



Periodic Safety Review

Assessment of the Heysham 1 & Hartlepool third periodic safety review (PSR3)

Project Assessment Report ONR-OFD-PAR-18-027
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EXECUTIVE SUMMARY

Title

ONR Assessment of the Heysham 1 & Hartlepool third Periodic Safety Review.

Permission Requested

This Office for Nuclear Regulation (ONR) Project Assessment Report (PAR) sets out the regulatory justification for the issue of a Decision Letter confirming that EDF Energy Nuclear Generation Ltd (NGL), “the licensee”, has carried out an adequate periodic safety review (PSR) of the Heysham 1 & Hartlepool nuclear power station safety cases to justify continued safe operations at the facility for the period 2019-29.

Background

A periodic safety review is carried out every 10 years to comply with Nuclear Site Licence Condition 15: Periodic Review. The purpose of the review is to revalidate the extant safety case, to ensure the plant and operations remain adequately safe and fully reflect the site licence requirements. This is achieved by reviewing the previous 10 years of operation together with considering changes in activities that impact on nuclear safety over the following 10 years. The review takes into consideration compliance with modern standards and potential impact of ageing and obsolescence.

This was the third set of the third round of periodic safety reviews (PSR3) which will be conducted on the fleet of nuclear reactors operated by NGL. The approach taken for PSR3 differed from previous PSRs in that the review structure was closely aligned to the latest International Atomic Energy Agency (IAEA) guidance on PSRs (SSG-25)¹ and the focus was on the adequacy and effectiveness of the normal business arrangements in place to ensure plant safety.

The timings for the production of the Heysham 1 and Hartlepool PSR3 meant that none of the improvements sought by ONR through findings raised from the assessment of the Dungeness B PSR3 submission were incorporated into the Heysham 1 & Hartlepool PSR3 submission. Improvements to the PSR submissions will be monitored as the PSR3 programme progresses through the NGL fleet.

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

ONR’s main area of work was in considering the adequacy of NGL’s review of the Heysham 1 & Hartlepool power station safety cases and safety management arrangements. This was the third of the PSR3 submissions based around the NGL corporate safety management arrangements and it was decided that the assessments would focus on the evidence to demonstrate effective implementation of the arrangements to deliver safety and periodic review. A total of 16 regulatory assessments were commissioned.

Matters arising from ONR's work

The approach adopted for PSR3, focussing on demonstrating that nuclear safety is maintained through the routine NGL safety management arrangements, is considered appropriate. This approach demonstrates the effectiveness of the ongoing safety management arrangements rather than the snapshot in time often found in previous PSRs. Benefit was taken and lessons were learnt from the assessment of the Hinkley Point B / Hunterston B and Dungeness B PSR3 submissions, which allowed a more in-depth review of the efficacy and implementation of the claimed safety management processes.

The safety case health review (SCHR) process and its implementation was reviewed in greater depth to understand how it functioned and how it supported the periodic safety review

¹ Guidance by International Atomic Energy Agency (IAEA) on PSR (SSG-25), reference 1

process through a rolling programme of high level safety case reviews. Overall ONR found the process beneficial to ensure that the safety cases were adequate and shortfalls identified and addressed. ONR identified a number of weaknesses in the implementation of the process and some improvements that would be needed to ensure that the SCHR process was sufficiently robust to support the expectations and requirements of a periodic safety review.

Safety shortfalls were identified by NGL then managed through the PSR3 recommendation process and have been categorised based on ALARP principles given their impact on safety. None of these were considered significant safety threats and NGL has a programme for all recommendations to be addressed by the end of 2021.

In total, ONR's assessments have raised nine findings and NGL will develop proposals for the resolution and close out these within agreed timescales. ONR considers the hazard and risk identified within each of the ONR findings are reasonable challenges which NGL has not adequately addressed. However, none are considered immediate threats to safe operation and can be progressed with on agreed timescales.

Conclusions

ONR considers that NGL has carried out an adequate periodic safety review of the Heysham 1 & Hartlepool nuclear power station's safety cases for the period 2019-29.

NGL's arrangements for LC 15 have been followed in that an adequate review of the station's nuclear safety case and safety management arrangements has been undertaken. The review did not identify any significant nuclear safety threats that would impact on station's operations for the period through to end of generation, currently 2024 for Heysham 1 and Hartlepool stations.

ONR's assessments of the Heysham 1 & Hartlepool PSR3 submission were considered to be thorough and systematic. ONR's assessment findings supported NGL's conclusion that no serious nuclear safety threats existed in continued operation of Heysham 1 & Hartlepool power station. ONR identified nine findings in its assessment work which NGL will close out within agreed timescales.

Recommendations

It was recommended that ONR confirms the adequacy of NGL's Heysham 1 & Hartlepool PSR submission by issuing a Decision Letter agreeing to the continued operation of the site for the period 2019-2029. However, a key outcome of ONR's assessment of PSR3 and the graphite safety cases is our intention to continue to challenge EDF NGL to ensure that it demonstrates that operations of the four reactors remain safe as the graphite cores age. Fundamental to this is the continuing requirement for EDF NGL to undertake regular inspections and analysis of the graphite core to demonstrate that they remain within the limits and conditions defined within the safety cases.

It was recommended that conditions are included in the Decision Letter with agreed timescales to address the outstanding NGL category B recommendations and ONR findings.

LIST OF ABBREVIATIONS

ABDS	Automatic Boiler Depressurisation System
ACWL	Active Core Weight Loss
AGR	Advanced Gas-cooled Reactor
ALARP	As low as reasonably practicable
BCU	Boiler Closure Units
BDB	Beyond Design Basis
BED	Boiler Emergency Depressurisation (valves)
BSL	Basic Safety Level
C&I	Control and Instrumentation
DB	Design Basis
DNB	Dungeness B
EAT	Extreme Ambient Temperature
EIMT	Examination, Inspection, Maintenance and Testing
ER	Equipment Reliability
ERR	Equipment Reliability Review
fpv	(reactor) full power years (of operation)
HRA	Hartlepool
HNB	Hunterston B
HPB	Hinkley Point B
HYA	Heysham A
IAEA	International Atomic Energy Agency
IJCO	Interim Justification for Continued Operation
INA	Independent Nuclear Assurance
IPRA	Independent Periodic Review Assessment
JER	Japanese Earthquake Response
LC	Licence Condition
LSD	Living safety case document
LLW	Low Level Waste
LMfS	Leadership and Management for Safety
LTFSC	Long Term Fire Safety Case
MS	Maintenance Schedule
NEC	Non-Elective Closure
NGL	EDF Energy Nuclear Generation Ltd
NNBR	New Normal Business Recommendation
NSC	Nuclear Safety Committee
NSP	Nuclear Safety Principles

ONR	Office for Nuclear Regulation
OPEX	Operational Experience
PCPV	Pre-Stressed Concrete Pressure Vessel
PLEX	Plant Life Extension
PSA	Probabilistic Safety Analysis
PSR	Periodic Safety Review
PSR3	Third round of PSRs undertaken on the NGL fleet of nuclear power stations
PVCW	Pressure Vessel Cooling Water
RGP	Relevant Good Practice
RQ	Regulatory Query
RWFI	Radioactive Waste Focus Index
SAP	Safety Assessment Principle(s)
SCAP	Safety Case Anomalies Process
SCHR	Safety Case Health Review
SDG	Site Decommissioning Group
SSD	Secondary Shut Down System
SF	Safety Factor
SIAL	Structural Integrity Assessment Limit
SQEP	Suitably Qualified and Experienced Person
SSC	Systems, Structures and Components
SRRT	Steam Release Reactor Trip
SRV	Safety Relief Valves
SSR	System Safety Review
TAG	Technical Assessment Guide (ONR)
TSD	Tertiary shut down system
TMLS	Through Life Management Strategy
WENRA	Western European Nuclear Regulators Association
ZW	Zonal Walk down

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Table 1: PSR3 Category B Recommendations

Table 2: Heysham 1 / Hartlepool / PSR3 Category B Recommendations Applicable to
Heysham 1 / Hartlepool

Table 3: ONR Heysham 1 / Hartlepool PSR3 Assessment Findings

1 PERMISSION REQUESTED

1. This ONR Project Assessment Report sets out the regulatory justification for issuing an ONR Decision Letter confirming that EDF Energy Nuclear Generation Ltd (NGL), "the licensee", has carried out an adequate Periodic Safety Review (PSR) of the Heysham 1 / Hartlepool nuclear power station's safety cases.
2. The requirement to carry out a PSR is based on the need for compliance with Nuclear Site Licence Condition (LC) 15: Periodic Review. International standards (Ref. 1) state that the period between PSRs should be 10 years. The Heysham 1 / Hartlepool PSR (Ref. 2) submitted to ONR covers the period January 2019 to 2029.
3. The regulatory process (Ref. 3) requires ONR to issue a statement in writing (a "Decision Letter") confirming its position on the adequacy of the licensee's PSR submission. The Decision Letter is issued one year after the formal submission date of the PSR. This letter sets out any regulatory requirements from the assessment of the PSR.

2 BACKGROUND

2.1 GENERAL

4. Heysham 1 / Hartlepool power station each operate two Advanced Gas-cooled Reactors (AGR), which commenced generation in 1983, and are currently scheduled to cease electrical generation in 2024.
5. The PSRs are conducted by NGL in a ten year rolling programme across their fleet of nuclear power stations. The Heysham 1 / Hartlepool PSR was the third set, of the third round of PSRs to be conducted, commonly referred to as PSR3 and formally submitted to ONR in January 2018 (Ref. 4). To maintain consistency across the PSR3 programme, the formal submission date was taken as 31 January 2018.
6. NGL concluded from its reviews that the current safety cases for Heysham 1 / Hartlepool remain appropriate. The ongoing management of nuclear safety risk was considered and it was concluded that adequate risk management arrangements were in place to ensure that the risk from operation of the stations will be maintained as low as reasonably practicable (ALARP) over the next PSR period. It was considered that continued operation² of Heysham 1 / Hartlepool to be acceptable for the next 10-year period.
7. ONR's guidance (Ref. 3) states that the purpose of the PSR is to consider all factors that may affect the safety of the plant over its life-time which are summarised under the following bullet points:
 - The degree to which the safety case conforms to modern standards and good practices.
 - The degree to which the safety documentation addresses the remnant life of the facility given changes in plant status through construction, commissioning, operations, post operations and decommissioning.
 - The adequacy of the arrangements in place to maintain safety until the next PSR or end of life.
 - Safety improvements to be implemented to resolve any identified safety issues.

² Operations has the meaning as defined in LC1

2.2 THE PERIODIC SAFETY REVIEW

8. NGL commenced the Heysham 1 / Hartlepool PSR3 in 2014 consistent with the approach set out in NGL's scoping document (Ref. 5). This document defined the scope of work to be undertaken and established the methodology, which was consistent with the HPB/ HNB PSR3 and DNB submissions. The structure of the review was aligned to the International Atomic Energy Agency (IAEA) PSR guidance (Ref.1), based around safety factors (SF), and better use of company processes to deliver PSR evidence where practicable to enable delivery of a more continuous review. The structure of the PSR3 submission is detailed in Appendix 1.
9. To enhance the continuous review activities, NGL introduced a safety case health review (SCHR) process that complimented the extant equipment reliability reviews (ERR), which focused on plant condition and reliability.
10. Zonal walkdowns were conducted to provide a high-level stand back review of the design and current actual configuration of the plant against the hazard safety case requirements. The walkdowns are termed 'zonal' as they were performed on the basis of physical zones containing nuclear safety related plant with the zones assigned according to the physical segregation provided by fire barriers and/or by separation.
11. To ensure consistency across the safety factor reviews and the PSR3 programme, NGL produced a synopsis document for each safety factor early in the PSR3 process. The synopsis documents set down the claims and arguments for each safety factor, to meet the IAEA objectives, and specified the review methods to be used to underwrite each claim.
12. The safety factor reviews focussed on providing evidence to support the claims and arguments laid out in the synopsis documents, to demonstrate that the NGL processes had adequately managed safety, and would continue to adequately manage safety, and the station would therefore be safe to operate for the forthcoming PSR period.
13. The reviews identified PSR recommendations which were categorised by their nuclear safety significance:
 - Category A: PSR identified nuclear safety significant issue which must be resolved by the ONR decision date.
 - Category B: PSR identified nuclear safety significant issue, which will be resolved by a timescale commensurate with its safety significance. The timescale will be shared with ONR.
 - New Normal Business Recommendations (NNBR): PSR identified issues of a low nuclear safety significance, e.g. potential improvement comprising good practices but with limited nuclear safety benefit. Timescales will be determined by existing normal business processes for prioritisation of work.
14. NGL identified no category A recommendations and six Category B recommendations specific to Heysham 1 / Hartlepool, see Table 1 (page 34), in addition to two Category B recommendations arising from the earlier HPB/HNB PSR3 that were also considered relevant to Heysham 1 / Hartlepool, see Table 2 (page 37).
15. NGL produced a plan to address all of its Cat B recommendations by the end of 2019 (Ref. 6). ONR considered this to be acceptable. A further 52 issues were identified of low nuclear safety significance and were categorised as new normal business recommendations which would be addressed through the routine processes and prioritisation.

16. NGL has followed its own internal assurance process in the production, review and assessment of its PSR3 and sentencing of observations. The final submission document and all of the supporting safety factor reports produced for the Heysham 1 / Hartlepool PSR3 have been subject to an Independent Periodic Review Assessment (IPRA) by NGL's Independent Nuclear Assurance (INA) (Ref.7). INA also participated in the working group that endorsed each category B recommendation raised in the PSR3.
17. The PSR3 Final Submission had been considered by the NGL Nuclear Safety Committee (NSC) (Ref. 8) which noted that a number of important issues were discussed in the PSR submission and were being managed appropriately in normal business. The committee noted that all actions raised from PSR2 were completed prior to the submission of the Heysham 1 / Hartlepool PSR3 to ONR.
18. Following this periodic safety review, the licensee concluded that the current safety cases for Heysham 1 / Hartlepool remained appropriate and adequate risk management arrangements were in place to ensure that the risk from operation of the station would be maintained ALARP over the next periodic safety review period. The licensee considered that continued operation of Heysham 1 / Hartlepool power stations was acceptable for the next 10-year period.

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

19. The assessment of the Heysham 1 / Hartlepool PSR3 submission benefited from the work conducted during the Hunterston B / Hinkley Point B and Dungeness B PSR3 assessments which had reviewed many of the NGL corporate processes.
20. ONR's main area of work was in considering the adequacy and implementation of NGL's review processes for the Heysham 1 / Hartlepool safety cases and safety management arrangements. Sampling of the outputs and outcomes of their arrangements was used to provide evidence of the effective implementation of the arrangements described and claims made in the PSR3 submission.
21. A total of 16 regulatory assessments were commissioned covering the following topic areas:
 - Structural Integrity (Ref. 9)
 - Mechanical Engineering (Ref. 10)
 - Civil Engineering (Ref. 11)
 - Electrical Engineering (Ref. 12)
 - Control and Instrumentation (Ref. 13)
 - Chemistry (Ref. 14)
 - Graphite (Ref. 15)
 - Fuel Safety (Ref. 16)
 - Internal Hazards (Ref. 17)
 - External Hazards (Ref. 18)
 - Fault Studies (Ref. 19)
 - Probabilistic Safety Analysis (PSA) (Ref. 20)
 - Leadership and Management for Safety, Quality and Supply Chain (Ref. 21)
 - Nuclear Liabilities (Ref. 22)
 - Radiological Protection (Ref. 23)

- Human Factors (Ref. 24)
22. A summary of ONR assessment views and findings are provided in Appendix 2. Although ONR considers that NGL's review of the Heysham 1 and Hartlepool safety cases was carried out in a systematic way, a number of shortfalls were identified and have been appropriately prioritised. Regulatory issues were raised where ONR's significant assessment findings could not be resolved within the assessment period and these are detailed in Table 3. The remainder of the recommendations raised during the assessments will be assigned low level regulatory issues or will be addressed through routine regulatory interventions.

4 MATTERS ARISING FROM ONR'S WORK

23. Based on the findings of ONR's assessments, ONR considers that, overall, NGL has carried out an adequate review of the Heysham 1 and Hartlepool Nuclear Power Station safety cases. This view is based on the findings of ONR specialist inspectors' assessment reports for specified topic areas (Refs. 9-24). The ONR assessments confirmed NGL's view that the safety case and safety management arrangements justify ongoing operations for a further 10 years.
24. The approach adopted for PSR3, focussing on demonstrating that nuclear safety is maintained through the routine NGL safety management arrangements, is considered appropriate and achieves the purpose stated in ONR's guidance (Ref. 3). This approach demonstrates the effectiveness of the ongoing safety management arrangements rather than the snapshot in time often found in previous PSRs. ONR benefited from the learnt lessons from the assessment of the Hinkley Point B / Hunterston B and Dungeness B PSR3 submissions which allowed a more in-depth review of the efficacy and implementation of the claimed safety management processes for the Heysham 1 / Hartlepool PSR3 submission.
25. Whilst the NGL process for conducting the PSR had improved, the timing of the Heysham 1 / Hartlepool PSR3 meant it did not adequately address the PSR shortfalls identified by ONR in the earlier Dungeness B assessment. The primary finding from previous assessments was concerned with the provision of adequate evidence in the PSR and ONR noted similar findings in this PSR submission. ONR are aware that NGL are currently implementing improvements to their PSR process, and ONR will expect to see further improvements in the implementation of the arrangements in later PSR3 submissions.
26. The lack of evidence included in this submission was mitigated by NGL's prompt response to queries and facilitation of evidence gathered during visits to Heysham 1, Hartlepool and the Barnwood corporate headquarters.
27. ONR sought assurance that the safety case health review (SCHR) process had been updated to incorporate improvements identified in previous ONR PSR3 assessments, ensuring they supported the periodic safety review process through a rolling programme of high level safety case reviews. Overall, ONR found the process beneficial to ensure that the safety cases were adequate and shortfalls were identified and addressed. ONR identified a number of weaknesses in the implementation of the SCHR process and some improvements that would be needed to ensure that the SCHR process was sufficiently robust to support the expectations and requirements of a periodic safety review. The following finding was raised:

ONR-HYA/HRA-PSR3-01

NGL should review the implementation of their SCHR process to ensure all safety cases have been adequately reviewed within the 10 year PSR period.

28. ONR acknowledges that NGL have and continue to implement improvements at Heysham 1 and Hartlepool, such as boiler modifications and other general plant condition improvements. These will be needed to support the safe operation of the plant through to the end of electrical generation.
29. ONR's assessment took into account NGL's identification of shortfalls and we consider the process followed by NGL was structured and subject to independent scrutiny. ONR judge NGL's categorisation of all shortfalls into category B or new normal business work-streams reasonable with the appropriate ALARP considerations and the impact on nuclear safety.
30. In total, ONR's assessments have raised nine findings (Table 3, page 38). The one which was common to many topics is summarised above; the more topic-specific findings are summarised in Appendix 2. NGL will develop proposals for the resolution of the nine ONR findings by 31 March 2019 and close out the findings within agreed timescales. ONR consider the hazard and risk identified within each of the findings are reasonable challenges which NGL has not adequately addressed. However, none are considered immediate threats to safe operation.
31. ONR will monitor the close out of all NGL's category B recommendations and ONR findings by the end of 2021 through normal business activities delivered by the ONR Heysham 1 and Hartlepool PSR3 project and specialist inspectors. Attention will be given to ensure the adequacy of response and effectiveness of implementation.

5 CONCLUSIONS

32. ONR consider that NGL has carried out an adequate periodic safety review of the Heysham 1 and Hartlepool nuclear power stations safety cases for the period 2019-29. This view is based on the following:
 - NGL's arrangements for LC 15 have been followed in that an adequate review of the station's nuclear safety case and safety management arrangements has been undertaken. This review was subject to independent review via NGL's internal assurance process and Nuclear Safety Committee.
 - NGL's review did not identify any significant nuclear safety threats that would impact on station's operations for the period through to end of generation, currently 2024. Safety shortfalls were identified through the PSR3 recommendation process and have been categorised based on ALARP principles given their impact on safety. NGL has a programme for all category B recommendations to be addressed by the end of 2019.
 - ONR's own assessment of the Heysham 1 and Hartlepool PSR3 submission in support of continued safe operations until 2024 were considered to be thorough and systematic.
 - ONR's assessment findings supported NGL's conclusion that no serious nuclear safety hazards exist in continued operation of Heysham 1 and Hartlepool power stations that are not already controlled through normal operational processes to reduce the risks ALARP. ONR identified nine findings in its assessment work for which NGL will develop proposals for resolution by 31 March 2019 and close out the findings within agreed timescales.
33. Electrical generation from reactors operation will be dependent on the outcomes of the ongoing programme of graphite core inspections and inspections of other key

structural components as part of the continued examination, inspection, maintenance and testing. Adequacy of the ongoing safety case, justifications and the safety of operations will also be confirmed by ONR as part of its permissioning process of engineering changes, Consents following each statutory shutdown of the reactors and through regular inspection activities.

6 RECOMMENDATIONS

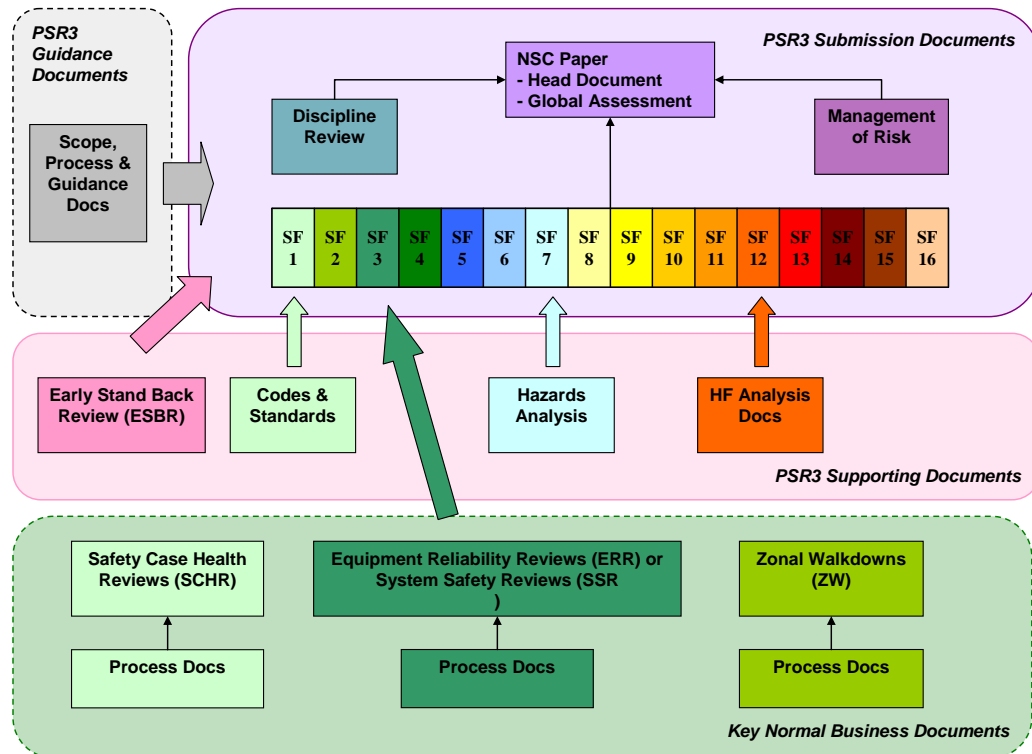
34. I recommend that ONR confirms the adequacy of NGL's Heysham 1 and Hartlepool PSR submission by issuing a Decision Letter agreeing to the continued operation of the site for the period 2019-2029, subject to the caveats highlighted above.
35. I recommend that conditions are included in the Decision Letter with timescales to address the outstanding NGL category B recommendations and ONR findings.

7 REFERENCES

- 1 *Periodic Safety Review For Nuclear Power Plants*. International Atomic Energy Agency (IAEA). Specific Safety Guide SSG-25. IAEA. Vienna. 2013. www.iaea.org.
- 2 NP-SC 7761 – Heysham 1 and Hartlepool Third Periodic Safety Review Final Submission - Version 03 -, 12 Dec. 2017, TRIM 2017/463182.
- 3 *Periodic Safety Review*, NS-TAST-GD-050 Revision 6. ONR. July 2017
http://www.onr.org.uk/operational/tech_asst_guides/index.htm
- 4 NSL/HYA 50828 (N) - PSR3 NP-SC 7761 - Submission letter, 17 January 2018, TRIM 2018/28065.
- 5 NGL - PSR3 - HYA/HRA Scope and arrangements - EC357352 HRA & EC357354 HYA - NP/SC 7761 - Rev 000 Ver 04, Oct 2013, TRIM 2016/114159.
- 6 HYA/HRA PSR3: Status of HYA/HRA PSR3 RMFs/ ONR findings, 10 Jan. 2019, TRIM 2019/10203.
- 7 INSA and IPRA certificates for the HYA/HRA PSR3 Final Submission and SF reports, 17 January 2018, TRIM 2016/28052.
- 8 EDF NGL - NSC Minutes - Meeting Held at Barnwood on 14th August 2017, TRIM 2018/28083.
- 9 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-029 - Assessment of the Structural Integrity aspects of the HYA/HRA PSR3, Aug 2018 TRIM 2018/248782.
- 10 NGL – Heysham 1 & Hartlepool - ONR-OFD-AR-18-033 - Mechanical Engineering Assessment of the HYA/HRA PSR3, Sep 2018, TRIM 2018/261361.
- 11 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-022 - Civil Engineering Assessment of the HYA/HRA PSR3, Sept 2018, TRIM 2018/285148.
- 12 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-031 - Assessment of the Electrical Systems aspects of the HYA/HRA PSR3, Nov 2018, TRIM 2018/252563.
- 13 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-042 - Control and instrumentation assessment of the HYA/HRA PSR3, Oct 2018, TRIM 2018/307660.
- 14 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-061 - Assessment of the Chemistry Aspects of the HYA/HRA PSR3, Nov 2018, TRIM 2018/203360.
- 15 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-002 - Assessment of the Graphite Aspects of the HYA/HRA PSR3 for the Period 2018–2028, Nov 2018, TRIM 2018/232194.
- 16 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-034 - Assessment of the Fuel Safety aspects of the HYA/HRA PSR3 for the Period 2018 – 2028, Nov 2018, TRIM 2018/264626.
- 17 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-058 - Internal Hazards Assessment of HYA/HRA PSR3, Nov 2018, TRIM 2018/360177.
- 18 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-038 - External Hazards Assessment of the HYA/HRA PSR3, Jan 2019, TRIM 2018/358062.
- 19 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18- 065 - Fault Studies Assessment of HYA/HRA PSR3, Jan 2019, TRIM 2018/93975.
- 20 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-052 - PSA Assessment of the HYA/HRA PSR3, Nov 2017, TRIM 2018/298581.
- 21 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-053 - Review of Supply Chain and Quality of the HYA/HRA PSR3, Dec 2018, TRIM 2018/388291.
- 22 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-030 - Assessment of the Nuclear Liabilities Aspects of the HYA/HRA PSR3, Jan 2018, TRIM 2018/248367.
- 23 NGL - Heysham 1 & Hartlepool - ONR-OFD-AR-18-036 - Radiological Protection Assessment of HYA/HRA PSR3, Aug 2018, TRIM 2018/200641.

APPENDIX 1 – PSR3 Submission Structure

36. The documentation provided by NGL follows the guidance laid out in International Atomic Energy Agency (IAEA) document number SSG-25 (Periodic Review for Nuclear Power Plants) (Ref.1). The documentation included a final submission document, zonal walkdown reports for Heysham 1 / Hartlepool and an early stand back review. The document structure and relationships are shown in the figure below.



37. The submission included a number of specified Safety Factor (SF) documents, as identified below:

- SF 1: Plant design
- SF 2: Actual condition of plant important to safety
- SF 3: Equipment qualification
- SF 4: Ageing, obsolescence and lifetime management
- SF 5: Deterministic safety analysis
- SF 6: Probabilistic safety analysis
- SF 7: Hazards analysis
- SF 8: Safety performance
- SF 9: Use of experience from other plants and research findings
- SF 10: Organisation, the management system and safety culture
- SF 11: Procedures
- SF 12: Human factors
- SF 13: Emergency planning
- SF 14: Radiological impact on the environment
- SF 15: Radiological protection
- SF 16: Decommissioning

APPENDIX 2 – ONR Assessment Topics

38. This appendix gives an overview of the various topics assessed within the Heysham 1 and Hartlepool PSR3 submission and presents the conclusions and ONR findings (where applicable) for each of the topics.

Structural Integrity (Ref. 9)

39. Overall ONR was satisfied, from a structural integrity perspective, that NGL produced the PSR3 for Heysham 1 / Hartlepool based on a reassessment of its processes and safety cases in line with ONR's expectations and that it has completed an assessment of current plant condition to compare it against the design intent and the predicted operating life of the stations.
40. The PSR3 identified a number of category B findings and normal new business recommendations relevant to structural integrity. ONR considered that issues related to structural integrity identified within the PSR3 review were being suitably dealt with through other standard NGL processes and where ONR deemed these were important has raised ONR recommendations to track their progress/outcome.
41. Regarding NGL's submission ONR sampled the following areas:
- Substantiation supporting Safety Factor 1 "Plant Design" and linkage to Safety Factor five, "deterministic safety analysis".
 - NGL's general approach to maintaining a living safety case, addressing engineering change and responding to safety case anomalies were sampled.
 - Consideration of modifications made to the safety case over the review period and findings from the safety case health reviews.
42. Whilst ONR was content with the PSR3 submission, there are aspects that the structural integrity specialist inspector considered should be improved.
43. The structural integrity specialist inspector did raise one finding in relation to the licensee demonstrating there is adequate provision for the examination, inspection, maintenance and testing of high density polyethylene piping:

Finding, ONR-HYA/HRA-PSR3-03

- The licensee should demonstrate there is adequate provision for the examination, inspection, maintenance and testing of high density polyethylene piping where this has been introduced for nuclear safety related applications.
44. Shortfalls have also previously been identified in the licensee's arrangements for corrosion management. These shortfalls prompted intervention by ONR and substantial improvement has resulted including the introduction of new technical standards for corrosion management and the formation of a number of corrosion management steering groups. Arrangements are in place for continued engagement between ONR and the licensee on corrosion management.
45. A number of recommendations were raised during the structural Integrity specialist inspector's assessment which require the licensee to provide further information and clarification on:
- the period of validity for the current boiler tube safety case.
 - the programme for implementation of safety enhancements resulting from the boiler lifetime inspection and monitoring programme.

46. The structural Integrity specialist inspector will raise a level 4 regulatory issue to capture these recommendations and will monitor progress in addressing these areas through routine interventions.

Mechanical Engineering (Ref. 10)

47. Overall, ONR was satisfied, from a mechanical engineering perspective, that the licensee has adequately satisfied the requirements of Site Licence Condition 15 Periodic review, which requires the licensee to make and implement adequate arrangements for the periodic and systematic review and reassessment of safety cases.
48. The scope of ONR's assessment for Mechanical Engineering was to consider:
- the extent to which Heysham 1 / Hartlepool and their safety cases conform to modern standards and practices, so far as is reasonably practicable;
 - the extent to which the safety documentation, including the licensing basis, remains valid;
 - the adequacy of the arrangements in place to maintain safety until the next PSR; and
 - the adequacy of its arrangements implemented to resolve safety issues.
49. Whilst ONR was content that the licensee has adequately satisfied the requirements of Site Licence Condition 15, there are aspects where the mechanical engineering specialist inspector considered reasonable improvements could be made. This has resulted in the following finding being raised:

Finding, ONR-HYA/HRA-PSR3-08

- **The licensee should demonstrate that it has adequate processes in place for identifying and reviewing modern standards for cranes and lifting equipment.**
50. The mechanical inspector identified that the licensee's review of codes and standards was not sufficient as it had not included all codes and standards that are relevant to cranes and lifting equipment. Although it states that it is in compliance with those it has reviewed, ONR's mechanical inspector judged there to be a gap in regard to the scope of the reviewed standards. ONR will continue to engage with the licensee to ensure that an adequate review against relevant codes and standards is conducted.
51. ONR has received an initial response to this finding and NGL have agreed to provide further evidence on how the codes & standards remain updated with modern practices and reviewed against its relevant items.
52. One recommendation was raised during the mechanical specialist inspector's assessment which requires the licensee to demonstrate that its equipment qualification arrangements provide adequate oversight to ensure that its individual procedures are implemented in a consistent and controlled manner and are appropriately reviewed. A level 4 regulatory issue will be raised to track this recommendation through routine regulatory business.
53. Based on the evidence considered the mechanical engineering specialist inspector judged that the licensee has demonstrated that:

- it has arrangements in place to review and assess conformance with modern standards and good practices;
- there are appropriate measures to ensure that safety documentation, including the licensing basis, remains valid;
- there are adequate arrangements to maintain safety within the next review period; and
- it has adequate arrangements in place to resolve safety issues.

Civil Engineering (Ref. 11)

54. ONR concurred, from a civil engineering perspective with the overall conclusions of the PSR, that the PSR is adequate and the licensee's arrangements and strategic programmes are appropriate for the safe operation of the reactors at Heysham 1 /Hartlepool for the next PSR period.
55. The civil engineering specialist inspector took note of previous ONR civil engineering assessments of PSR3 documentation for other stations and considered the applicability of any findings and recommendations to Heysham 1/ Hartlepool stations. Earlier PSR3 assessments provided confidence in the general adequacy of NGL's corporate arrangements, this assessment focused on the implementation and the outcomes of the arrangements to support operations for a further ten years.
56. The general scope of the civil engineering assessment was:
- to review the production and content of the Heysham 1/ Hartlepool PSR submission and determine if the PSR is adequate and the approach and format of the submission are in line with ONR and IAEA guidance;
 - to assess the adequacy of the recommendations made by the licensee as a result of their reviews;
 - to identify any additional issues or site system shortfalls against modern standards resulting from ONR assessment;
 - decide on the suitability of the submission and agree an improvement programme to address any significant issues; and
 - to examine their arrangements and strategic programme for the operation of the reactors to see if they are appropriate for the next 10 years of operations and supported by the PSR.
57. Whilst from a civil engineering perspective the conclusion was that the PSR was adequate, a number of findings were identified where further reasonable improvements could be made.
58. With respect to the pre-stressed concrete pressure vessel (PCPV) and boiler closure units (BCUs), the civil engineering specialist inspector reviewed the safety related plant identified in the inspection procedures. The Inspector considered that it was adequate with the exception of the rubber bearings that support the PCPV which are not identified in the MS or supporting procedures as requiring inspection.
59. The living safety document (LSD) acknowledges that the bearings are a main structural element or component of the PCPV and the LSD acknowledges that a number of protections are provided to the bearings against faults and hazards. The civil engineering specialist would therefore expect that an appropriate visual inspection regime would be described in the MS and the following finding has been raised:

Finding, ONR-HYA/HRA-PSR3-04

- **NGL should include a separate activity for Primary Circuit Pressure Vessel (PCPV) bearing inspections in the Maintenance Schedule for both stations.**
60. In an initial response to this finding, NGL acknowledged that this has been a topic of discussion in the past, and that agreement for an anticipated resolution, and any appropriate closure criteria will be agreed with ONR.
61. For Hartlepool the civil engineering specialist inspector did not find a separate entry for the fuel pond in the MS or receive any documentation that confirmed that there was a process to ensure that the pond would be inspected at no more than three yearly intervals. Despite assurances during the inspector's site visit that the station was compliant with mandatory company requirements, the inspector has been unable to confirm that this is the case and considers this is a shortfall against SAP EMT.2 and has therefore raised the following recommendation:

Finding, ONR-HYA/HRA-PSR3-05

- **In order to comply with the mandatory requirements of CTS/230, NGL should provide a separate item within the Hartlepool Maintenance Schedule (or MITS) for the inspection of the Fuel Storage Pond that demonstrates that the maximum pond inspection frequency is not more than every 3 years.**
62. In an initial response to this finding, NGL has acknowledged that generic work has been done in this area and they will therefore be able to provide a closure statement. ONR will continue to engage on this matter until the evidence has been provided.
63. NGL's company specification for the review of maintenance and inspection identifies that LC 28 reviews are considered important to equipment reliability (ER), whilst noting that ER also covers additional aspects not included within the LC 28 compliance arrangements. Where performance deficiencies are identified, the required improvement actions will be captured in system action plans. The inspector could find no evidence that they have been carried out for safety related civil systems, therefore the following recommendation has been raised:

Finding, ONR-HYA/HRA-PSR3-06

- **In relation to civil structures, NGL should confirm its proposals to address the absence of LC 28 Reviews, required by Company Specification BEG/SPEC/FENG/017.**
64. In an initial response to this finding, NGL have agreed they will clarify how the ER process is applied to the management of civil structures. ONR will continue to engage on this matter until the evidence has been provided.
65. A number of other recommendations were also raised during the civil engineering assessment; a level 4 regulatory issue will be raised to capture these recommendations which will be followed up on during routine regulatory business. The recommendations identify areas for improvement in the management of the civil engineering assets, to better align the current practices with fleet-wide company standards and guidance and with relevant good practice. These recommendations will assist the licensee in developing an acceptable improvement programme, and to enable ONR to monitor progress with addressing these areas through routine interventions.

Electrical Engineering (Ref. 12)

66. Overall, from an electrical engineering perspective, ONR was satisfied that the Heysham 1/ Hartlepool PSR3 met the requirements of LC 15 Periodic review, which requires that the licensee makes and implements adequate arrangements for the periodic and systematic review and reassessment of safety cases.
67. The scope of the electrical engineering assessment included the licensee's electrical systems safety case review, and particularly its consideration of the actual condition of plant; the effects of plant ageing, and degradation and equipment together with obsolescence; the use of operational experience, and also developments including the consideration of changes made to relevant electrical engineering codes and standards.

The electrical engineering specialist inspector assessed the effectiveness of the arrangements in addressing the specific electrical engineering RQs, recording judgements made against each RQ. The focus of the RQs predominately relate to the adequacy of the examination, maintenance, inspection, testing and lifetime management arrangements of the stations' electrical equipment within the following systems:

- Emergency generation.
 - 11kV essential supplies.
 - 415V essential and auxiliary supplies.
 - No-break electrical systems.
 - Lightning protection systems and earthing.
 - Associated cabling and cabling containment and support structures.
 - Associated electrical protection and control systems.
68. The electrical engineering specialist inspector considered the review reports submitted by the licensee provided evidence that the relevant good practice has been adopted regarding a systematic review and reassessment of the electrical structures, systems and components that play an important role in supporting the Heysham 1 and Hartlepool safety cases.
69. The electrical engineering specialist inspector considers the licensee has performed an effective review of the electrical engineering aspects of its safety cases for Heysham 1 and Hartlepool and is managing plant condition, ageing and obsolescence issues in an acceptable manner. It was also considered that the licensee is applying relevant good practice when assessed against ONR or other published guidance.
70. During the electrical engineering assessment there were no new findings or recommendations raised and the electrical engineering specialist inspector did not consider it proportionate or targeted to introduce any additional regulatory oversight of the delivery of the licensee's electrical engineering new normal business recommendations, as routine regulatory engagement between ONR and the central technical organisation are already established.

Control and Instrumentation (C&I) (Ref. 13)

71. Overall, ONR consider that the arrangements that are in place to manage the reliability and safety of C&I nuclear safety systems and equipment at Heysham 1/ Hartlepool are adequate to support operations over the next PSR period.
72. The general scope of ONR's assessment for Control and Instrumentation (C&I) assessment was focused on:
- Obsolescence management;

- Ageing equipment management;
 - Knowledge retention and dissemination;
 - Cyber security management;
 - Equipment configuration control management;
 - In-core thermocouple management;
 - Item equivalency evaluation process;
 - Decommissioning phase C&I preparations.
73. In addition to the above, the C&I specialist inspector also undertook an overarching assessment of the implementation of current arrangements for ageing and obsolescence and examination, inspection, maintenance and testing, in relation to the systems covered by system health indicator programme for pressure vessel cooling water system and condensate polishing plant and make up water treatment plant.
74. Whilst ONR was broadly satisfied that the licensee has adequately satisfied the requirements of Site Licence Condition 15, there are aspects where the C&I specialist inspector considered reasonable improvements could be made. This did not result in an ONR finding being raised, however the C&I specialist inspector did reference out to a previous finding regarding cyber security (see below) raised during the Hunterston B and Hinkley Point B PSR3 assessment which is also relevant to Heysham 1 and Hartlepool:

Finding, HNB / HPB PSR3 C&I 01

NGL should undertake a station wide review of cyber security arrangements as part of the PSR process, and clarify how cyber security issues are integrated / addressed in the equipment reliability process

75. The C&I specialist inspector noted that the Heysham 1 and Hartlepool PSR3 was the first opportunity for the licensee to address the above issue. The C&I specialist inspector continues to track progress on this issue through regulatory interventions with NGL.
76. A number of recommendations were also raised during the C&I assessment which will be followed up on during routine regulatory business. The recommendations identify potential areas for improvement in relation to benchmarking to measure their C&I ageing equipment management processes against international NPP operators; ensure personnel have the knowledge to identify C&I ageing mechanisms and this knowledge remains current; introduce arrangements to ensure C&I equipment degradation is identified so mitigating actions can be taken; and also to consider implementation of system handover documents.
77. The C&I specialist inspector has raised a level 4 regulatory issue (6873) to capture these recommendations and will monitor progress with addressing these areas through routine interventions.

Chemistry (Ref. 14)

78. Overall, the ONR chemistry specialist inspector judged there to be sufficient evidence within the suite of PSR submissions, supporting documentation, responses to queries and visits to station to be able to support acceptance of PSR3 for Heysham 1 and Hartlepool for the period until January 2029.
79. The chemistry specialist inspector opted to target assessment upon the impact of chemistry control on the fuel, boilers and pressure vessel cooling water (PVCW). Each of these represents an area with a number of safety case anomalies process (SCAP)

- entries and associated interim justification for continued operation (IJCOs) with relevance to chemistry. The chemistry specialist inspector referenced recent inspections and assessment work where relevant to the body of assessment undertaken. Notably, future safety case submissions pertinent to failed fuel and the mitigation of carbon deposition are anticipated and the subject of separate assessment.
80. A sample was undertaken looking more generally at chemistry compliance to gain confidence in broader chemistry control, while also seeking to understand plans to manage resource and succession planning given challenges associated with an approaching change in operations from power generation to defueling at Heysham 1 and Hartlepool.
81. Whilst ONR were content that the licensee has adequately satisfied the requirements of Site Licence Condition 15, a number of recommendations were raised during the chemistry assessment which will be followed up on during routine regulatory business. The recommendations identify potential areas for improvement in relation to the following:
- reviewing the SQEP in the chemistry team to meet the Hartlepool station nuclear baseline.
 - demonstrate that Heysham 1 have considered preventative measures to reduce the incidence of PVCW leaks, and specifically Heysham 1 should justify why it is not reasonably practicable to implement sparging of the RFT water, as undertaken at Hartlepool.
82. The chemistry specialist inspector identified repeat reliance in PSR3 submissions from plant life extension (PLEX) activities. Highlighting that the drivers behind PSRs and PLEX are fundamentally different, with the latter driven by extending commercial generation which are not formally assessed by ONR. The chemistry specialist inspector noted it is unclear if all PLEX findings important to safety have been captured by PSR3 processes. ONR have an existing level 4 regulatory issue covering this issue and the chemistry specialist inspector will progress through normal business.
83. Additionally, the chemistry specialist inspector considered that five repeat recommendations from the previous assessments of the PSR3 of Hinkley Point B, Hunterston B and Dungeness B are also relevant to Heysham 1 / Hartlepool, these recommendations include the following:
- NGL should include chemistry compliance and discussion of important processes to chemistry within the PSR submission,
 - NGL should provide a demonstration that safety-related PLEX findings relied upon by PSR3 are captured and are being appropriately managed.
 - NGL should provide a demonstration that the chemistry inputs, assumptions, sensitivities and links to the chemistry safety case are appropriate for FEAT-DIFFUSE6 and TUBELIFE/TUFARI modelling.
 - NGL should provide a demonstration that suitable and sufficient consideration has been given to chemistry effects during accidents.
84. The repeat recommendations identified above have all been assigned a regulatory issue and the chemistry specialist inspector will continue to track progress on all regulatory issues with NGL through routine regulatory interventions.

Graphite (Ref. 15)

85. Overall, the ONR graphite specialist inspector was content with the evidence sampled concerning the graphite integrity aspects, he concluded that Heysham 1 / Hartlepool PSR3 demonstrates that NGL has suitable management processes in place for the next PSR period.
86. The ONR graphite specialist inspector highlighted that demonstration of the continued fitness for purpose of the graphite core requires regular inspection, this will enable the licensee to demonstrate tolerance to the expected degree of core cracking and oxidation.
87. The graphite specialist inspector was satisfied that with respect to graphite core integrity aspects, the PSR3 has been conducted in accordance with relevant good practice and adequate arrangements are in place to support the continued operation of Heysham 1 / Hartlepool power stations.
88. With regards to graphite weight loss, ONR noted the need for continuing careful assessment of the graphite weight loss, supported by regular sampling of core properties using trepanning. This is due to the uncertainties in the calculations; the forecasts only allow confidence over a relatively short period of operation, up to the three-yearly operation period of consent granted by ONR for the return to service of the stations following a periodic shutdown. Regular inspections and trepanning are therefore an essential part of the method to ensure that the graphite weight loss remains within the limits.
89. The graphite specialist inspector considered the following items in the review of the PSR3 documents:
- to assess the adequacy of any recommendations made by the licensee as a result of the reviews it has conducted;
 - to identify any additional issues or site system shortfalls
 - to decide upon the suitability of the submission and to agree an improvement programme to address any significant issues;
 - to examine the strategic programme for the operation of the reactors.
90. Whilst ONR was content that the licensee has adequately satisfied the requirements of Site Licence Condition 15, areas were identified where it was considered reasonable improvements could be made. The ONR graphite specialist inspector highlighted that all recommendations raised should be implemented before the onset of keyway root cracking predicted in 2021 according to NGL's models. The recommendations raised were:
- NGL made a safety case commitment to demonstrate that inter-sleeve gapping does not challenge cooling of the fuel for post-stress reversal operation. NGL should inform ONR on the result of this commitment during the first quarter of 2019.
 - That NGL use the estimates for the number of cracks in the core at the 99.9th percentile confidence level for Heysham 1 / Hartlepool, ensuring consistency with estimates for other AGRs.
 - That NGL produces a safety case supporting operation beyond the onset of key way route cracking before the predicted date for onset.
 - That NGL continues to develop improved inspection and monitoring technology of the Heysham 1 / Hartlepool graphite cores.
 - The revised safety case justifying operation beyond the current 43% SIAL limit should be presented to ONR when available.

- That NGL develops a strategy to determine and reduce the uncertainties in graphite weight loss in the regions of the core yet to be sampled.
 - That NGL should consider plant modification and/or seismic qualification of either the secondary or the tertiary shutdown systems before the onset of keyway root cracking (separate finding raised in fault studies section).
91. The recommendations above will be shared with NGL and will be discussed through routine regulatory meetings commencing early 2019. The graphite specialist inspector will raise a level 4 regulatory issue to track the recommendations to completion through normal regulatory business.

Fuel Safety (Ref. 16)

92. Overall, from a nuclear fuel safety perspective, ONR was satisfied with the adequacy with which the licensee has reviewed its safety case in accordance with its LC15 arrangements. Based on the fuel safety specialist inspectors sample, the Inspector judged that continued operation of both sites is acceptable for the next 10 year period.
93. However, in coming to this conclusion the fuel safety specialist inspector noted that in some cases the evidence was not effectively presented in the PSR3 submission and was required to make judgements based on further discussion combined with information from previous assessments and ongoing interactions with NGL under the fuels topic.
94. The fuel safety specialist inspector's assessment has been focussed primarily on the adequacy of the submission and therefore of the NGL periodic review. It has not sought to make a complete review of all the aspects of the PSR but has sampled the following areas in order to establish the quality of the licensee's periodic safety review:
- Identification of process shortfalls.
 - Implementation of countermeasures or improvements.
 - Progress compared to previous PSRs.
95. Whilst ONR was broadly satisfied that the licensee has adequately satisfied the requirements of Site Licence Condition 15, there are aspects that the fuel safety specialist inspector considered reasonable improvements could be made.
96. During the fuel safety assessment, the inspector identified continuing underperformance in the implementation of the SCHR, recommending an ONR intervention in order to assess the SCHR process effectiveness at a broader level. This issue has been captured in the fault studies assessment in section 116 of this report where PSR3 finding ONR- Heysham 1 / Hartlepool PSR3-01 has been raised to track progress in the implementation of SCHR improvements.
97. The fuel safety specialist inspector raised a number of recommendations during the fuel safety assessment, which were in relation to ONR considering the review of the application of EDF-NGL "Dynamic ALARP" principle and ONR considering tracking the replacement of the IFDF blowers at Heysham 1 / Hartlepool power stations. These issues will be followed up on during routine regulatory business.
98. The fuel safety specialist inspector identified the introduction of NGL's living safety case documentation as good practice. These documents provide improved safety case clarity, accessibility and currency. The inspector found sufficient evidence that EDF-NGL is maintaining control and oversight of the AGR fuel design, and is content that NGL is acting as a satisfactory informed customer.

Internal Hazards (Ref. 17)

99. Overall, from an internal hazards perspective, ONR did not consider the PSR demonstrated that a systematic and comprehensive review had been undertaken due to the shortfalls in the completeness of the PSR, and considered this a significant shortfall against relevant good practice.
100. The overall scope of the internal hazards assessment was to establish that the internal hazard aspects of the Heysham 1 / Hartlepool PSR are adequate, meeting ONR expectations. This was achieved by:
- Gaining confidence that the Licensee had undertaken an adequate internal hazards review of the extant safety case.
 - Gaining confidence that the Licensee had taken into account learning from experience and future foreseeable challenges.
 - Establishing the Licensee had adequately identified and sentenced shortfalls and developed a credible resolution plan to implement the PSR improvements in a timely manner.
101. The internal hazards inspector judged that the SCHR process for Heysham 1 / Hartlepool resulted in only a limited number of internal hazards being selected for review as part of PSR3. The inspector did not consider that Heysham 1 / Hartlepool PSR3 aligned with ONR's expectation that a PSR requires a systematic and comprehensive review. This issue has been captured in the fault studies assessment in section 127 of this report where PSR3 finding ONR-HYA / HRA-PSR3-01 has been raised to track progress in the implementation of SCHR improvements.
102. The internal hazards inspector raised an additional recommendation associated with the fire hazards safety case not being the subject of a SCHR prior to PSR3 submission. The inspector noted that the decision on whether to update the fire safety case subsequent to the PSR3 is still to be determined, this is despite the fact that it had been scheduled for update. The internal hazards inspector recommended that the fire safety case should be subject to a detailed review to ensure risks are reduced to ALARP.
103. The internal hazards inspector will take this recommendation forward through routine regulatory interventions and an ONR regulatory issue has been raised to ensure the recommendation is adequately monitored and progressed.

External Hazards (Ref. 18)

104. Overall, from an external hazards perspective, ONR did not consider the PSR demonstrated that a systematic and comprehensive review had been undertaken due to the shortfalls in the completeness of the PSR and considered this a significant shortfall against relevant good practice.
105. The general scope of ONR's assessment for external hazards assessment was focused on:
- Seismic Hazards
 - Accidental Aircraft Crash Hazards
 - External Flooding
 - Extreme Wind
 - Industrial Hazards
 - Extreme Ambient Temperatures (EAT)
 - Lightning

106. The external hazards inspector identified a number of areas where reasonable improvements could be made. NGL's evidence indicates that there may be safety case shortfalls (gaps) in the seismic and other external hazards safety cases due to multiple safety case modifications and addendums recorded in ECs and other documents, these have not been consolidated into the safety case itself. ONR judge that further work is required to clarify the seismic hazards safety case documentation for Heysham 1 / Hartlepool, including consideration of whether they should be consolidated into a single document. This also applies to the seismic LSD. The inspector noted that ONR have raised this issue previously. The following finding has been raised to progress this issue with NGL:

Finding, ONR-HYA/HRA-PSR3-02

The external hazards safety cases should be reviewed and any revisions needed to repair shortfalls or gaps to be implemented to timescales agreed with the licensee.

107. NGL have provided an initial response informing ONR that SCHR will be performed on external hazard cases as a matter of normal business. Any shortfalls and gaps identified will be prioritised as part of routine business.
108. A number of recommendations and observations were raised during the external hazards assessment which will be followed up on during routine regulatory business. The recommendations identify safety case and safety case health review shortfalls and the licensee's failure to adequately resource its arrangements for Licence Condition 14 and 15 compliance from an external hazards perspective.
109. The external hazards specialist inspector noted shortfalls in the PSR submission references to the LSDs for the claims on plant cooling systems, there is no probabilistic beyond design basis analysis for seismic events and there is no consolidated aircraft impact safety case document for Heysham 1 / Hartlepool.
110. The external hazards specialist inspector has raised these recommendations so that the licensee can develop an acceptable improvement programme and to enable ONR to monitor progress, particularly via ONR's regular Hazards Governance meetings with the licensee, additionally a level 4 regulatory issue has been raised to track the recommendations and it is recommended that suitably targeted site inspections should be undertaken by ONR.
111. The external hazards specialist inspector raised a number of observations which are generally positive and noted he will continue to monitor these areas via normal regulatory engagements with the licensee.

Fault Studies (Ref. 19)

112. ONR judged, from a fault studies perspective, that an adequate review had been carried out and that there was no immediate safety case concerns that would affect the safety of reactor operation. The fault studies specialist inspector concluded from a fault studies perspective, ONR can issue a positive PSR decision letter stating that an adequate review had been completed.
113. The fault studies specialist inspector did however note that the PSR report focussed on the processes that had been set up with little information on implementation and did not include a self-assessment as to whether Licence Condition 15 requirement had been met. Considerable interaction with the licensee was required. The key

information supporting the conclusion that a systematic and comprehensive review had been carried out was provided only after prompting from ONR.

114. The general scope of ONR's assessment for fault studies assessment was focused on:
- Reviewing completion of activities identified as necessary in the Heysham 1 / Hartlepool PSR2.
 - PSR3 completeness including claims made vs LC15(1) requirement.
 - Adequacy of SCHR report coverage from a fault studied perspective which supports PSR3.
 - Sample the review provided by Annual Scoping Workshops.
 - ALARP Judgments made on Shortfalls in Secondary and Tertiary Shutdown Systems.
115. The fault studies specialist inspector highlighted the slow rate at which PSR2 identified corrective actions have been completed to date, and suggested that the claimed nuclear safety benefit from more frequent reviews in the PSR3 gradualist approach may not be being realised. To realise the benefit, actions must be closed out on a timescale commensurate with the review frequency.
116. The fault studies specialist inspector found that the safety case health review process consisted of an annual scoping workshop, which assigned priority to review safety case areas based on a scoring system, with those safety case areas scoring highest being subject to a detailed review first. However, to date, not all safety case areas have been subject to a detailed review and published in a dedicated report, and the annual scoping workshops do not provide sufficient depth of review to fulfil the overarching requirement to review each safety case area.
117. During the reviews of the SCHR process and its outputs it was clear that whilst in general it was beneficial, ONR considered that the implementation of the SCHR process was not sufficiently robust to fully support the PSR requirements. ONR has identified that a number of safety cases have not been subject to an adequate review since PSR2, this is in part due to new PSR3 arrangements being implemented in 2014 (6 years into the PSR 10-year cycle). The Inspector concluded that NGL should ensure full benefit can be taken from the SCHR process in support of a PSR. The following finding has been raised to track this issue:

ONR-HYA/HRA-PSR3-01

NGL should review the implementation of their SCHR process to ensure all safety cases have been adequately reviewed within the 10 year PSR period.

118. NGL have provided an initial response to this finding and have confirmed that detailed safety case reviews of the identified Heysham 1 / Hartlepool Safety Cases are targeted to be completed by 2021. The annual SCHR report for 2018 will be produced earlier than planned and this will provide details of the remaining safety cases until this work is completed.
119. The fault studies specialist inspector found the ALARP argument relating to the SSD and the TSD to be inadequate because it does not address key way root cracking, this is an important change that is expected to occur within a few years, and long before the end of the PSR3 period.
120. NGL informed ONR that in support of achieving the end of Station Lifetime ambitions, a new project to scope SSD investment requirement will begin early in 2019 and in

advance of the current predicted dates for onset of keyway root cracking in the core. ONR will continue to engage on this issue, the following finding has been raised:

ONR-HYA / HRA-PSR3-07

An ALARP argument addressing the acknowledged shortfalls in the SSD and TSD systems coupled with the onset of key way root cracking should be developed. The argument should be developed promptly, in time to allow any implementation of any necessary modifications before the onset of key way root cracking occurs.

121. The fault studies specialist inspector identified that the IAEA PSR Guide includes a check list of tasks that should be completed as part of a review of a nuclear power plant's deterministic safety analysis. The inspector noted that two items on the list are not addressed in any of the arguments put forward in the SF05 report, these were associated with:
- Review of the application of the concept of defence in depth; and
 - Evaluation of whether appropriate deterministic methods have been used for development and validation of emergency operating procedures and the accident management programme at the plant.

122. The inspector judged that the omission is in marked contrast with ONR's view as set out in ONR's Safety Assessment Principals (FA.1), also noting that the IAEA PSR guide also makes it clear that beyond design basis matters should be addressed in a PSR. The following finding has been raised to track this finding:

ONR-HYA / HRA-PSR3-09

EDF NGL should carry out a review of the application of concept of defence in depth, and an evaluation of whether appropriate deterministic methods have been used for development and validation of emergency operating procedures and the accident management programme at the plant, as suggested in the IAEA PSR guide (SSG-25).

123.

124. The fault studies specialist inspector noted the PSR report focussed on the processes that had been set up with little information on implementation, and did not include a self-assessment as to whether Licence Condition 15 requirements had been met. Considerable interaction with the licensee was required by the fault studies specialist inspector. The key information supporting the conclusion that a systematic and comprehensive review had been carried out was provided only after prompting from ONR.

Probabilistic Safety Analysis (PSA) (Ref. 20)

125. Overall, from a PSA perspective, ONR concluded that PSR3 for Heysham 1 / Hartlepool is adequate for the period January 2019 to January 2029 subject to suitable and satisfactory safety case submissions to a committed schedule to transition between operational phases.
126. Consistent with IAEA guidance the scope of the ONR, PSA assessment considered whether:
- the PSA is consistent with modern standards and meets relevant good practice
 - the PSA reflects the actual plant and safety case

- the PSA results indicate that risks are broadly acceptable or are tolerable if ALARP; and
 - NGL's internal arrangements to deliver these are adequate and in line with IAEA guidance
127. The PSA specialist inspector noted gaps against relevant SAPs, however, the inspector did not consider these gaps to be significant, and noted that improvements in PSAs have been made as a result of PSA developments since the last PSR for Heysham 1 / Hartlepool. These gaps are already being monitored through routine regulatory business and have been captured in the ONR regulatory issues database.
128. NGL has undertaken a series of ALARP reviews of the risks presented by both stations between PSR2 and PSR3. This has been done using the insights from the PSAs. This demonstrated that substantial plant modifications were implemented around the time of PSR2, with incremental improvements thereafter. The most recent ALARP review included replacement and refurbishment of equipment to maintain the reliability of ageing plant. The PSA specialist inspector's ALARP assessment concluded that NGL has provided adequate evidence that further ALARP analysis or plant improvements is not needed to support PSR3, other than those currently in progress by NGL.

Supply Chain and quality (Ref. 21)

129. Overall, from a supply chain and quality management perspective, ONR judged that the requirements of LC15 for making and implementing adequate arrangements for PSR have been met.
130. The general assessment scope for supply chain and quality management focused on NGL's management arrangements for its supply chain in relation to management of safety within the overall PSR submission focusing on:
- Verification statements and executive summary.
 - Sections relating to management, focused on each of the sixteen safety factor reviews, including safety factor 10 on organisation, safety factor 16 on decommissioning and NGL's management system and safety culture.
131. The supply chain and quality assessment tested the adequacy of the submission by comparing a relevant sample of it against ONR technical assessment guide NS-TAST-GD-077 supply chain management arrangements for the procurement of nuclear safety related items or services, which references the ONR SAPs for capable organisation.
132. The supply chain and quality inspector raised one recommendation in this area, this related to if the licensee had reviewed whether the supply chain and contractor base for Heysham 1 / Hartlepool will be adequate and capable in the scenario of possible extended generation and in decommissioning.
133. The licensee informed the inspector that the supply chain strategy for decommissioning is currently in production. A project definition document laying out the 'End of Generation Optimisation' strategy for region 1 operations is in the very early stages of formulating the Supply Chain focus areas. The licensee informed the inspector that their programme is supported by a governance process and associated support structure, and have identified lifetime and transition managers to support the business units through the end of generation and decommissioning phases.

134. In the supply chain and quality inspector's opinion, this is a reasonable indicator of future intent to create a strategy for the supply chain during decommissioning, notwithstanding that such an activity should have been identified and described as part of the PSR3 process itself, rather than in response to challenge from ONR. This recommendation will be followed up on during routine regulatory engagements and a regulatory issue has been raised to track progress.

Radioactive Waste Management and Decommissioning (Ref. 22)

135. Overall, from a nuclear liabilities assessment perspective, ONR is broadly satisfied with the claims, arguments and evidence laid down within the licensee's safety case. From the evidence sampled, the nuclear liabilities specialist inspector judged that there is no impact on nuclear safety which would prevent the continued operations of Heysham 1 / Hartlepool power stations, recognising that updated safety cases will be required to address end of generation activities.
136. The scope of work for PSR3 from a nuclear liabilities perspective can be summarised as follows:
- To review the production and content of Heysham 1 / Hartlepool and to determine that the licensee's submission is in line with ONR and international guidance.
 - To assess the adequacy of any recommendations made by the licensee as a result of the reviews it has conducted.
 - To identify any additional issues or site system shortfalls against modern standards, resulting from the ONR assessment.
 - To decide upon the suitability of the submission and to agree an improvement programme to address any significant issues.
137. The nuclear liabilities specialist inspector noted the submission described adequate radioactive waste management arrangements and systems to support the continued safe operation of the plants, consistent with ONR's SAPs and other relevant good practice.
138. With regards to decommissioning, the PSR submission described the arrangements to develop and maintain the decommissioning strategy and plans. Recognising that end of generation is imminent, the decommissioning strategy and plans are currently undergoing a substantial review which is due for submission to NDA in September 2019. Adequacy of the revised decommissioning strategy and plans will therefore be the subject of separate regulatory engagements, outside the PSR process.
139. NGL acknowledge that there will be significant changes as the sites transition into defueling and early decommissioning activities, as such there is a significant programme of work currently being undertaken by EDF Energy NGL to address this. The preparations for the transition into defueling and early decommissioning activities has been driven predominantly at a corporate level, however site teams are now being established at Heysham 1 / Hartlepool sites to support this activity.
140. NGL recognise that updated safety cases, strategies and plans will be required to address end of generation activities. Therefore, the nuclear liabilities inspector will track progress through routine regulatory engagement.

Radiological Protection (Ref. 23)

141. Overall, ONR judged, from a radiological protection assessment perspective, that sufficient evidence has been provided to demonstrate the adequacy and effectiveness of arrangements for radiological protection until the next PSR or end of life.
142. The scope of work for the radiological protection PSR3 assessment can be summarised as:
- To review the production and content of the Heysham 1 / Hartlepool PSR3 and to determine that the licensee's approach and format of the submissions is in line with ONR and international guidance;
 - To assess the adequacy of any recommendations made by the licensee as a result of the reviews it has conducted;
 - To identify any additional issues or station system shortfalls against modern standards, resulting from the ONR assessment; and
 - To decide upon the suitability of the submission and to agree an improvement programme to address any significant issues.
143. Whilst from a radiological protection perspective the conclusion was that the PSR was adequate, a number of findings have been identified where further reasonable improvements could be made.
144. One recommendation identified that there is a risk that core station radiological protection resources will become inadequate at both Heysham 1 / Hartlepool over the period covered by PSR3. This is due to the increasing age profile of existing radiological protection staff, the difficulties NGL has experienced in the recruitment and retention of new radiological protection staff, and the requirement for the stations' radiological protection staff to deliver local radiological protection training in addition to their normal, routine duties.
145. NGL has acknowledged this issue, ONR will review NGL's progress in developing and implementing a strategy to address this issue with the licensee's during 2019.
146. The radiological protection specialist inspector noted the utility of a useful addendum to SF15 that contained site specific information for the purposes of the Heysham 1 / Hartlepool assessment. The inspector recommended a similar document should be produced to supplement the Heysham 2/ Torness PSR3 submission.

Human Factors (Ref. 24)

147. Due to resource constraints, it has not been possible for the ONR human factors assessor to complete his assessment report. However, a file note has been produced to capture discussions between ONR human factors specialist Inspectors, confirming ONR had received responses to human factors queries that were satisfactory for the purposes of his assessment, and that the human factors specialist inspector had identified no immediate safety significant concerns that required regulatory attention.
148. ONR undertook a detailed assessment of human factors aspects of the Hinkley Point B /Hunterston B PSR3 in 2016. This was the first of the round of PSR3 submissions which would be completed on the fleet over the next ten years. The licensees claimed demonstration of safe operation of both stations during the next ten-year period (2016-2026), principally due to extant management arrangements which would effectively manage risk to the end of generation and into defueling.

149. Given the human factors processes claimed in the Hinkley Point B / Hunterston PSR3 are corporate, a fleet wide regulatory issue was raised to manage the findings from the assessment. The findings from the human factors assessment concluded it was not clear that the corporate review processes are sufficiently robust to effectively manage and reduce future human factors related risks SFAIRP.
150. ONR commenced human factors assessment of the Heysham 1 / Hartlepool PSR3 submission submitted to ONR in January 2018, predominantly to assess evidence towards resolution of the regulatory issue above. The human factors assessment of the Heysham 1 / Hartlepool PSR3 did not reveal significant new evidence of the adherence to, or the effectiveness of, these processes, confirming the on-going validity of the regulatory issue.
151. The human factors specialist inspector noted that further work is required by EDF, focused on ensuring consistent and robust implementation of EDF's human factors arrangements within its safety assessment and engineering design activities. The human factors specialist inspector therefore recommended that ONR initiates a programme of regular corporate interventions with the licensee to progress the regulatory issue to resolution.

Table 1 –Heysham 1 / Hartlepool PSR3 Category B Recommendations

Safety Factor	Recommendation Number	Title	Planned completion
1 – Actual condition of plant important to safety	SF2 Rec 001	Corrosion management is identified as an issue across the fleet. A WANO peer review at HYA in 2016 identified an Area for Improvement concerning corrosion management. CTS/031 has been issued but it is judged that further work is required to effectively implement this guidance.	<p>Recommended Action: It is recommended that CTO and HAR/HYA develop and implement a comprehensive corrosion management strategy in line with the requirements of CTS/031.</p> <p>Probable or Defined Closure Criteria: This recommendation can be closed out once agreement from the Corrosion Steering Group and the Corrosion Working Group is obtained that CTS/031 is appropriately implemented at HAR and HYA.</p>
2 – Actual condition of plant important to safety	SF2 Rec 2	Degradation of the plant's civil structures is a key issue at HAR and HYA. The threat to Building Envelope, Building Fabric and Site Infrastructure is captured in the Civil Assets TLMS and in the NG Risk Log (HAR Risks R08743, R08744 & R08745 and HYA Risks R08546, R08547 & R08548). A number of associated work programmes are listed in the MTP / PLEX investment lists.	<p>Recommended Action: The proposed solution is to carry out the refurbishments required to address the issues raised in the Civil Assets TLMS / NG Risk Log to Ensure that safety case claims for all normal and extreme weather conditions are met in the future. Key items are listed below: 1. HAR Building Structural and Fabric Improvement (Work packs 353685 / 336553) 2. HYA Civil & Infrastructure Programme (Work packs 356700 / 345949)</p> <p>Probable or Defined Closure Criteria: Probable closure will be when the refurbishments /replacements are completed and the claims within the safety case can be assured for the future.</p>
	SF2 REC 3	The HAR and HYA Fire Suppression systems are suffering from various plant reliability and degradation issues. A number of work programmes are listed in the MTP / PLEX investment lists.	<p>Recommended Action: The proposed solution is to carry out the refurbishments as identified in the MTP /</p>

Safety Factor	Recommendation Number	Title	Planned completion
			<p>PLEX investment lists to ensure that the plant continues to meet the requirements of the safety case with regard to the overall integrity, reliability, performance and continued qualification of the plant against the relevant hazards.</p> <p>Key items are listed below:</p> <ol style="list-style-type: none"> 1. Refurbishment of HAR / HYA Fire Suppression Systems (Work packs 107304 / 356716) 2. Replace FJFS air system pipework at HAR (Work pack 356832) 3. Replace FJFS pipework and external fire hydrant system pipework at HYA (Work pack 329121) <p>Probable or Defined Closure Criteria: Probable closure will be when the refurbishments are completed and the claims within the safety case can be assured for the future. A SACI associated with the recent HYA FJFS event recovery is being progressed under CR 1033234.</p>
	SF2 REC 4	<p>The Gas Turbine (GT) control systems at HAR and HYA are a high maintenance burden. It is expected that performance will reduce over time further challenging reliability and potentially leading to a safety case shortfall. A GT Working Group has been established to define the specifics of the remedial work at each station.</p>	<p>Recommended Action: The proposed solution is for the GT Working Group to carry out optioneering to determine the best course of action at each station to ensure that safety case claims on the system are met in the future.</p> <p>Probable or Defined Closure Criteria: Probable closure will be when the defined solution is identified and the associated works are completed so that the claims within the safety case can be assured for the future.</p>

Safety Factor	Recommendation Number	Title	Planned completion
3 - Ageing, obsolescence and lifetime management	SF4 REC 1	Benchmarking exercises have been conducted to establish best practices for proactive obsolescence management. During the production of this SF a number of outstanding actions were identified.	<p>Recommended Action:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Implement learning from international benchmarking exercises (AR 959727) into the EDF Energy Obsolescence Management Strategy. <input type="checkbox"/> Formalise the proactive strategy and revise BEG/SPEC/FENG/016to account for updates. <p>Probable or Defined Closure Criteria: This recommendation can be closed out once agreement from the FPHC is obtained that the chosen proactive obsolescence strategy has been developed and rolled out across the fleet.</p>
	SF4 REC 2	The Burst Can Detection trolleys are suffering from ageing and obsolescence. The trolleys at HYA were not part of the fleet upgrade project. They were modified in the past and are of a unique design. Much of the equipment on the trolleys is obsolete.	<p>Recommended Action: Conduct an ageing and obsolescence review of the current HYA BCD equipment and establish a long term strategy to ensure reliable operation to the end of station life and decommissioning Requirements.</p> <p>Probable or Defined Closure Criteria: This recommendation can be closed out once a long term strategy has been developed and agreed with the PHC.</p>

Table 2 – HPB/HNB PSR3 Category B Recommendations Applicable to Heysham 1 / Hartlepool

Safety Factor	Recommendation Number	Title	Planned completion
1 - Plant Design	SF1 Rec 001	The ongoing fleet implementation of the SCHR process requires appropriate process governance arrangements to be established	DAO/PROC/003 and BEG/SPEC/DAO/008 have been updated to detail the new oversight arrangements and oversight reviews to address this Issue.
2 - Equipment qualification	SF3 Rec 001	The ongoing implementation of the Zonal Walk downs (ZWs) and Zonal Based Views (ZBVs) requires effective process governance and oversight arrangements to be established.	DAO/PROC/003 and BEG/SPEC/DAO/008 have been updated to detail the new oversight arrangements and oversight reviews to address this Issue.

Table 3 – ONR Heysham 1 / Hartlepool PSR3 Assessment Findings

ONR Finding	Detail
<p>ONR-HYA/HRA-PSR3-01</p> <p>Fault Studies</p> <p>Issues Database Number: 6893</p>	<p>NGL should review the implementation of their SCHR process to ensure all safety cases have been adequately reviewed within the 10 year PSR period.</p>
<p>ONR-HYA/HRA-PSR3-02</p> <p>External Hazards</p> <p>Issues Database Number: 6894</p>	<p>The external hazards safety cases should be reviewed and any revisions needed to repair shortfalls or gaps to be implemented to timescales agreed with the licensee.</p>
<p>ONR-HYA/HRA-PSR3-03</p> <p>Structural Integrity</p> <p>Issues Database Number: 6895</p>	<p>The licensee should demonstrate there is adequate provision for the examination, inspection, maintenance and testing of high density polyethylene piping where this has been introduced for nuclear safety related applications.</p>
<p>ONR-HYA/HRA-PSR3-04</p> <p>Civil Engineering</p> <p>Issues Database Number: 6949</p>	<p>NGL should include a separate activity for PCPV bearing inspections in the Maintenance Schedule for both stations, or justify why they do not need to do so.</p>
<p>ONR-HYA/HRA-PSR3-05</p> <p>Civil Engineering</p> <p>Issues Database Number: 6896</p>	<p>In order to comply with the mandatory requirements of CTS/230, NGL should provide a separate item within the Hartlepool & Heysham 1 Maintenance Schedules (or MITS) for the inspection of the Fuel Storage Pond that demonstrates that the maximum pond inspection frequency is not more than every 3 years.</p>
<p>ONR-HYA/HRA-PSR3-06</p> <p>Civil Engineering</p> <p>Issues Database Number: 6897</p>	<p>In relation to civil structures, NGL should confirm its proposals to address the absence of LC 28 Reviews, required by Company Specification BEG/SPEC/FENG/017 for both stations.</p>
<p>ONR-HYA/HRA-PSR3-07</p> <p>Fault Studies</p> <p>Issues Database Number: 6948</p>	<p>An ALARP argument addressing the acknowledged shortfalls in the SSD and TSD systems coupled with the onset of key way root cracking should be developed. The argument should be developed promptly, in time to allow any implementation of any necessary modifications before the onset of key way root cracking occurs.</p>
<p>ONR-HYA/HRA-PSR3-08</p> <p>Mechanical Engineering</p> <p>Issues Database Number: 6898</p>	<p>The licensee should demonstrate that it has adequate processes in place for identifying and reviewing modern standards for cranes and lifting equipment.</p>
<p>ONR-HYA/HRA-PSR3-09</p> <p>Fault Studies</p> <p>Issue Database Number: 6968</p>	<p>EDF NGL should carry out a review of the application of concept of defence in depth, and an evaluation of emergency operating procedures and the accident management programme at the plant, as suggested in the IAEA PSR guide (SSG-25).</p>

