NGL arrangements.

3.4.6 PSSR

110. The Pressure Systems Safety Regulations (PSSR) competent persons (CP) confirmed [33] that they are content for R3 to start-up.

3.4.7 SECURITY OVERVIEW

111. During the period of the R3 outage, the ONR site security inspector has maintained regular contact with site, including during the COVID-19 pandemic. The outage period has seen occasional NISR 2003 Regulation 10 notifications for shortfalls in the numbers of Civil Nuclear Constabulary on site, all of which were mitigated by site using arrangements agreed with ONR. The ONR site security inspector confirmed that he had no objections to the return to service of R3 [34].

3.5 ENGAGEMENT WITH OTHER GOVERNMENT AGENCIES

112. The Scottish Environment Protection Agency (SEPA) site inspector for Hunterston B was informed that ONR intended to issue a Licence Instrument giving its Consent to the restart of R3. SEPA confirmed [35] that it had no objections to this.

4 MATTERS ARISING FROM ONR'S WORK

113. No issues preventing issue of this Licence Instrument arose from the assessment of the licensee's safety justification by ONR specialist inspectors.

114. As the Project Inspector for the outage, I have considered the licensee's request to ONR to grant a consent under LC30(3) to start-up HNB R3 on completion of its periodic shutdown. To inform my work, I have taken note of the statements associated with safety contained in the request letter, the findings of the periodic shutdown work undertaken by EDF NGL's internal regulator (INA), the statements of the PSSR competent persons and the findings and advice of ONR specialist inspectors and the ONR nominated site inspector.

115. EDF NGL will convene an OSRC prior to start-up to review the fitness for service of the plant and endorse return to service.

116. ONR specialist inspectors from the following disciplines undertook assessments to support ONR permissioning return to service:

- Graphite
- Civil engineering
- Structural integrity
- Mechanical engineering
- Electrical engineering

- Control and instrumentation
- Conventional Health and safety

117. Each discipline has produced a report that presents the inspection findings, inspectors' opinions, judgments and recommendations. No actions requiring resolution before granting of Consent were raised.

5 CONCLUSIONS

118. The Hunterston B Reactor 3 periodic shutdown 2019 has been undertaken in accordance with the requirements of the work scope outlined within the Outage Intentions Report.

119. EDF NGL has followed its arrangements in undertaking the periodic shutdown, culminating in the Hunterston B Station Director writing to ONR requesting Consent to start-up Reactor 3. His letter stated that he was satisfied that were no safety issues associated with return to service of Reactor 3.

120. EDF NGL's internal regulator, INA, has provided a concurrence statement that confirmed that they have no issues that would prevent the return to service of Reactor 3 following its periodic shutdown.

121. ONR inspectors have sampled the safety management and engineering activities throughout the shutdown and judged them to be adequate, and all support issuing Consent to start-up the reactor.

122. A separate PAR has been produced to assess the suitability of the graphite core for a further period of operation which has been Accepted by ONR.

123. I consider that the licensee delivered a shutdown that was safely managed and completed the required safety-related work activities.

124. Following assessment and inspection of matters arising in relation to the Hunterston B R3 periodic shutdown 2019, and taking into account the more recent readiness inspections completed by ONR, I am satisfied that the licensee's justification to start-up the reactor and operate for a further period is adequate; consequently, Consent to start-up the reactor can be granted.

6 RECOMMENDATIONS

125. I recommend that, in response to the request by NGL, ONR issue Licence Instrument 566 granting Consent under LC30(3) of Nuclear Site Licence Sc.13 to start-up Hunterston B Reactor 3 following the 2019 Periodic Shutdown.

7 REFERENCES

[1] EDF, HNB R3 2019 Outage - Restart Consent request letter LC30(3). CM 2020/244698.

[2] ONR-OFD-PAR-20-004 - Agreement to NP/SC 7766 Stage Submission 1: An Operational Safety Case for Hunterston B R3 to a Core Burn-up of 16.425 TWd Following the 2018 Graphite Core Inspection Outage. CM 2020/157574.

[3] HNB Requirement for Consent to Restart R3 and R4 post Statutory Outages. CM 2015/435748.

[4] HNB R3 2015 - Statutory Outage - Consent to Restart Reactor 3. CM - 2015/452747.

[5] Hunterston B Licence Instrument: Agreement No. 559. CM 2018/383404.

[6] 6. NGL - BEG/SPEC/OPSV/EPG/085, Rev 006 – Pandemic Contingency Plan, March 2020.

[7] EDF - Hunterston B R3 2019 Outage Intentions Report. CM 2018/312798.

[8] EDF - OFD - Hunterston B - ONR-OFD-CR-18-797 - Outage Intentions Meeting and Issues Management. CM 2019/42051.

[9] HNB R3 2018 EDF Outage Deferral Request Letter. CM 2018/36122.

[10] HNB R3 Outage 2019 - Early Outage Review - INA. CM 2019/168152.

[11] NGL - Hunterston B - ONR-OFD-AR-19-001 - Civil Engineering Inpsection in support of RTS of R3. CM 2019/131054.

[12] HNB R3 Statutory outage - Civil Engineering report - Inspector Update. CM 2020/102082.

[13] NGL - Hunterston B - ONR-OFD-AR-19-032 - Assessment of Structural Integrity in Support of RTS of R3. CM 2019/82666.

[14] NGL - Hunterston B - ONR-OFD-IR-18-217 - Mechanical Engineering Inspection in Support of RTS of R3. CM 2019/83248.

[15] ONR-OFD-IR-20-001 - Systems Based Inspection of Shutdown Systems. CM 2020/122870.

[16] EDF, HNB R3 2019 - Statutory Outage - Start Up meeting Report and Presentation. CM 2019/334998, 2019/280172.

[17] HNB R3 Statutory Outage 2019 - Mechanicall Engineering Report - Inspector Update - CM 2020/105671.

[18] NGL - Hunterston B - ONR-OFD-IR-18-219 - Electrical Engineering Inspection in Support of RTS of R3. CM 2019/92261.

[19] HNB R3 Statutory Outage 2019 - Electrical Engineering Report - Inspector Update. CM 2020/222715.

[20] NGL - Hunterston B - ONR-OFD-IR-18-212 - Control and Instrumentation Inspection in Support of RTS of R3. CM 2019/77667.

[21] HNB R3 Statutory Outage 2019 - C&I Report - inspector Update. CM 2020/111769.

[22] NGL - Hunterston B - ONR-OFD-IR-18-207 -CH&S Inspection in Support of RTS of R3. CM 2019/68517.

[23] HNB R3 Statutory Outage 2019 - CH&S Report - Inspector Update. CM 2020/113834.

[24] Hunterston B - ONR-OFD-IR-18-221 - LC26 Compliance Inspection - 5-7 March 2019, CM 2019/78558.

[25] HNB R3 Statutory Outage - Decay Heat System Update. CM 2020/103319.

[26] ONR-OFD-DR-20-001 - ONR's consideration of HNB long term GC winding safety case justifying the continued operation of GC through to end of generation for R3&4. CM 2020/103918.

[27] ONR-OFD-CR-20-268 Level 4 Structural Integrity Boiler Meeting 2nd July 2020. CM 2020/200684.

[28] HNB R3 Statutory Outage 2019 - Sesimic Enhancement Update. CM 2020/103454.

[29] ONR-OFD-IR-19-100 - Hunterston B - R3 Outage 2019 – Start-Up Meeting and Annual Review of Safety. CM 2019/336936.

[30] ONR-OFD-IR-19-202 - Hunterston B - R3 Outage 2019 – RTS Readiness Inspection. CM 2020/98586.

[31] ONR-OFD-IR-20-025 - Hunterston B - R3 Outage 2019 – LC30 and RTS Readiness Inspection. CM 2020/231122.

[32] EDF, HNB R3 Outage 2019 - INA Concurrence Part B. CM 2020/245412.

[33] EDF, HNB R3 - Outage 2019 - PSSR Restart Letter. CM 2020/245411.

[34] Hunterston B R3 - Outage Restart email - ONR Security. CM 2020/225265.

[35] SEPA, HNB R3 - Outage Restart - Restart Request. CM 2020/223135.