Office for Nuclear Regulation

Periodic Safety Review

Assessment of the Heysham 2 and Torness third periodic safety review (PSR3)

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EXECUTIVE SUMMARY

Title
Assessment of the Heysham 2 and Torness third periodic safety review (PSR3).

Permission Requested
This Office for Nuclear Regulation (ONR) Project Assessment Report (PAR) sets out the regulatory justification for the issue of a Decision Letter relating to the third periodic safety review of Heysham 2 and Torness. The Decision Letter will confirm that EDF Energy Nuclear Generation Ltd (NGL) "the licensee" has carried out an adequate periodic safety review (PSR) of the Heysham 2 and Torness nuclear power station safety cases to justify continued safe operations at the facility for the period 2020 - 2030.

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 periodic safety review (PSR3) completed for Heysham 2 and Torness. 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. ONR has previously assessed the equivalent PSR3 submissions for Hunterston B and Hinkley Point B, Dungeness B, and Heysham 1 and Hartlepool.

The timing for the production of the Heysham 2 and Torness PSR3 meant that not all of the improvements sought by ONR through findings raised from the assessment of the Hunterston B and Hinkley Point B, Dungeness B, and the Heysham 1 and Hartlepool PSR3 submissions were incorporated into the Heysham 2 and Torness PSR3 submission. Further improvements will be monitored through NGL's response to these findings and regular ONR engagement. It will also be ensured that learning from previous PSR3's is adequately implemented in the PSR3 submission for Sizewell B, due in 2024.

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 2 and Torness power station safety cases and safety management arrangements. This was the fourth of the PSR3 submissions based around the NGL corporate safety management arrangements. The assessments were focused on the evidence to demonstrate effective implementation of the arrangements to deliver safety and periodic review. A total of 16 regulatory assessments were commissioned and a themed inspection focusing on ageing management on both Heysham 2 and Torness stations was conducted, these inspections informed the PSR3 assessment work undertaken.

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.

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

Through previous PSR3's, 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 process through a rolling programme of high level safety case reviews. Overall ONR found the process beneficial and learning had been taken forward and incorporated within the Heysham 2 and Torness PSR3 submission. This ensured that a more thorough review of the safety cases was conducted and shortfalls identified and addressed. ONR identified that there is an opportunity to further improve the implementation of the SCHR process, clearly identifying and documenting the level of review required for each safety case 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 which will be 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 2024.

In total, ONR's assessments have raised seven 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 through agreed timescales.

Conclusions

ONR considers that NGL has carried out an adequate periodic safety review of the Heysham 2 and Torness nuclear power station's safety cases for the period 2020-30.

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 2030 for Heysham 2 and Torness stations.

ONR's assessments of the Heysham 2 and Torness PSR3 submission were considered thorough and systematic. ONR's assessment findings supported NGL's conclusion that no serious nuclear safety threats existed in continued operation of Heysham 2 and Torness power station. ONR identified seven findings in its assessment work, which NGL will close out within agreed timescales.

Recommendations

It is recommended that ONR confirm the adequacy of NGL's Heysham 2 and Torness PSR3 submission by issuing a Decision Letter agreeing to the continued operation of the site for the period 2020-2030. 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 is recommended that conditions be 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
AETP	Active Effluent Treatment Plant
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
fpy	(reactor) full power years (of operation)
HRA	Hartlepool
HY2	Heysham 2
HPB	Hinkley Point B
HNB	Hunterston B
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)
TOR	Torness
TSD	Tertiary shut down system
TMLS	Through Life Management Strategy
WENRA	Western European Nuclear Regulators Association
ZW	Zonal Walk down

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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 2 and Torness nuclear power stations.

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 it is reasonable to perform a PSR about every 10 years. The Heysham 2 and Torness PSR (Ref. 2) submitted to ONR covers the period January 2020 to 2030.

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 within one year of the formal submission date of the PSR. The decision letter sets out any regulatory requirements arising from the assessment of the PSR.

2 BACKGROUND

2.1 GENERAL

4. Heysham 2 and Torness power stations operate two Advanced Gas-cooled Reactors (AGR), which commenced generation in 1988, and are currently scheduled to cease electrical generation in 2030.

5. The PSRs are conducted by NGL in a ten year rolling programme across its fleet of nuclear power stations. The Heysham 2/Torness PSR is the third PSR for these stations, commonly referred to as PSR3, and was formally submitted to ONR in January 2019 (Ref. 4). To maintain consistency across the PSR3 programme, the formal submission date was taken as 31 January 2019.

6. NGL concluded from its reviews that the current safety cases for Heysham 2/Torness 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 operation[2] of Heysham 2/Torness is 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 2/Torness PSR in 2015 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 Hinkley Point B/ Hunterston B, Dungeness B and Heysham 1/ Hartlepool PSR3 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 focus on plant condition and reliability.

10. Zonal walk downs 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 walk downs 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 until at least the next 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 one category A recommendation and five Category B recommendations specific to Heysham 2/Torness, see Table 1; in addition three Category B recommendations arising from the earlier Hinkley Point B/ Hunterston B and Dungeness B PSR3's were also considered relevant to Heysham 2/Torness, see Table 2.

15. NGL has produced a plan to address all of its Category B recommendations by the end of 2024 (Ref. 6). A further 41 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 2/Torness 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 A and B recommendation raised in the PSR3.

17. The PSR3 Final Submission has been considered by the NGL Nuclear Safety Committee (NSC) (Ref. 8) which noted that a number of important issues were discussed in the PSR3 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 2/Torness PSR3 to ONR.

18. Following this periodic safety review, the licensee concluded that the current safety cases for Heysham 2/Torness 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 2/Torness 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 2/Torness PSR3 submission took benefit from the work conducted during the Hunterston B/Hinkley Point B, Dungeness B and the Heysham 1/Hartlepool 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 2/Torness 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 and 2 ageing management related inspections 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)
- Ageing Management Themed Inspections (Ref. 25)

22. A summary of ONR assessment views and findings are provided in Appendix 2. Although ONR considers that NGL's review of the Heysham 2 and Torness safety cases was carried out in a systematic way, a number of shortfalls were identified and have been appropriately prioritised. Regulatory issues have been 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 to low-level regulatory issues which will be tracked through routine regulatory interventions.

4 MATTERS ARISING FROM ONR'S WORK

23. Based on the findings of ONR's assessments, I consider that NGL has carried out an adequate review of the Heysham 2 and Torness Nuclear Power Station safety cases. This view is based on the findings of ONR specialist inspectors' assessment reports for specified topic areas (Refs. 9-25). 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 took benefit from and learnt lessons from the assessment of the Hinkley Point B/Hunterston B, Dungeness B and Heysham 1/Hartlepool PSR3 submissions. This allowed a more in-depth review of the efficacy and implementation of the claimed safety management processes for the Heysham 2/Torness PSR3 submission.

25. Whilst the NGL process for conducting the PSR has improved, the timing of the Heysham 2/Torness PSR3 meant it did not adequately address all of the PSR shortfalls identified by ONR in the earlier PSR3 assessments. NGL are currently implementing improvements to close out the remaining shortfalls, ONR continue to engage, ensuring that improvements are implemented in a timely manner to support the Sizewell B PSR3 submission expected in 2024.

26. The lack of included evidence was mitigated by NGL's prompt response to queries and facilitation of evidence gathered during visits to Heysham 2/Torness and the Barnwood corporate headquarters.

27. ONR is content that the safety case health review (SCHR) process has been updated to incorporate improvements identified in previous ONR PSR3 assessments. However, ONR has identified weaknesses in the implementation of the SCHR process in previous PSR3 assessments. The finding below was raised during the PSR3 assessment for Heysham 1 and Hartlepool and is equally relevant to Heysham 2 and Torness. ONR acknowledges that NGL continue to implement improvements to address this finding and will continue to engage with NGL to monitor the adequacy of these further improvements.

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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 identified shortfalls relating to the adequacy of, and individual's awareness of NGLs fleet wide process for the management of ageing assets on Heysham 2 and Torness, the process is more aligned to a roadmap document with the intention of signposting users out to the appropriate management procedures. ONR found the document to be convoluted and does not explicitly direct the user to the relevant sections of the management procedure relevant to ageing. NGL have initiated a full review of the ageing management process, which ONR will continue to monitor.

29. ONR's assessment took into account NGL's identification of shortfalls and I consider the process followed by NGL was structured and has been subject to independent scrutiny. I judge NGL's categorisation of all shortfalls into category A and B or new normal business work-streams reasonable with the appropriate considerations of ALARP, timescales for resolution and the impact on nuclear safety.

30. In total, ONR's assessments have raised seven findings (Table 3, page 42). The finding, which was common to a number of disciplines (relating to ageing management), is outlined above, the more topic-specific findings are summarised in Appendix 2. NGL will develop proposals for the resolution of the seven ONR findings by 31 March 2020 and close out the findings within agreed timescales. I consider 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.

31. ONR will monitor the close out of all NGL's category A and B recommendations by the end of 2024 and ONR findings by the end of 2021 through normal business activities. Attention will be given to ensure the adequacy of response and effectiveness of implementation.

5 CONCLUSIONS

32. I consider that NGL has carried out an adequate periodic safety review of the Heysham 2 and Torness nuclear power stations for the period 2020-30. 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 2030. 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 A and B recommendations to be addressed by the end of 2024.
- ONR's own assessment of the Heysham 2 and Tormess PSR3 submission in support of continued safe operations until 2030 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 2 and Torness power stations that are not already controlled through normal operational

processes to reduce the risks ALARP. ONR identified seven findings in its assessment work for which NGL will develop proposals for resolution by 31 March 2020 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 confirm the adequacy of NGL's Heysham 2 and Torness PSR submission by issuing a Decision Letter agreeing to the continued operation of the site for the period 2020-2030, 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 A and B recommendations and ONR findings detailed in Appendix 2.

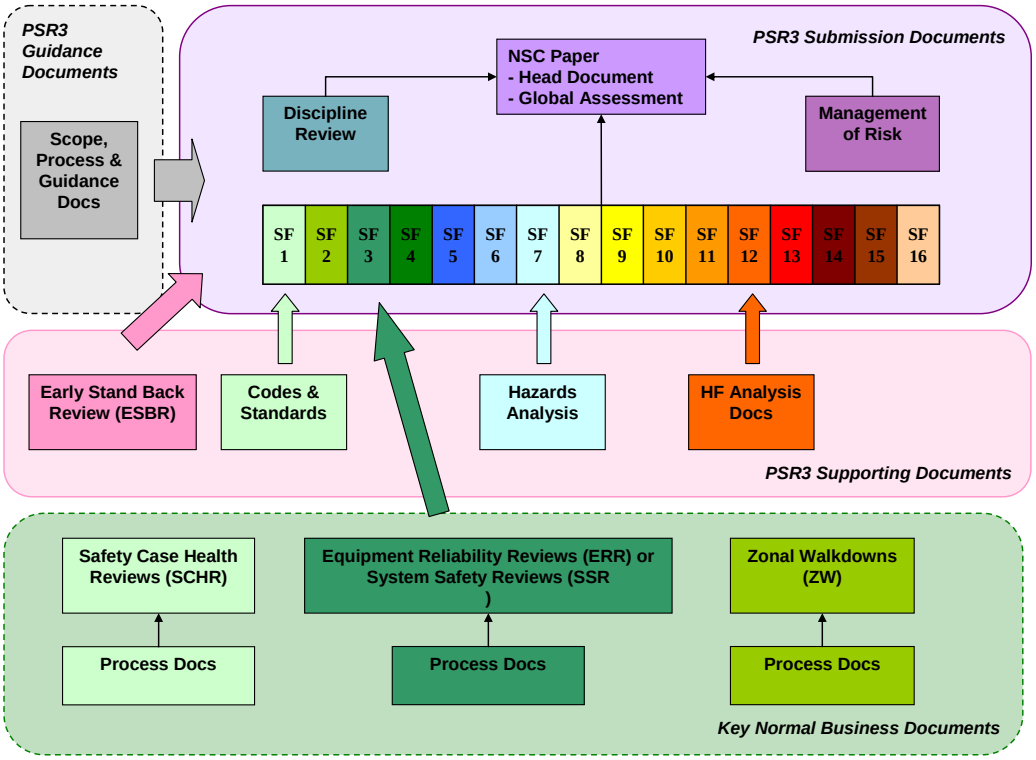
REFERENCES

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 2 and Torness Third Periodic Safety Review Final Submission - Version 06-, 18 Dec. 2018, CM9 2019/23279.
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/TOR/50638R - PSR3 NP/SC 7777 – Heysham 2 and Torness Submission letter, 23 January 2019, CM9 2019/26029.
5 NGL - PSR3 – HY2/TOR Scope and arrangements – EC356165 HYB and EC 356172 TOR - NP/SC 7735 - Rev 00 Ver 02, Nov. 2015, CM9 2016/114112.
6 HY2/TOR PSR3: Status of HY2/TOR PSR3 RMFs/ ONR findings, 20 Dec. 2019, CM9 2019/375607.
7 INSA and IPRA certificates for the HY2/TOR PSR3 Final Submission and SF reports, 10 January 2019, CM9 2019/266301.
8 EDF NGL - NSC Minutes - Meeting Held at Barnwood on 19th September 2018, CM9 2019/339827.
9 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-049 - Assessment of the Structural Integrity aspects of the HY2/TOR PSR3, Oct 2019 CM9 2019/261380.
10 NGL – Heysham 2 & Torness - ONR-OFD-AR-19-050 - Mechanical Engineering Assessment of the HY2/TOR PSR3, Dec 2019, CM9 2019/290008.
11 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-071 Civil Engineering Assessment of the HY2/TOR PSR3, Dec 2019, CM9 2019/373971.
12 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-054 - Assessment of the Electrical Systems aspects of the HY2/TOR PSR3, Dec 2019, CM9 2019/267567.
13 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-058 - Control and instrumentation assessment of the HY2/TOR PSR3, Dec 2019, CM9 2019/293211.
14 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-038 - Assessment of the Chemistry Aspects of the HY2/TOR PSR3, Nov 2019, CM9 2019/268241.
15 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-063 - Assessment of the Graphite Aspects of the HY2/TOR PSR3, Nov 2019, CM9 2019/296600.
16 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-033 - Assessment of the Fuel Safety and criticality aspects of the HY2/TOR PSR3, July 2019, CM9 2019/184995.
17 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-060 - Internal Hazards Assessment of HY2/TOR PSR3, Nov 2018, CM9 2019/293072.
18 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-039 - External Hazards Assessment of the HY2/TOR PSR3, Oct 2019, CM9 2019/278846.
19 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-040 - Fault Studies Assessment of HY2/TOR PSR3, Oct 2019, CM9 2019/130301.
20 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-052 - PSA Assessment of the HY2/TOR PSR3, Oct 2019, CM9 2019/280679.
21 NGL - Heysham 2& Torness - ONR-OFD-AR-19-044 - Review of Leadership & Management for Safety & Supply Chain and Quality of the HY2/TOR PSR3, Dec 2019, CM9 2019/227947.
22 NGL - Heysham 2 & Torness - ONR-OFD-AR-19- 061- Assessment of the Nuclear Liabilities Aspects of the HY2/TOR PSR3, Dec 2019, CM9 2019/248439.
23 NGL - Heysham 2 & Torness - ONR-OFD-AR-19-064 - Radiological Protection Assessment of HY2/TOR PSR3, Dec 2019, CM9 2019/298858.
24 NGL – Heysham2 and Torness – ONR-OFD-AR-19-077 - Human Factors Assessment of HY2/TOR PSR3, December 2019, CM9 2019/378298.

25 NGL – Heysham 2 and Torness – ONR-OFD-IR-19-051 & ONR-OFD-IR-19-079, Ageing Management Themed Inspections, May-October 2019, CM9 2019/225632 & 2019/292824

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 2/Torness 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 2 and Torness 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 2/Torness based on a reassessment of its processes and safety cases in line with ONR's expectations.

40. Regarding NGL's submission ONR sampled the following areas:

- Management of structural integrity based time-limited safety cases.
- Deterministic software management.
- Arrangements for research work programmes.
- System health management arrangements.
- Work request arrangements.
- Boiler integrity management.
- Corrosion management.
- Management of organisational learning.

41. Whilst ONR was content with the PSR3 submission, and the arrangements in place to deal with and prioritise risks, there are areas where the structural integrity specialist inspector considered further monitoring is required to ensure future work is adequately completed. The following recommendations were raised to monitor these areas;

- The further work NGL is conducting to justify the longer-term integrity of plant items with high nuclear safety significance, and with standalone safety cases such as boiler components, the structural integrity specialist inspector was content that NGL's business plan has captured this scope of work.
- 9%Cr breakaway oxidation is predicted to be the dominant contributor to the risk of failure of boiler tubes in 3 years based on current assessments. As a result, NGL will be revising its assessments in this area.
- The current interim justification for continued operation for the Water Ingress Safety Case expires in May 2020. The structural integrity specialist inspector recommends that ONR review the anticipated update of this justification on its completion.
- Corrosion management remains an on-going issue at both stations and NGL should ensure the adequate implementation of the arrangements for corrosion management processes (and associated training) which should include the adoption of recommendations made in NGL's technical standard CTS/021 for the inspection of tanks.

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

Mechanical Engineering (Ref. 10)

43. Overall, ONR was satisfied, from a mechanical engineering perspective, that NGL's arrangements and their implementation align with ONR guidance and is content that continued implementation of its arrangements will ensure that NGL's claim that continued operation of both Torness and Heysham 2 is acceptable for the next 10 year period, until 2030.

44. The scope of ONR's assessment for Mechanical Engineering was to consider:

- Safety Factor 1: Plant design.
- Safety Factor 2: Actual condition of plant important to safety.
- Safety Factor 4: Ageing, obsolescence and lifetime management.
- Mechanical engineering discipline review
- Codes and standards review supporting my assessment of SF1 and the discipline review.

45. The mechanical engineering specialist inspector noted that BS 2573 has been superseded by a more modern standard (BS EN 13001) that may result in changes to how NGL operates, or maintains its existing cranes in order to meet modern standards when BS 2573 is formally withdrawn. There was also no evidence of a procedure or guidance in place to ensure that the transition from BS 2573 to BS 13001 is managed when the old standard is withdrawn.

46. NGL have provided an initial response (Ref.6) to this finding with further supporting information for consideration to close out this finding. ONR will review this additional information and provide feedback to NGL on the adequacy of the information provided.

47. Whilst ONR was content that NGL 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-HY2/TOR-PSR3-06

- **NGL should demonstrate that it has adequate processes in place for managing the transition to modern standards prior to superseded or aged standards being withdrawn.**

48. A number of lower level recommendations were raised during the mechanical specialist inspector's assessment, the most significant of which are;

- NGL should demonstrate that it has considered the implications following the publication of new standards on the HVAC systems.
- NGL should demonstrate that there is a single procedure for the management of ageing assets.
- NGL should demonstrate that appropriate training is provided to relevant users of NGL's existing process on their approach to ageing management.

49. A level 3 regulatory issue will be raised (see ageing management themed inspection section) to track the ageing management related recommendations and a level 4 regulatory issue will be raised to track the remaining recommendation through routine regulatory business.

50. Based on the evidence considered the mechanical engineering specialist inspector judged that NGL 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)

51. ONR concurred, from a civil engineering perspective, with the overall conclusions of the PSR3, that the PSR3 is adequate and NGL's arrangements and strategic programmes are appropriate for the safe operation of the reactors at Heysham 2 and Torness for the next PSR period.

52. 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 2 and Torness 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.

53. The general scope of the civil engineering assessment was:

- to review the production and content of the Heysham 2 and Torness PSR submission and determine if the PSR3 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 NGL 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 PSR3.

54. Whilst from a civil engineering perspective the conclusion was that the PSR was adequate, a number of recommendations were identified where further reasonable improvements could be made, the most significant of which are ;

- Confirming that NGL's recommendation PSR3/HYT/SF02/REC/003, relating to the Heysham 2 active effluent treatment plant (AETP) has also considered any civil engineering related aspects. The AETP is an environmental safety related plant. However, its service availability has the potential to impact on nuclear safety related plant, including the fuel ponds.
- NGL should conclude the formal update of technical governance documents TGN 125 and TGN 128 and further consideration should be given to the frequency of the Technical Governance Civil Engineering Working Group meetings to enable this to be achieved.
- NGL should exercise every effort to resolve the long-standing issue at Heysham 2 concerning the investigation into blockages in some of the Unlined Monitoring Ducts.

55. A level 4 regulatory issue will be raised to capture these recommendations, which will be followed up on during routine regulatory business.

Electrical Engineering (Ref. 12)

56. Overall, from an electrical engineering perspective, the ONR electrical engineering specialist inspector was satisfied that the Heysham 2 and Torness PSR3 met the requirements of LC 15 Periodic review, and has no objection to issuing a positive Decision Letter to EDF Energy Nuclear Generation Limited.

57. The scope of the electrical engineering assessment was conducted in two parts, the first phase was to sample the adequacy of the Safety Factor review reports which were judged to be most relevant to the scope of my assessment including;

- Safety Factor 2: Actual condition of plant important to safety.
- Safety Factor 4: Ageing, obsolescence and lifetime management.
- Discipline Review.
- Early Stand Back Review Report.
- Codes and Standards Review.
- Independent Periodic Review Assessment Clearance Certificates.

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

- Gas circulators
- Unit/Station/Generator transformers
- Grid systems
- No-Break supplies
- Short break supplies
- Emergency generation
- Main electrical system
- Lighting and small power
- Earthing and lightning protection
- Associated cabling and cabling containment and support structures
- Associated electrical protection and control systems

58. The electrical engineering specialist inspector assessed the adequacy of the NGL's electrical systems review and its consideration of actual condition of the plant and equipment, the effects of ageing, degradation and obsolescence on plant and equipment, operational experience arising from this plant and equipment and changes to applicable codes and standards.

59. The electrical engineering specialist inspector considered that the Heysham 2 and Torness review provided evidence that relevant good practice had been implemented, and that a systematic review and reassessment of the electrical systems and equipment that support systems important to safety in accordance with the Heysham 2 and Torness safety cases has been undertaken.

60. In addition, the electrical engineering specialist inspector considered that the Heysham 2 and Torness shortfalls identified within their own review have been prioritised in order of their nuclear safety significance. No new findings or recommendations were raised during ONR's assessment from an electrical engineering perspective.

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

61. Overall, the C&I engineering specialist inspector considered that the arrangements in place to manage the reliability, and ageing and obsolescence of C&I nuclear safety systems and equipment at Heysham 2 and Torness are adequate to support operations over the next 10 year PSR period.

62. The general scope of ONR's assessment for Control and Instrumentation (C&I) assessment was focused on:

- Obsolescence management;
- Ageing equipment management;
- Knowledge capture and dissemination;
- Cyber security management of portable devices / removable media;
- Prevention of unapproved component changes;
- Examination, inspection, maintenance and testing (EIMT) arrangements in relation to:
- In-core thermocouple management;
- Protection relay management;
- As found condition (AFC) recording;
- Equipment operating environment specification and control;
- The item equivalency evaluation (IEE) process.

63. In addition to the above, ONR specialist inspectors undertook an overarching assessment of the implementation of current arrangements for ageing and obsolescence, and examination, inspection, maintenance and testing arrangements in relation to nuclear safety systems. These systems included In-core thermocouple and protection relay management, including as found condition recording management.

64. Although ONR's C&I specialist inspector judged that NGL's arrangements to manage C&I nuclear safety systems to be adequate , they considered that NGL have not adequately progressed and implemented the PSR3 improvements identified below at Heysham 2, Torness and previous stations which have recently been subject to PSR3 assessments. A level 3 regulatory issue has been raised to track progress against the finding below to ensure the timely implementation of the associated improvements.

Finding, HY2/TOR-PSR3-05

For HY2/TOR, I do not consider that EDF NGL have satisfactorily addressed the following findings and recommendations that were raised during earlier, ONR's PSR3 assessments:

- **HNB/HPB PSR3 C&I Finding 1: EDF 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.**
- **HNB/HPB PSR3 C&I Recommendation 3: EDF NGL should consider including further information in future periodic safety review submissions regarding the following;**
  - **Confidence of C&I ageing mechanisms**
  - **Changes in C&I ageing and obsolescence predictions since the previous PSR**
  - **The benefits that research and / or testing has had in providing an accurate understanding of the age conditioning process.**

65. NGL have accepted this finding (Ref.6) and have informed ONR that further engagement will be undertaken to find an appropriate way forward in addressing this issue.

66. 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, which include adopting a consistent approach to recording as found condition, ensuring that a C&I SQEP participates in walkdowns of systems that utilise C&I equipment and consider how the categorisation/classification guidance for C&I Modifications and Replacements can be more effectively applied with regards to Category 3 engineering changes.

67. The C&I specialist inspector has raised a level 4 regulatory issue to capture these recommendations and will monitor progress with addressing these areas through routine interventions.

Chemistry (Ref. 14)

68. Overall, the ONR chemistry specialist inspector was content that the overall approach for PSR3 of Heysham 2 and Torness supported continued operations over the next 10 year PSR period.

69. The chemistry specialist inspector targeted assessment upon the impact of chemistry control focusing on the main feed system and the main boilers at Heysham 2, and on the condensate polishing plant and make up water treatment plant at Torness, as these systems were assigned a red or amber average SHIP score in the previous PSR period.

70. A sample was undertaken looking more generally at chemistry compliance to gain confidence in broader chemistry control and a sample of the central technical organisation driven operational experience (OPEX) initiatives and OPEX driven by the site chemistry teams was undertaken.

71. Whilst the ONR chemistry inspector was content that the overall approach for PSR3 of Heysham 2 and Torness was appropriate, a number of recommendations were identified relating to the availability of suitable and sufficient chemistry evidence to support the PSR3 submission. The most significant of which are;

- NGL should provide suitable and sufficient chemistry evidence in future PSR submissions, including the PSR3 of Sizewell B, in order to adequately demonstrate chemistry compliance.
- NGL should update the relevant system safety review documents to improve the clarity, accessibility and currency of the chemistry related aspects of the safety case.
- NGL should develop a method for routine assessment of its compliance with it's off-load chemistry control parameters (BEOM/004) at Heysham 2 and Torness.

72. The ONR chemistry specialist inspector has identified that this is a continuation of a trend identified in ONR's assessment of previous PSR3 submissions and will be raising a level 4 regulatory issue to track progress with NGL through routine regulatory interventions and ensure this issue is addressed to support subsequent PSR submissions.

Graphite (Ref. 15)

73. Overall, the ONR graphite specialist inspector was content with the evidence sampled concerning the graphite integrity aspects, they concluded that Heysham 2 and Torness PSR3 demonstrates that NGL has suitable management processes in place for the next PSR period.

74. The ONR graphite specialist inspector highlighted that demonstration of the continued fitness for purpose of the graphite core requires regular inspection; this will enable NGL to demonstrate tolerance to the expected degree of core cracking and oxidation.

75. During the ONR graphite specialist inspectors assessment the following areas were selected for review to ensure the risks to integrity of the graphite core are being managed;

- Key way root cracking (KWRC).
- The assumed behaviour of Heysham B/ Torness graphite material at high weight loss and irradiation fluence.
- The performance of seal rings and interactions with the graphite moderator bricks.
- The implications of increased weight loss for the current safety case.
- Channel bore inspections to support operation pre and post KWRC.
- The cracking in peripheral shielding bricks.

76. NGL states that the expected evolution of graphite material properties at HYB/TOR is based on that of Hinkley point B and Hunterston B due to similar grades of graphite being used at each station. NGL are undertaking further work to review predictions relating to the divergence in material property behaviour.

77. The ONR graphite specialist inspector noted that the design of the graphite moderator bricks at Heysham B and Torness is different from the rest of the AGR operating fleet in that it incorporates seal rings between graphite bricks. NGL states that a systematic failure of the seal rings could occur post KWRC. This could lead to debris with the potential to challenge the ability to move or adequately cool fuel.

78. ONR is aware that work is ongoing to address all potential consequences of a seal ring / brick interaction. This includes stress analysis and experimental activities. The results of these activities will be incorporated within the onset of KWRC safety case. The ONR graphite specialist inspector will track progress on these updates through a level 4 regulatory issue.

79. The ONR graphite specialist inspector identified that at the time of the production of the PSR report, NGL did not have a clear strategy for raising the mean active core weight loss limit (currently 14%) as it was NGL's view that the current limit would not be challenged until ~2022. Due to the significance of this operational limit and the apparent absence of a strategy to manage the risk, the ONR graphite specialist inspector will track this issue to ensure appropriate visibility of NGL's actions in addressing the active core weight loss limit.

80. To address these perceived shortfalls, the ONR graphite specialist inspector has raised level 4 regulatory issues 7663 and 7662 to monitor the actions being taken by the license to mitigate any risk.

Fuel and Criticality Safety (Ref. 16)

81. Overall, from a nuclear fuel and criticality safety perspective, the ONR fuel and criticality specialist inspector was satisfied with the adequacy with which NGL has

reviewed its safety case in accordance with its LC15 arrangements. Based on the fuel and criticality safety specialist Inspector's sample, the Inspector judged that continued operation of both sites is acceptable for the next 10 year period.

82. The fuel and criticality safety specialist inspector's assessment has been focussed primarily on the adequacy of the submission, the PSR process and current operations, therefore of the NGL periodic review. The sample includes;

- Fuel Safety Case management and review processes.
- Corporate Governance of the Nuclear Fuel Supply Chain and Fuel Performance.
- Station specific management of Nuclear Fuel.
- Detection and management of failed Nuclear Fuel.
- Organisational Learning for Nuclear Fuel.
- Criticality Safety of Nuclear Fuel.

83. During the fuel and criticality safety specialist inspectors' assessment, they identified a gap between how Heysham 2 and Torness are maintaining safety cases and the expectations of ONR's safety assessment principals. The issue is in relation to safety cases being actively maintained throughout each of the lifecycle stages, reviewed regularly and ensuring safety cases are easily accessible and understandable to its users.

84. The fuel and criticality safety inspector identified that NGL had a good practice for managing their safety case documentation "the living safety case approach" which had been adopted by other stations, and would of expected equivalent arrangements for Heysham 2 and Torness managing their safety case documentation and communicating it to its users.

85. Whilst ONR was content that NGL has adequately satisfied the requirements of Site Licence Condition 15, there are aspects that the fuel and criticality safety specialist inspector identified that reasonable improvements could be made which resulted in the following finding being raised;

Finding, ONR-HY2/TOR-PSR3-03

NGL should adequately demonstrate that the Heysham 2 and Torness safety case is suitably presented, accessible and understandable to its users (plant operators and station management).

86. NGL have accepted this finding (Ref.6) and have informed ONR that a programme of work will be undertaken to find an appropriate way forward in addressing this issue.

87. The fuel and criticality safety specialist Inspector raised one other recommendation in relation to the adequacy of Heysham 2 and Torness fuel supply chain performance monitoring and risk management processes. A level 4 regulatory issue will be raised to track progress with this issue through routine regulatory interventions.

Internal Hazards (Ref. 17)

88. Overall, from an internal hazards perspective, there were no significant shortfalls identified during the assessment of the Heysham 2 and Torness PSR3 submission, and it was concluded that an adequate PSR3 review has been undertaken.

89. The overall scope of the internal hazards assessment was to establish that the internal hazard aspects of the Heysham 2 and Torness PSR are adequate and meet ONR expectations. This was achieved by:

- Gaining confidence that NGL had undertaken an adequate internal hazards review of the extant safety case.
- Gaining confidence that NGL had taken into account learning from experience and future foreseeable challenges.
- Establishing that NGL had adequately identified and sentenced shortfalls and developed a credible resolution plan to implement the PSR improvements in a timely manner.

90. Whilst ONR was content that NGL has adequately satisfied the requirements of Site Licence Condition 15, the ONR internal hazards specialist inspector identified a number of observations of low significance where further improvements could be made relating to the safety case health review (SCHR) process.

91. The observations are related to the application of the SCHR process and ensuring that NGL undertake a combination of high-level reviews, with a rolling programme of more detailed safety case reviews on a prioritised basis. NGL should also consider further improving the auditable trail by providing clear links to how operating experience it articulated within the SCHR.

92. ONR already have a level 3 “extant” regulatory issue to track NGL’s progress on improving the SCHR process (including implementation), the internal hazards inspector will take the less significant observations forward through routine regulatory interventions to ensure they are adequately monitored and progressed.

External Hazards (Ref. 18)

93. Overall, from an external hazards perspective, ONR judged that NGL has adequately met its commitments under LC15. However, continued focus is required to ensure timely implementation of further improvements as identified in ONR’s recommendations and findings.

94. The general scope of ONR’s assessment for external hazards assessment was focused on identifying dominant risks based on the NGL safety cases and current/topical issues based on regulatory intelligence. The areas of focus for the external hazards assessment include;

- Seismic hazards
- Accidental aircraft impacts
- External flooding
- Extreme wind
- Industrial hazards
- Extreme ambient temperatures (EAT)
- Lightning
- Drought
- Biological fouling
- Solar storms
- Airborne particulates

95. Guidance (UKCP18) has highlighted that hot summers and heat waves are expected to become more common due to climate change and NGL’s EAT safety case does not mention of how the frequency of the high or low EAT hazard could change as a result of climate change. In addition, this does not align with the expectations of ONR SAP’s

which states that: “the reasonably foreseeable effects of climate change over the lifetime of the facility should be taken into account”. In the external hazards specialist inspectors view, NGL should further consider the potential implications of the increased frequency of high EAT events on safety related plant.

96. The external hazards specialist inspector considers that NGL can partly address this finding through an ongoing work programme and subsequent review of hazards safety cases. However, given the potential interactions between the EAT hazard and safety significant systems, ONR have raised the following finding to monitor NGL’s progress and close-out of this issue.

Finding, ONR-HY2/TOR-PSR3-04

NGL should consider means to demonstrate or ensure adequate resilience of nuclear safety systems against high extreme ambient temperature design basis events with adequate allowance for climate change.

97. NGL have accepted this finding (Ref.6) and have informed ONR that a programme of work will be undertaken to find an appropriate way forward in addressing this issue.

98. A further finding was raised during ONR’s external hazards assessment, this was in relation to the secondary shut down system and the tertiary shut down system at Heysham 2 and Torness not being qualified against the design basis seismic event. The same finding was identified during the fault studies specialist inspectors’ assessment who will be leading on the close out of this finding; further information can be found in the fault studies section of this report.

99. The external hazards specialist inspector has raised one recommendation relating to supplying further information on lightning hazard design basis for individual buildings at Heysham 2 and Torness, to provide evidence of the results from the most recent lightning protection surveys, which should also include information on the level of protection for individual buildings.

100. The external hazards specialist inspector will raise a Level 4 regulatory issue to track this recommendation to completion through routine regulatory engagements with NGL.

Fault Studies (Ref. 19)

101. Overall, from a fault studies perspective, the ONR fault studies specialist inspector judged that an adequate PSR review has been carried out by NGL, and supports ONR issuing a positive PSR decision letter.

102. The general scope of ONR’s assessment for fault studies assessment was to:

- Review the production and content of the Heysham 2 and Torness 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.
- Carry out a sample / deep dive into a couple of areas, taking into account previous PSR3 submissions and trying to avoid same or similar areas.
- Form a judgement on whether learning has been taken forward from previous PSR3 assessments and have been considered / addressed in the Heysham 2 and Torness submission.
- To identify any additional issues or site system shortfalls against modern standards resulting from ONR assessment.
- Decide on the suitability of the submission and the improvement programme to address any significant issues.

- 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.

103. Whilst ONR was content that NGL has conducted an adequate PSR, the fault studies specialist inspector identified areas where further improvements could be made.

104. During the fault studies specialist inspectors assessment they identified that the most recent analysis for the onset of keyway root cracking is predicted to occur around mid-2022, this was previously expected in 2028. The ONR fault studies specialist inspector noted that this does not undermine the current 'essentially intact' safety case but will need to be addressed on a timescale commensurate with the onset of keyway root cracking.

105. The fault studies specialist inspectors noted that if key way root cracking predictions are realised, then the safety case (key way root cracking changes the ALARP balance with respect to the secondary shut down systems) is unlikely to remain robust for the next ten years PSR period.

106. NGL are undertaking a programme of work to plan and implement the required secondary shut down systems improvements, and to conduct adequate deterministic safety analysis to justify the performance of the systems. ONR acknowledges progress is being made which will need to be addressed on a timescale commensurate with the onset of keyway root cracking. The finding below has been raised to monitor progress.

Finding, ONR-HY2/TOR-PSR3-01

I recommend a PSR3 finding for EDF NGL to perform adequate deterministic safety analysis to justify the performance of the Secondary Shutdown Systems for the actual condition of the plant and intended future operation, including both the Nitrogen and Boron Bead Systems. Furthermore, EDF NGL should provide adequate justification for the level of seismic qualification of the Secondary Shutdown Systems.

107. NGL have provided an initial response to this finding (Ref.6), informing ONR that there is an existing secondary shutdown system upgrade programme ongoing that will identify a suitable approach for this finding.

108. During the fault studies specialist inspectors assessment they identified that Heysham 2 and Torness have a high reliance on manual isolation for boiler faults within a response time of within 30 minutes following a water ingress fault. Failure to manually isolate the fault boiler can lead to high consequences due to the loss of both Post Trip Cooling Lines of Protection.

109. The fault studies specialist inspector identified a number of issues which should be considered by NGL to reduce the risk from water ingress faults to as low as reasonably practicable which include;

- OPEX from Heysham 2 boiler tube plate leak demonstrates that an incorrect quadrant was identified as the fault quadrant, casting doubt on ALARP claims.
- Deterministic safety analysis to substantiate operator action timescales is not available for some water ingress faults (stainless steel failures due to carburisation).
- The 30-minute grace time to isolate the fault boiler assumes a maximum graphite weight loss of 14%, which is expected to be exceeded by 2022 and within the 10 year PSR period.

- Vessel overpressure protection equipment has been implemented on other AGR sites to reduce the risk of water ingress faults by automatic means

110. The following finding has been raised to monitor progress.

Finding, ONR-HY2/TOR-PSR3-02

EDF NGL to carry out optioneering, informed by adequate deterministic safety analysis and relevant good practice on other AGR sites, to reduce the risk from water ingress faults on Heysham 2 and Torness as low as reasonably practicable.

111. NGL have accepted this finding (Ref.6) and have informed ONR that a programme of work will be undertaken to find an appropriate way forward in addressing this issue.

112. The fault studies specialist inspector will raise a level 3 regulatory issues to track these findings to completion through routine regulatory engagements with NGL.

Probabilistic Safety Analysis (PSA) (Ref. 20)

113. Overall, from a PSA perspective, ONR concluded that an adequate PSR for the Heysham 2 and Torness nuclear power stations have been conducted, justifying continued safe operations for the period January 2020 to January 2030.

114. The general scope of ONR's assessment for PSA was focused on safety factor 6 (PSA) and the supporting references. The areas of focus included;

- The use of the risk monitor in operational decision making and work planning.
- Demonstration that risks are reduced to a level that is ALARP.
- Status of the fuel route PSAs.
- Use of the PSA to identify adverse reliability trends.
- How results and insights from the pilot studies (fire, shutdown and level 2 PSA) are being taken into account at Heysham 2 and Torness.

115. The PSA specialist inspector noted minor shortfalls against relevant SAPs, however, the inspector did not consider these to be significant. Further engagement is required on how NGL conduct the justification or update of generic data sources used in the AGR fuel route PSAs and further discussions are required on submission of Heysham 2 and Torness fuel route PSA engineering changes to ONR.

116. The shortfalls that were noted will be captured in an ONR regulatory issue, and the actions will be progressed as normal business items through routine Level 4 engagements between NGL and ONR.

Leadership and management for Safety and Supply Chain and quality (Ref. 21)

117. Overall, from a leadership and management for safety, and a supply chain and quality management perspective, ONR were satisfied that NGL's arrangements are adequate for the management of nuclear safety at both Heysham 2 and Torness. There are no objections to ONR issuing a decision letter, justifying continued operations for the next PSR period.

118. The general assessment scope for leadership and management for safety, and supply chain and quality management focused on NGL's management arrangements in relation to management of safety within the overall PSR submission.

119. A series of meetings and site visits were undertaken at the two sites to discuss and clarify issues identified during the assessment. Some of the areas where discussions were held included;

- Cost challenge and potential impact on organisational shape, size and capability;
- Ageing workforce (station and prime contractor) and need for knowledge capture and transfer;
- Ageing plant, increased maintenance, spares unavailability and long-term spares degradation;
- Preparations for end of generation with changes to organisational capability and up-skilling/re-skilling.

120. Whilst ONR was content that NGL has conducted an adequate PSR, the leadership and management for safety and quality and supply chain management specialist inspector identified areas where further improvements could be made.

121. Two corporate Level 4 Regulatory Issues will be raised to ensure appropriate regulatory focus on the recommendations raised, these recommendations relate to further improving the informed customer and quality assurance process. Regulatory issues will be followed up on during routine regulatory interventions with NGL.

Radioactive Waste Management and Decommissioning (Ref. 22)

122. Overall, from a nuclear liabilities assessment perspective, ONR are satisfied that the PSR3 has been conducted in accordance with relevant good practice, and has demonstrated adequate arrangements to support continued operation of Heysham 2 and Torness power stations for the PSR3 period up to January 2030.

123. The scope of work for the PSR3 assessment of the Heysham 2 and Torness submission was focused on the adequacy of the radioactive waste management systems and associated arrangements to meet their nuclear safety role through the ten-year PSR period. The assessment of the radioactive waste management operations was focused on the following facilities;

- Active Effluent Treatment Plant (AETP)
- High Activity Debris Vault (HADV)

124. Based upon the nuclear liabilities specialist inspectors' assessment of radioactive waste operations, and NGL's assessment in support of the PSR3 submission, ONR concluded that NGL have adequately reviewed the extent to which the facilities, and the supporting safety documentation, conform to modern standards and relevant good practices.

125. Evidence demonstrates that the condition of the radioactive waste management facilities are reviewed annually, through safety case health reviews, supported by facility walk downs and sharing of lessons and experiences across the Heysham 2 and Torness stations, and from the wider AGR fleet.

126. During the nuclear liabilities specialist inspectors assessment a discrepancy was identified between the requirements within NGL's arrangements to produce a five year radioactive waste management plan, and the Torness three year waste reduction plan. ONR are satisfied that the scope of the recommendation does not impact upon nuclear safety, however, a Level 4 regulatory issue has been raised to monitor progress on this issue through routine regulatory interventions.

Radiological Protection (Ref. 23)

127. Overall, from a radiological protection assessment perspective, sufficient evidence has been provided to demonstrate the adequacy and effectiveness of arrangements for radiological protection until the next PSR or end of life.

128. ONR's radiological protection specialist inspector noted the PSR3 submission contained a high level SF15 radiological protection report, and although late, a "site specific issues" addendum for Heysham 2 and Torness was provided which formed the basis of the radiological protection assessment with the aim to;

- Provide confirmation that the RP arrangements, processes and procedures are in line with the claims, arguments and evidence outlined in SF15 of the PSR3 and the addendum.
- Provide regulatory confidence in the NGL's RP arrangements, processes and procedures with regards to LC15 Periodic Review.

129. The radiological protection specialist inspector was satisfied that the SF15 approach and structure remains adequate and provides a good overview of the RP arrangements and performance. However, in the absence of a site specific issue addendum, the PSR3 submission falls short of providing an adequate level of radiological protection information. ONR's assessment therefore focuses on the radiological protection addendum that was subsequently produced to support the PSR3 submission for Heysham 2 and Torness.

130. Although the radiological protection specialist inspector found the PSR3 submission to be adequate, a number of recommendations were identified where NGL could make further improvements which include;

- NGL should consider utilising the production of a site specific addendum to SF15 that contained site specific issues to support future PSR submissions.
- NGL should consider the risk and impact of core station radiological protection resources over the period covered by the PSR3 to 2030. These issues relate to the increasing age profile of existing radiological protection staff and the difficulties NGL has experienced in the recruitment and retention of new radiological protection staff.

131. The ONR radiological protection specialist inspector will raise Level 4 regulatory issues and track progress on these recommendations through routine regulatory interventions.

Human Factors (Ref. 24)

132. Overall, the human factors specialist inspector was content that NGL has completed an adequate PSR review to support continued operations of Heysham 2 and Torness stations for the next ten-year PSR period.

133. The general assessment scope for the human factors was focused on the following areas within the overall PSR submission;

- Scope of Heysham 2 and Torness PSR3 human factors review.
- Relevant good practice utilised to inform the human factors review.
- Implementation of the Heysham 2 and Torness PSR3 human factors review strategy including:
    - Significant Human Based Safety Claims

- Human Machine Interfaces
- Fuel Route
- Maintenance
- Manage of procedures.

- Consideration of operating experience.
- Identification of gaps to relevant good practice.

134. No recommendations were raised during the human factors PSR assessment for Heysham 2 and Torness. NGL acknowledged that the new normal business recommendations identified during their own assessment to secure further lesser safety significant improvements has been completed in line with human factors relevant good practice.

135. The human factors specialist inspector will monitor progress against these minor improvements through routine regulatory interventions. A number of extant regulatory issues are currently open to track these improvements and gain assurance that NGL continues to deliver improvements in this area.

Ageing Management Themed Inspections (Ref. 25)

136. In line with ONR's operating reactor sub-division strategy, a multi-disciplined ageing management themed inspection was developed to support ONR's assessment of the Heysham 2 and Torness PSR3.

137. Overall, after considering all the evidence examined during the ageing management inspections undertaken at the Heysham 2 and Torness, ONR judged that arrangements for ageing management and their practical application have been adequately implemented.

138. ONR's approach was to utilise fault analysis to identify associated systems important to safety that may be influenced by ageing, then use these systems as a sample for the ageing management inspections conducted at Heysham 2 and Torness stations with input from NGL's corporate centre at Barnwood.

139. The focus of the inspection was to establish if NGL's arrangements are adequately implemented to detect the onset of equipment degradation, and also to quantify the extant material condition and the rate of ageing of nuclear safety significant plant.

140. Whilst ONR were content that NGL was adequately managing the ageing of systems important to safety, areas were identified where further improvements could be made.

141. NGL utilise an overarching "roadmap" document and 36 supporting management procedures rather than a specific ageing management procedure. During ONR's interventions, inspectors found the overarching document to be convoluted and does not explicitly direct the user to the relevant section of the management procedure relevant to ageing. This has resulted in the following finding being raised.

Finding, ONR-HY2/TOR-PSR3-07

NGL should provide and implement a single procedure for ageing management of nuclear safety assets, or provide evidence that their current arrangements are adequate in delivering timely age related modifications to plant.

142. NGL have accepted this finding (Ref.6) and have informed ONR that a working group has been set up to review and establish a baseline to identify the current gaps. ONR has raised a level 3 regulatory issue to track this finding, and will monitor progress on implementing further improvements through regulatory interventions.

143. A number of observations were made during ONR's ageing management inspection, which will be followed up on during routine regulatory business. The recommendations identify areas for improvement, the most significant of which are;

- Familiarising station personnel and implementation of the existing ageing management processes.
- NGL to demonstrate that uncertainty related to corrosion under insulation is captured in order to support judgement that the system can maintain safety.
- Implementation of proportionate, risk-based measures to manage supply chain risks arising from component changes and ensure competence as an intelligent customer.
- Adopt a consistent approach to recording as found condition.
- Ensuring that a C&I SQEP participate in walk downs of systems that utilise C&I equipment.
- Consider how the categorisation/classification guidance for C&I Modifications and Replacements can be more effectively applied with regards to category 3 engineering changes.

144. There were no findings from this inspection that could significantly undermine nuclear safety. ONR has raised a level 4 regulatory issue to capture these observations, which will allow ONR to monitor the implementation of further improvements through routine regulatory interventions.

Table 1 –Heysham 2/Torness PSR3 Category A and B Recommendations

Safety Factor	Recommendation Number	Category	Title	Planned completion
2 – Actual condition of plant important to safety	SF2 Rec 001	B HYB/TOR	Material condition of the H&V systems at HYB and TOR has been identified as a concern and has been captured in NG risk log (HYB Risk R02532 and TOR Risk R00660).	**Recommended Action:** The proposed solution is to carry out the refurbishments identified in the MTP to ensure that the plant continues to meet the requirements of the safety case with regard to overall integrity, reliability and performance. Key items are listed below: 1. HYB H&V Refurbishment - Rolling Programme (Work pack 328185) 2. TOR H&V Refurbishment – Rolling Programme (Work pack 332708) **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.
	SF2 REC 002	B HYB	No evidence to support that a safety systems review (SSR) has been conducted for the HYB quadrant excess drainage (QED) pumps.	**Recommended Action:** It is recommended that HYB review the performance of the QED pumps as part of the SRR process. **Probable or Defined Closure Criteria:** This recommendation can be closed out once it can be demonstrated that the HYB QED pumps are covered by SSR review.
	SF2 REC 003	B HYB	No evidence to support that a safety systems review (SSR) has been conducted for the HYB active effluent treatment (AETP).	**Recommended Action:** It is recommended that HYB review the performance of the AETP as part of the SRR process.

Safety Factor	Recommendation Number	Category	Title	Planned completion
				Probable or Defined Closure Criteria: This recommendation can be closed out once it can be demonstrated that the HYB AETP is covered by SSR review.
4 - Ageing, obsolescence and lifetime management Original recommendation; "PSR3/HYT/SF04/REC/001"	SF4 REC 001	A HYB/TOR	Review of the life limiting safety case identified that original design life for predominantly reactor internal components for HYB and TOR are due to expire and no resource has been allocated to justify this within the MDI process.	**Recommended Action:** Review the time limited safety cases in table H2 of safety factor 4 to confirm the scope of review including components limited by a 30 year original design life and applicable degradation mechanisms. **Probable or Defined Closure Criteria:** This recommendation can be closed out once the EC has achieved "modified status".
	SF4 REC 002	B HYB/TOR	Discussions at HYB and TOR stations identified that there is no comprehensive coverage of preventative maintenance for critical spares held in stores to align with international best practice.	**Recommended Action:** Supply chain • Conduct a workshop with relevant departments to establish a strategy for implementation of maintenance routines on components in stores. Engineering • Establish scope of "critical spares" which require in stores maintenance requirement input. • Conduct a review of identified critical spares to establish if in store maintenance is required as established within appendix B of BEG/SPEC/PRO/040 (currently in draft).

Safety Factor	Recommendation Number	Category	Title	Planned completion
				Supply chain and Engineering • Implement scheduled maintenance requirements through an agreed methodology. **Probable or Defined Closure Criteria:** This recommendation can be closed out on the following criteria: • In store maintenance requirements have been identified for at least SPV critical spares. • A method has been established for implementing the routines. • Undertaking of a self-assessment after a suitable period of time to review the implementation of the "critical spares" process.
5 - Deterministic safety analysis	SF5 REC 003	B HYB/TOR	Graphite team to set up a programme by end of 2018 (including project controls, funding and identifying required resources) to ensure that all inspections, modifications and EC's, required to support the ongoing safe operation of HYB and TOR (given the most recent predicted timescales for onset of keyway root cracking), are progressed in a timely and controlled manner.	This recommendation is required, as the predicted timescales for onset of keyway root cracking (KWRC) has changed from 2028 to mid-2022. Currently there is not a safety case for operation of HYB and TOR after the onset of KWRC. It is anticipated that to be able to justify continued operation beyond the onset of KWRC some plant modifications will be required. To identify the onset of KWRC, a suitable inspection programme needs to be developed. All these aspects need to be suitably controlled and as such, a programme is deemed to be required. **Recommended Action:**

Safety Factor	Recommendation Number	Category	Title	Planned completion
				To set up a programme to ensure funding and resources are put in place in a timely manner to support the inspections. Modifications and EC's required to support the onset of KWRC. **Probable or Defined Closure Criteria:** This recommendation should be able to close once the programme is set up and funded. The completion of the programme is not required to close this recommendation.

Table 2 – HPB/HNB and HYA/HRA PSR3 Category B Recommendations Applicable to Heysham 2/Torness

Safety Factor	Recommendation Number	Title	Planned completion
2 – Actual condition of plant important to safety Original recommendation; "PSR3/HHB/SF01/REC/001"	SF1 Rec 001	Implement fleet wide SCHR governance arrangements.	DAO/PROC/003 and BEG/SPEC/DAO/008 have been updated to detail the new arrangements and oversight reviews to address this issue.
3 - Equipment qualification Original recommendation; "PSR3/HHB/SF03/REC/001	SF3 Rec 001	Establish effective process, governance and oversight arrangements for zonal walk downs (ZW's) and zonal based views (ZBV's).	DAO/PROC/003 and BEG/SPEC/DAO/008 have been updated to detail the new oversight arrangements and oversight reviews to address this issue.
4 - Ageing, obsolescence and lifetime management Original recommendation; "PSR3/HH1/SF04/REC/001"	SF4 REC 001	Benchmarking exercises have been conducted to establish best practices of proactive obsolescence management. During the production of this SF a number of outstanding actions were identified.	To address this recommendation and to implement the international learning, HYA/HRA has purchased a proactive obsolescence management system (POMS) and obsolescence management tools. HYA's main focus for 2018 is SPV obsolescence. The plan is to identify equipment which is obsolete and create an action plan with an owner and delivery date. On completion of the SPV mitigation, the focus will be safety system performance SSP1 (CO_2 primary coolant plant), SSP2 (emergency boiler feed pumps (EBFP) and high pressure back up cooling system (HPBUCS) systems) and SSP5 (emergency generation systems). The relevant action plans for these systems will drive the mitigation for the equipment, as per BEG/SPEC/FENG/016. The identified programme of work is ongoing and has been discussed with ONR at the local ONR interaction at HY1 in Q2 2018.

Table 3 – ONR Heysham 2/Torness PSR3 Assessment Findings

ONR Finding	Detail
ONR-HY2/TOR-PSR3-01 **Fault Studies** **Issues Database Number: 7769**	EDF NGL to perform adequate deterministic safety analysis to justify the performance of the Secondary Shutdown Systems for the actual condition of the plant and intended future operation, including both the Nitrogen and Boron Bead Systems. Furthermore, the Licensee should provide adequate justification for the level of seismic qualification of the Secondary Shutdown Systems.
ONR-HY2/TOR-PSR3-02 **Fault Studies** **Issues Database Number: 7770**	EDF NGL to carry out optioneering, informed by adequate deterministic safety analysis and relevant good practice on other AGR sites, to reduce the risk from water ingress faults on HY2 and TOR as low as reasonably practicable.
ONR-HY2/TOR-PSR3-03 **Fuel Safety** **Issues Database Number: 7771**	NGL should demonstrate that the HY2 and TOR safety case is suitably presented, accessible and understandable to its users (plant operators and station management).
ONR-HY2/TOR-PSR3-04 **External Hazards** **Issues Database Number: 7772**	The Licensee should consider means to demonstrate or ensure adequate resilience of nuclear safety systems against conservatively estimated high EAT design basis events with adequate allowance for climate change.
ONR-HY2/TOR-PSR3-05 **Control and Instrumentation** **Issues Database Number: 5095**	For HY2 / TOR, EDF NGL have satisfactorily addressed the following issues that were raised during earlier ONR's PSR3 assessments: □ HNB/HPB PSR3 C&I Finding 1 □ HNB/HPB PSR3 C&I Recommendation 3 This Finding and Recommendation need to be addressed for HY2 / TOR.
ONR-HY2/TOR-PSR3-06 **Mechanical Engineering** **Issues Database Number: 7773**	The Licensee should demonstrate that there is a procedure in place for managing the transition to modern standards prior to superseded or aged standards being withdrawn. The Licensee should consider whether there are consequences of BS 13001 that might drive NGL to amend its examination, inspection, maintenance or testing regime on cranes within the lifetime of the PSR3 review period.
ONR-HY2/TOR-PSR3-07 **General** **Issues Database Number: 7774**	NGL should provide and implement a single procedure for ageing management of nuclear safety assets, or provide evidence that their current arrangements are adequate in delivering timely age related modifications to plant.