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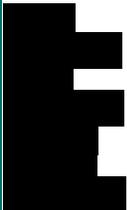
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EXECUTIVE SUMMARY

Dungeness B Updated Safety Case for Plug Unit Weld Integrity

NP/SC 7540 Revision 003 Addendum 1: Updated Safety Case for the Plug Unit Weld Integrity Addendum 1: ALARP Risk Management of Neutron Scatter Plugs

Permission Requested

In accordance with arrangements made under Licence Condition 22(1) – Modification or Experiment on Existing Plant, attached to nuclear site licence No 61, EDF Energy Nuclear Generation Limited (NGL) has requested ONR's agreement to its proposal to operate as described in the document titled: NP/SC 7540 Revision 003 Addendum 1: Updated Safety Case for Plug Unit Weld Integrity Addendum 1: ALARP Risk Management of Neutron Scatter Plugs dated 16 April 2015 and as requested in the licensee's letter NSLDNB50805Y dated 29th June 2015.

Background

The fuel plug units (FPU) at Dungeness B are the top part of the fuel stringer and support the fuel during its time in the reactor and fuelling handling operations in other facilities. In building a fuel stringer, seven fuel elements are attached to the fuel plug unit via a tie bar. The tie bar is not in tension whilst the fuel is in the reactor, but is during fuel lifting operations. Failure of the FPU during these operations could lead to dropped fuel and hence it needs to be of adequate integrity.

Since the beginning of reactor operation at Dungeness B, it has been recognised that there have been issues with the integrity of the FPUs. A safety case produced by NGL in March 2014 allowed the station to continue to use FPUs for a year and this period of validity was extended for a further 6 months in April 2015 to allow their use up to 30 September. The safety case submission proposes operation without a time limit and ONR agreement will allow NGL to implement this safety case.

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

ONR has carried out a programme of technical assessment work in two technical areas:

- Structural integrity assessment
- Fault studies assessment

In both cases, the specialist inspector has concluded that ONR should issue a licence instrument.

Matters arising from ONR's work

For this assessment, effort has been concentrated on structural integrity and fault studies. The assessment has concluded that there are no outstanding issues and hence no matters arising, although the structural integrity assessor has recommended that ONR should monitor continuing testing of the FPUs by the licensee.

Conclusions

This report concludes that:

- The licensee has completed its due process for the proposal.

- The technical assessments support ONR providing Agreement to the proposal.

It further recommends that ONR should provide agreement to the licensee's proposal to operate in accordance with the updated safety case for the fuel plug unit as Dungeness B licence instrument 548.

Recommendations

I recommend that the Superintending Inspector:

- Signs this Project Assessment Report to confirm support for the ONR technical and regulatory arguments that justify issuing Dungeness B Licence Instrument 548.
- Signs this Project Assessment Report approving its release for publication, after redaction where appropriate.
- Signs Dungeness B Licence Instrument 548.

LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
FPU	Fuel plug unit
INSA	Independent nuclear safety assessment
LI	Licence instrument
NGL	EDF Energy Nuclear Generation Limited
NSC	Nuclear safety committee
NSP	Neutron Scatter Plug
ONR	Office for Nuclear Regulation

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1 PERMISSION REQUESTED

1. In accordance with arrangements made under Licence Condition 22(1) – Modification or Experiment on Existing Plant, attached to nuclear site licence No 61, EDF Energy Nuclear Generation Limited (NGL) has requested ONR’s agreement to its proposal to operate as described in the document titled: NP/SC 7540 Revision 003 Addendum 1: Updated Safety Case for Plug Unit Weld Integrity Addendum 1: ALARP Risk Management of Neutron Scatter Plugs dated 16 April 2015 (Ref 1) and as requested in the licensee’s letter NSLDNB50805Y dated 29th June 2015 (Ref 2).

2 BACKGROUND

2. The fuel plug units (FPU) at Dungeness B are the top part of the fuel stringer and support the fuel during its time in the reactor and fuelling handling operations in other facilities. In building a fuel stringer, seven fuel elements are attached to the fuel plug unit via a tie bar. The tie bar is not in tension whilst the fuel is in the reactor, but is during fuel lifting operations. Failure of the FPU during these operations could lead to dropped fuel and hence it needs to be of adequate integrity.

3. Failure of the integrity of an FPU could lead to dropped fuel with consequent fuel damage and a potential radiological release in one of the following facilities:

- Fuel handling at the reactor
- Fuelling machine
- Buffer storage tubes
- Irradiated fuel disposal facility

4. The licensee has summarised the history of safety cases for the FPUs in Ref 3. This notes that a revised justification for FPU integrity was first produced in 2008 as NP/SC 7540 Rev 0. Over the intervening period there have been a number of issues identified and safety cases have been produced to address them. Since the start of reactor operation there have been issues with the FPUs, and in particular the lower part of the unit known as the neutron scatter plug (NSP). Approximately 70 NSPs were taken out of service in the first 20 years of operation. To address the issues with NSPs there have been two key improvements:

- “Original design” NSPs have been modified
- New NSPs have been made to a “revised design”

Original designs NSPs are not being reused in the reactor core, but there are still some within the core, including unmodified ones, that will be removed as the associated fuel needs to be discharged. Some of these may remain in the core until 2023. There have also been issues with weld integrity in other parts of the FPU.

5. The licensee prepared a consolidated safety case for the FPUs in NP/SC 7540 Rev 3 (Ref 4) in April 2014. This recognised that the FPUs were susceptible to the following issues that could impact on their integrity:

- FPU welds of original manufacture components exhibiting lack of penetration.
- FPU welds may exhibit a reduced fracture toughness based upon observation of high levels of ferrite and consideration of thermal ageing effects.
- NSP and scatter plug support FPU components are susceptible to seizure and subsequent failure during fuel handling.
- The central plug of original manufacture NSPs is susceptible to in-service dimensional changes/distortion.

- The central plug of original manufacture NSPs may potentially seize at reactor operating temperatures.
6. The licensee's intent was that the whole safety case for the FPU would be in NP/SC 7540 Rev 3, which was issued in March 2014. However, it was unable to include a satisfactory safety case for the NSP. The outcome was that the licensee proposed that it would limit the validity of the safety case in NP/SC 7540 Rev 3 to 31 March 2015 and made 4 commitments, including completing the safety case for the NSPs. The period of validity of the safety case was further extended to end September 2015 by a category 2 modification (Ref 5) due to problems with the facility needed to do some of the testing and to allow time for ONR assessment. In NP/SC 7540 Rev 3 Add 1 (Ref 1), NGL updated the safety case to discharge the commitments in NP/SC 7540 Rev 3 and requested ONR acknowledgement or agreement in Ref 1.
 7. ONR agreement to the safety case will allow NGL to continue to operate the plant without any time restrictions on fuel plug unit handling.

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

3.1 SCOPE

8. Since the FPU safety case is complex and addresses a range of potential issues, ONR has carried out a programme of work to assess the licensee's submissions and provide agreement to the request rather than simply acknowledge it under ONR's flexible permissioning arrangements. This approach was accepted by the Civil Nuclear Reactor Programme's Operating Reactors Sub-Programme Board. The licensee has formally requested agreement to NP/SC 7540 Rev 3 Add1, but much of the safety case is in NP/SC 7540 Rev 3. The assessment has therefore considered the adequacy of both of these safety case documents.
9. The ONR assessment has considered three key elements:
 - Confirmation that the licensee has completed its due process for both safety case documents
 - Structural integrity assessment to confirm that the safety case provides adequate justification that the integrity of the FPU meets the claims in the safety case.
 - Fault studies assessment to confirm that the consequences of FPU failure and the response to it are adequate.

3.2 LICENSEE'S DUE PROCESS

10. The licensee's arrangements require it to categorise all modifications and it has assigned the two modifications to the FPU safety case to Category 1. This requires it to submit them for independent nuclear safety assessment (INSA) and to its nuclear safety committee (NSC) for consideration and advice. The licensee's current arrangements also require the licensee to submit the safety case to ONR for agreement or acknowledgement.
11. NP/SC 7540 Rev 3 was submitted to the NSC in draft form in March 2014. The minutes of the meeting (Ref 6) required Dungeness B to provide:

- A report detailing the completion of verification, INSA approval and implementation of NP/SC 7540 Rev 3. This was provided as a matter arising to the NSC in May 2014 (Ref 3) and noted in the minutes of the meeting (Ref 7).
- A summary of the strategy for reducing the risks from the fuel plug unit welds that are most susceptible to failure. NGL completed by presenting the Nuclear Safety Requirements Specification (NSRS) for NP/SC 7540 Rev 003 Add. 1 to the NSC in September 2014 (Ref 8).

INSA of the safety case is reported in Ref 9 and did not require any formal actions. At the time, the licensee's arrangements did not require it to submit NP/SC 7540 Rev 3 to ONR and hence it was able to implement the safety case without ONR agreement or acknowledgement. I conclude that NGL adequately completed its due process for NP/SC 7540 Rev 3.

12. NP/SC 7540 Rev 3 Add 1 was submitted to the NSC in May 2015 (Ref 10). The NSC was supportive of the safety case. It noted that the project will continue to monitor and inspect FPU's and review the results annually. It placed an action on Dungeness B to report the results to the NSC annually. The safety case has been subject to INSA (Ref 11), which has concluded that the presented is appropriate and ALARP. I therefore conclude that NGL has adequately completed its due process for NP/SC 7540 Rev 3 Add 1.
13. Overall, I conclude that the licensee has adequately completed its due process for the two safety cases.

3.3 STRUCTURAL INTEGRITY ASSESSMENT

14. The structural integrity assessment (Ref 12) considered the impact of the following key issues from NP/SC 7540 Rev 3 and NP/SC 7540 Rev 3 Add 1 :
 - Developments in the understanding of component fracture toughness after higher than expected delta ferrite levels were found in FPU castings.
 - Identification of anomalies in the lifting integrity fault schedule.
 - The potential for NSP central plug dimensional changes and their potential effect on FPU integrity.
 - Monitoring of NSP central plug behaviour.
 - Continuing a program of materials testing.
 - Analysis to determine implications of creep on weld integrity if NSP central plug seizure occurs at operating temperatures.
 - Re-evaluation of the ALARP position.
15. The structural integrity specialist inspector has assessed the licensee's integrity claims and associated arguments presented in the two safety cases and where appropriate the supporting references as well as seeking clarification in meetings with the licensee. In each case he has concluded that the licensee has presented sufficient evidence to support the safety case claims.
16. The structural integrity inspector has noted that the licensee has made a commitment in relation to continued inspection of NSP welds, further push out testing, monitoring of operating experience, longer term aging trials on original and new NSP material samples and inspection of ex-service NSP pins. He has recommended that ONR should monitor progress on this.

17. The structural integrity specialist inspector has concluded that he has found no evidence that in his opinion prevents the issue of the licence instrument granting agreement for continued defueling of plug units containing original manufacture NSPs.

3.4 FAULT STUDIES ASSESSMENT

18. The safety case considers failure of the plug unit to be a credible event. Therefore the fault studies assessment (Ref 13) has addressed the following aspects of the safety case:

- Evaluation of the radiological consequences from a fuel drop.
- Station arrangements for mitigation of fuel drop radiological consequences.

These are covered for the four facilities listed in para 3.

19. The fault studies specialist inspector reviewed NP/SC 7450 Rev 3 Add 1 and found that the supporting references to it did not provide clear picture of the radiological consequences of a failed FPU. He therefore requested information from the licensee, which clarified the consequences and concluded that he did not dispute the quality of the code used or the model applied by the licensee.
20. The fault studies specialist inspector also found that the safety case submissions did not provide detail of the mitigation after a failed FPU, particularly in the reactor. The licensee provided further information on this and the fault studies inspector concluded that he was content that adequate arrangements were available for bringing the reactor to a safe state after a fuel drop fault.
21. Finally the fault studies specialist inspector reviewed the ALARP case for gradual reduction of the number of original NSPs in the core reducing to zero by about 2023. He found that the ALARP reasoning for this was acceptable.
22. The fault studies specialist inspector concluded that from a fault studies point of view the arguments and evidence presented provided reasonable support to the proposed use of gradually decreasing numbers of original NSPs in the remaining period of DNB operation – until the end of 2028. He recommended that from fault studies point of view, issuing a licence instrument as requested by the licensee was appropriately supported.

3.5 CONSULTATION WITH OTHER REGULATORS

23. I have judged that there are no matters associated with the proposal that require consultation with other regulators.

4 MATTERS ARISING FROM ONR'S WORK

24. For this assessment, effort has been concentrated on structural integrity and fault studies. The assessment has concluded that there are no outstanding issues and hence no matters arising, although the structural integrity assessor has recommended that ONR should monitor continuing testing of the FPUs by the licensee.

5 CONCLUSIONS

25. This report presents the findings of the ONR assessment of the NGL proposal to operate Dungeness B in accordance with the safety case in NP/SC 7450 Rev 3 Add 1.
26. I have concluded that:
- The licensee has completed its due process for the proposal.
 - The technical assessments support ONR providing agreement to the proposal.
27. To conclude, I am satisfied with the claims, arguments and evidence laid down within the proposal and that ONR should provide its Agreement to the proposal. I have therefore drafted an Agreement to NP/SC 7540 Revision 003 Addendum 1 Proposal Version No: 3 (Category 1) as LI 548 (Ref 14). The LI is one of the standard formats given within ONR procedures and does not require review by the Solicitors Office.

6 RECOMMENDATIONS

28. I recommend that the Superintending Inspector:
- Signs this Project Assessment Report to confirm support for the ONR technical and regulatory arguments that justify issuing Dungeness B Licence Instrument 548.
 - Signs this Project Assessment Report approving its release for publication, after redaction where appropriate.
 - Signs Dungeness B Licence Instrument 548.

7 REFERENCES

1. *Updated Safety Case for the Plug Unit Weld Integrity Addendum 1: ALARP Risk Management of Neutron Scatter Plugs*
EDF-NGL modification submission NP/SC 7540 Revision 003 Addendum 1 dated 16 April 2015
Trim ref 2015/255062
2. EDF-NGL letter *NSLDNB50805Y* dated 29 June 2015
Trim ref 2015/253217
3. Email Aiden Rose, EDF NGL to [REDACTED] ONR dated 10 September 2015
Trim ref 2015/355609
4. *Updated Safety Case for Plug Unit Weld Integrity*
EDF-NGL modification submission NP/SC 7540 Revision 003 dated 2 April 2014
Trim ref 2014/142176 & 2015/355625
5. EDF-NGL letter *NSLDNB50799N* dated 13 March 2015
Trim ref 2015/101490
6. *Dungeness B Nuclear Safety Committee Minutes of the Meeting Held at Barnwood on 21 March 2014*
Trim ref 2014/142160
7. *EDF NGL Nuclear Safety Committees Minutes of the Meeting Held at Sizewell B on 14 & 15 May 2014*
Trim ref 2014/210901
8. *EDF NGL Nuclear Safety Committees Minutes of the Meeting Held at Hinkley Point B on 10 & 11 September 2014*
Trim ref 2014/353255
9. *Updated Safety Case for Plug Unit Weld Integrity*
EDF NGL Milestone Full INSA Approval Statement, Dungeness B, EC No 335466 Rev 1, NP/SC No NP/SC 7540 Rev 3, Version No 6 dated 28 March 2014
Trim ref 2014/162521
10. *EDF NGL Nuclear Safety Committees Minutes of the Meeting Held at Sizewell B on 6 May 2015*
Trim ref 2015/232574
11. *Updated Safety Case for Plug Unit Weld Integrity, Addendum 1: ALARP Risk Management of Neutron Scatter Plugs*
EDF NGL Milestone Full INSA Approval Statement, Dungeness B, EC No 354751, NP/SC No NP/SC 7540 Rev 3 Add 1, Version No 3 dated 26 June 2015
Trim ref 2015/253282
12. *Updated Safety Case for Plug Unit Weld Integrity*
Dungeness B
Structural Integrity Assessment of the Updated Safety Case for Plug Unit Weld Integrity at Dungeness B, Modification Submission
ONR assessment report ONR-CNRP-AR-15-050 Rev 0 dated 18 September 2015
Trim ref 2015/340723
13. *Updated Safety Case for Plug Unit Weld Integrity*
Dungeness B
Fault Studies Assessment
ONR Assessment Report ONR-CNRP-AR-15-051 Rev 0 dated 21 September 2015
Trim ref 2015/316999

14. *Agreement to Operate in Accordance with the Updated Safety Case for Fuel Plug Unit Integrity*
Licence Instrument 548 issued as ONR letter DNB 71269N dated 25 September 2015
Trim ref 2015/357684