



**ONR Agreement to NP/SC 7789 Update to the Graphite Weight Loss Structural Integrity
Assessment Limit**

Project Assessment Report ONR-OFD-PAR-20-023
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EXECUTIVE SUMMARY

Title

ONR Agreement to NP/SC 7789 Update to the Graphite Weight Loss Structural Integrity Assessment Limit.

Permission Requested

The Licensee EdF Energy Nuclear Generation Limited (NGL) has requested that the Office for Nuclear Regulation (ONR) issue an Agreement to the safety case NP/SC 7789, under arrangements made under Licence Condition (LC) 22(1) (Modification or Experiment on Existing Plant).

NP/SC 7789 provides an update of the graphite weight loss Structural Integrity Assessment Limit (SIAL) to 50% for Heysham 1 (HYA) and Hartlepool (HRA) power stations.

Background

Nuclear site licensees are required to comply with conditions attached to the nuclear site licence. LC 22 provision (1) states that modification or experiment on existing plant requires that the Licensee shall make and implement adequate arrangements to control any modification or experiment carried out on any part of the existing plant or processes which may affect safety. For the safety case NP/SC 7789 presented to ONR for Agreement, these arrangements relate to potential damage mechanisms that can be induced by graphite weight loss.

The current operating period for HYA/HRA is limited by the graphite weight loss SIAL value of 43% justified by NP/SC 7623. The licensee produced NP/SC 7789 to justify a SIAL value of 50%. The most significant claim of this safety case is substantiated by the results of Material Test Reactor (MTR) experiments commissioned by NGL and which have been carried out over a number of years.

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

NGL's safety justification for the extension of the SIAL to 50% for HYA/HRA power stations was examined by a graphite specialist ONR inspector. No other specialist assessment was required for the case presented.

Overall, the specialist inspector considered that the claims and arguments presented in the safety case was suitably supported by evidence. The specialist inspector had no objection to Agreeing to safety case NP/SC 7789 under LC 22(1).

Matters arising from ONR's work

ONR's graphite structural integrity specialist assessment did not identify any nuclear safety concerns that would prevent Agreement to the extension of the SIAL to 50%. The assessment conclusions were supported by evidence that:

- the MTR experiment has produced valuable information;
- suitable margins against brick failure were demonstrated;
- the specialist inspector did not find any significant shortfalls in the claims, arguments and evidence presented.

Conclusions

ONR's assessment confirms that the justification in safety case NP/SC 7789 supports the extension of the SIAL to 50%.

Recommendation

I recommend that ONR should issue Licence Instruments 572 and 633 under LC22 (1) for Nuclear Site Licence 59 and 60, giving ONR's Agreement to safety case NP/SC 7789 which provides a justification for an update of the SIAL to 50% graphite weight loss.

LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
HRA	Hartlepool Power Station
HYA	Heysham 1 Power Station
LC	Licence Condition
MTR	Material Test Reactor
NGL	EdF Energy Nuclear Generation Limited
ONR	Office for Nuclear Regulation
PAR	Project Assessment Report
SAP	Safety Assessment Principle(s)
SIAL	Structural Integrity Assessment Limit

TABLE OF CONTENTS

1	PERMISSION REQUESTED	7
2	BACKGROUND	7
3	ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR IN CONSIDERATION OF THIS REQUEST	7
4	MATTERS ARISING FROM ONR'S WORK.....	8
5	CONCLUSIONS	8
6	RECOMMENDATIONS.....	8
7	REFERENCES	9

1 PERMISSION REQUESTED

1. The Licensee, EdF Energy Nuclear Generation Limited (NGL), has requested that the ONR issue an Agreement to the safety case NP/SC 7789 (Ref. 1): Update to the Graphite Weight Loss Structural Integrity Assessment Limit (SIAL), under arrangements made under LC 22(1) (Modification or Experiment on Existing Plant).
2. The safety case covers changes at both Heysham 1(HYA) and Hartlepool (HRA) power stations. ONR has chosen to assess the safety case for Agreement (Ref. 2) due to the safety significance of the limit which NGL seeks to modify.

2 BACKGROUND

3. During normal operation of an Advanced Gas-cooled Reactor (AGR), oxidation results in the gradual loss of graphite moderator. The nuclear site licence under LC 22 (1): Modification or experiment on existing plant requires that the Licensee makes and implements adequate arrangements to control any modification or experiment carried out on any part of the existing plant or processes which may affect safety. For the safety case NP/SC 7789 presented for ONR assessment, these arrangements relate to potential concerns related to damage mechanisms such as those that can be induced by graphite weight loss.
4. During operation, graphite weight loss changes the thermal and mechanical properties of graphite. To justify operation of the AGRs, NGL assesses the structural integrity of the core at different stages of its lifetime. Confidence in the assessments used to support the graphite safety case therefore requires the availability of leading graphite property data. The SIAL represents the extent of the graphite property database. The Licensee has produced safety case NP/SC 7789 to justify a value of the SIAL at HYA and HRA of 50% weight loss. The most significant claim of this safety case is substantiated by the results of experiments in the Petten materials test reactor (MTR) in the Netherlands which were commissioned by NGL and which have been carried out over a number of years.

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

5. NGL's justification for increasing the SIAL in Ref. 1 is based on the following claims:
 - Claim 1: Data obtained from Phase 2 of the Petten MTR experiment can be used to increase the Structural Integrity Assessment Limit from 43% to 50%, and demonstrate a lack of cliff edge at 50%, thus enabling structural integrity assessments of graphite components that have a weight loss of up to 50%.
 - Claim 2: The structural integrity weight loss issues identified in previous weight loss safety cases have been reviewed and the limits associated with them have been re-assessed.
 - Claim 3: The progression of weight loss is gradual and is confirmed by sampling.
 - Claim 4: Statistical forecasts can be used to show that the 50% SIAL will not be reached at HRA until October 2022 and at HYA until 2030.
6. In accordance with ONR's regulatory permissioning arrangements (Ref. 3) and the Safety Assessment Principles (SAPs) in Ref. 4, ONR has carried out a graphite specialist assessment of the safety case. A technical report in Ref. 5 was produced to provide a view on the adequacy of the claims, arguments and evidence presented in the safety case NP/SC 7789 (Ref. 1).

4 MATTERS ARISING FROM ONR'S WORK

7. The matters arising from the work carried out by the ONR specialist are summarised as follows. The graphite inspector has assessed the claims, arguments and evidence presented in the safety case.
8. The ONR graphite integrity assessment considers that NGL has produced a satisfactory safety case and supports ONR issuing an Agreement. This conclusion was supported by the evidence that:
 - The specialist graphite inspector is content that the MTR experiment has produced valuable information;
 - The specialist graphite inspector confirmed that suitable margins against the potential for brick failure were demonstrated.
9. NGL provided a revision of the safety case in Ref. 6 during ONR's specialist assessment. The specialist assessment in Ref. 5 recommended that the project inspector confirms that the margins presented in the revised safety case are consistent with those presented during the specialist assessment of Ref. 1. I confirm that the margins presented during the specialist assessment are appropriately referenced in the revised safety case in Ref. 6. The recommendation from the specialist inspector has therefore been suitably addressed in the revised safety case.
10. To conclude, the assessment findings did not identify any safety shortfalls and the Inspector recommended that ONR Agrees to NGL's safety case NP/SC 7789.

5 CONCLUSIONS

11. ONR has completed the assessment of NGL's safety justification NP/SC 7789 which updates the SIAL to 50% for HYA and HRA power stations.
12. Based on the work carried out by ONR, I am satisfied that an Agreement should be provided to the safety case under LC22(1).

6 RECOMMENDATIONS

13. I recommend that ONR should issue Licence Instruments 572 and 633 under LC22(1) for Nuclear Site Licence 59 and 60, giving ONR's Agreement to safety case NP/SC 7789 which provides a justification for an update of the SIAL to 50% weight loss.

7 REFERENCES

1. NP/SC 7789. Update to the graphite weight loss structural integrity assessment limit. Version 05. January 2020. CM9 2020/64453.
2. ONR-OFD-DR-20-048. Decision record to support the chosen permissioning strategy to regulate the implementation of the licensee's safety case NP/SC 7789. CM9 2020/323131.
3. *ONR Guide – The Purpose and Use of Permissioning - NS-PER-GD-001 Revision 4*. March 2020. <http://www.onr.org.uk/operational/assessment/index.htm>
4. *Safety Assessment Principles for Nuclear Facilities*. 2014 Edition, Revision 1. January 2020. <http://www.onr.org.uk/saps/saps2014.pdf>.
5. ONR-OFD-AR-20-048 - Hartlepool & Heysham 1 Power Stations. Graphite Weight Loss Structural Integrity Assessment Limit. Assessment of Safety Case NP/SC 7789. CM9 2020/281629.
6. NP/SC 7789. Update to the graphite weight loss structural integrity assessment limit. Version 07. January 2021. CM9 2021/10944.