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Amendment to Nuclear Safety Requirements at Hunterston B Power Station

Revision to Nuclear Safety Requirement 5

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Revision 0
30 March 2016

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EXECUTIVE SUMMARY

Background

EDF Energy Nuclear Generation Ltd (hereafter referred to as NGL) complies with Licence Condition 23 operating rules through technical specifications, which form the principal means by which it demonstrates the requisite conditions and limits necessary for safety. Nuclear Safety Requirements (NSRs) constitute a subset of operating rules that are approved by ONR under Licence Condition (LC) 23(4), amendments to which are subsequently approved under LC 23(5).

NSR 5 specifies the requirements for the reactor heat removal systems, including the required equipment availability to successfully perform its intended nuclear safety function in post-trip heat removal. NGL considers that the current version of NSR 5 and associated technical specification Limiting Conditions of Operation (LCO 5.3.2) for the post-trip reactor heat removal system, do not adequately reflect the recent plant modifications and diversification of equipment in the post-trip heat removal systems. As a result the NSR is required to be updated to meet the key limits identified in the updated safety case and to reflect the intended claims on the modified design.

The proposed changes to NSR 5 are incidental to the updated safety case for Hunterston B power station back-up cooling system (BUCS) modifications; NGL has classified this amendment as a category 2 modification; i.e. if the changes to the NSR were inadequately conceived or executed, it is possible that future changes to LCO 5.3.2 could erode margins to the existing NSR and potentially result in the reduced availability of plant post-trip cooling. This amendment will act as an enabler to a future amendment to supporting LCOs. It will also provide wider benefits to nuclear safety associated with increased flexibility, reliability and diversity of equipment of the feed water supply and BUCS. This will ensure an adequate water supply to support effective post-trip reactor heat removal.

Permission Requested

NGL has requested approval under LC 23(5) of an amendment to replace NSR 5 - Revision 5, dated 15 May 2014, with NSR 5 – Revision 6. ⁽¹⁾ This approval will come into effect on 1 April 2016. NGL's application proposes changes to the NSR to specify the minimum water levels for the new main BUCS system. It also outlines requirements for the availability of a number of alternative feed water systems to better reflect the safety claims on these systems.

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

Assessment of this submission has been undertaken according to the following parameters:

1. An examination of the associated Engineering Change category 2 proposal. This focussed upon verifying that appropriate evidence has been provided to underpin the changes in availability requirements of nuclear safety-significant post-trip reactor cooling systems;
2. An examination of the associated nuclear safety justification presented for the NSR changes in claimed components of the post-trip reactor cooling systems;
3. An examination of the consistency between the category 2 Engineering Change and associated amendments to NSR 5;
4. Confirmation of appropriate rigour of Independent Nuclear Safety Assessment (INSA) and submission to the Nuclear Safety Committee in accordance with arrangements made under LC22(1);

5. Confirmation of appropriate margin, where practicable, between the LCOs and the proposed NSRs.

Matters arising from ONR's work

During the course of assessing this submission, ONR has reviewed the nuclear safety justification for the specific NSR 5.3.2 amendments relating to:

- The specification of the minimum operating water level required for the newly constructed main BUCS water storage tank available during operation at power.

Unavailability of the main BUCS water storage tank is permitted on the basis that adequate water supplies can be provided by the alternative BUCS water storage plant with supply from the Reserve Feedwater (RFW) tanks. ONR was satisfied that the proposed changes to NSR 5.3.2 are demonstrably underpinned by an appropriate nuclear safety justification for the operational configurations. ONR was further satisfied that all configurations are appropriately conservative to the extant LCO.

ONR has examined NGL's INSA Approval Statement ⁽³⁾ and considers that it constitutes an independent assessment of the licensee's submission of appropriate rigour and depth.

The modification was duly noted, in accordance with the licensee's Licence Condition 22 arrangements, at the January 2015 Nuclear Safety Committee.⁽⁴⁾

Conclusions

ONR has judged that each of the five assessment parameters has been satisfactorily addressed. ONR was satisfied, based on the areas of the submission examined, that appropriate nuclear safety justification has been presented by the licensee to demonstrate sufficient levels of conservatism between the proposed NSR 5 Revision 6 and the extant LCOs.

Recommendations

It was recommended that the ONR Deputy Chief Inspector should sign Licence Instrument No. 553 and thus approve NGL's request under LC 23(5) to amend NSR 5, replacing Revision 5 with Revision 6.

LIST OF ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
BUCS	Back Up Cooling System
EBF	Emergency Boiler Feed
EC	Engineering Change
HNB	Hunterston B
INSA	Independent Nuclear Safety Assessment
LC	Licence Condition
LCO	Limit and Condition of Operation
MGTT	Million Gallon Townswater Tank
NGL	EdF Energy Nuclear Generation Limited
NSC	Nuclear Safety Committee
NSR	Nuclear Safety Requirement
ONR	Office for Nuclear Regulation
RFW	Reserve Feedwater

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1 PERMISSION REQUESTED

1. EDF Energy Nuclear Generation Ltd (NGL) has written to the Office for Nuclear Regulation (ONR) in letter NSL HNB50504R, dated 26 February 2015 ⁽¹⁾ to request Approval from ONR to an amendment to Nuclear Safety Requirements (NSR) at Hunterston B (HNB).
2. Approval is sought, under Licence Condition (LC) 23(5) to replace NSR 5 Revision 5, ⁽⁵⁾ dated 15th May 2014, with NSR 5 Revision 6. ⁽⁶⁾
3. This request is supported by a Category 2 Engineering Change (EC 333274) ⁽⁷⁾ that outlines the safety case justification for the proposed amendments to NSR 5. The EC presents claims, arguments and evidence to support the assertion that the amendment will constitute an overall benefit to nuclear safety by allowing increased flexibility, reliability and diversity of the feed water supply and Back Up Cooling System (BUCS) in the post-trip reactor heat removal system.

2 BACKGROUND

4. NGL complies with Licence Condition 23 through Technical Specifications, which form the principal means by which it demonstrates the requisite conditions and limits necessary for safety. Nuclear Safety Requirements constitute a subset of Operating Rules that are approved by ONR under Licence Condition 23(4), amendments to which are subsequently approved under Licence Condition 23(5).
5. Nuclear Safety Requirement (NSR) 5 specifies the requirements for the reactor heat removal system including the required equipment availability to successfully perform its intended nuclear safety function in post-trip heat removal of the plant. The Back Up Cooling System (BUCS) is a post-trip boiler feed system that is able to supply the main boilers of both reactors. It is the only feed source which is qualified for an infrequent (bottom line) seismic event. The safety case requirement for the BUCS is to ensure the availability of at least 1080Te of back up feed water for at least 24 hours in the event of a requirement for post-trip cooling. The BUCS and the Emergency Boiler Feed (EBF) system are used for post-trip reactor cooling. The BUCS is a diverse and alternative system to the EBF system.
6. The original BUCS safety case claimed that the Million Gallon Townswater Tank (MGTT) was the seismically qualified source of water supplies in the event of an infrequent seismic event. However NGL demonstrated that it was not reasonably practicable to maintain the seismic qualification of the MGTT and supply routes. Modifications have been made to the BUCS and are outlined in the Engineering Change Summary (EC 354418) ⁽²⁾ including the addition of a 1200m³ BUCS tank constructed on an elevated site to maintain a diverse source of feed water able to withstand an infrequent (bottom line) seismic event.
7. The updated Technical Specification Limiting Conditions of Operations (LCO 5.3.2) take in to account that, although unlikely, it is possible that the main BUCS tank could become unavailable as a result of fault or an emergent maintenance requirement. To provide further defence-in-depth and diversification of feed water supply routes the LCOs specify the availability of the alternative BUCS tank, the Reserve Feedwater (RFW) supply route and stocks.
8. NGL states in its submission that it considers the current version of NSR 5 does not adequately reflect the recent plant modifications and diversification of equipment in the post-trip heat removal systems. As a result, NGL considers that NSR 5 and associated Technical Specification Limiting Conditions of Operation (LCO 5.3.2) for the post-trip reactor heat removal system are required to be updated to meet the key limits

identified in the closing safety case ⁽⁷⁾ and to reflect the intended claims on the modified design.

9. In NGL's submission they state that if the changes to the NSR were inadequately conceived or executed it is possible that future changes to LCO 5.3.2 could erode the margin to safety case limits and potentially result in reduced availability of post-trip cooling plant; on this basis the licensee has classified the amendment to be a category 2 modification in accordance with its arrangements under LC22(1). NGL has stated that the changes to the NSR will provide wider benefits to nuclear safety associated with increased flexibility in maintenance and equipment reliability and alleviate undue safety risks in a post trip accident cooling scenario.
10. NGL's submissions present analysis and justification of the modifications of the post-trip reactor heat removal system below, leading to proposed limits and additional clauses to the NSR 5.3.2:
 - The specification of the minimum operating water level not less than 5.5m required for the newly constructed main BUCS water storage tank to be available during operation at power
 - Unavailability of the main BUCS water storage tank is permitted on the basis that adequate water supplies can be provided by the alternative BUCS water storage plant with supply from the RFW tanks. This is specified in the NSR 5 Issue 6 Table 5.3.2-1, which defines the water level of the specified RFW tanks to ensure that adequate water can be supplied to the BUCS from the RFW tanks. These availability requirements meet the safety case limits with an included margin to the safety case limit.
11. NGL's analysis is structured within one claim in accordance with *claims – arguments – evidence* format; this is consistent with its arrangements made under licence condition 14:

Claim 1: The proposed NSR updates are in accordance with the closing safety case for HNB BUCS Modifications ⁽⁷⁾ and specifies the acceptable water levels of the main BUCS and alternative BUCS and RFW required to support the essential functions of trip, shutdown and post-trip cooling.

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

12. At the time the BUCS was commissioned in 2015, the station implemented associated updates to LCO 5.3.2 on the basis that the new limits remained conservative with respect to the original nuclear safety requirement. As indicated within NGL's submission, the proposed update to NSR 5 will provide wider benefits to nuclear safety associated with increased flexibility in maintenance and equipment reliability and alleviate undue safety risks in a post trip accident cooling scenario.
13. The proposed category 2 classification is considered to be appropriate for this amendment in light of the significant redundancy and diversity in available post-trip cooling should the modification be inadequately conceived or executed. ONR's assessment of this submission is therefore appropriately constrained to
 1. An examination of the associated Engineering Change Category 2 proposal, focussed upon verifying that appropriate evidence has been provided to underpin the changes in availability requirements of nuclear safety-significant post-trip reactor cooling systems;

2. An examination of the associated nuclear safety justification presented for the NSR changes in claimed components of the post-trip reactor cooling systems;
3. An examination of the consistency between the Category 2 Engineering Change and associated amendments to NSR 5;
4. Confirmation of appropriate rigour of Independent Nuclear Safety Assessment (INSA) and submission to the Nuclear Safety Committee in accordance with arrangements made under LC22(1);
5. Confirmation of appropriate margin, where practicable, between the LCOs and the proposed NSRs.

4 MATTERS ARISING FROM ONR'S WORK

14. During the course of assessing the submission, I have reviewed the specific NSR amendment to NSR 5.3.2.

4.1 Post-trip reactor heat removal system

15. The tables below are extracts from the licensee's submission ⁽⁵⁾⁽⁶⁾ to illustrate the extent of the proposed changes to text for NSR 5.3.2:

Current text for NSR 5.3.2: ⁽⁵⁾

NSR 5.3.2 During OPERATION AT POWER:

The BUCS water storage tank shall be AVAILABLE with a water level of not less than 3.0 metres;

OR

A supply route from an RFW tank shall be AVAILABLE.

Proposed new table and text for NSR 5.3.2: ⁽⁶⁾

NSR 5.3.2 During OPERATION AT POWER:

The Main BUCS water storage tank shall be AVAILABLE with a water level of not less than 5.5 metres;

OR

The Alternative BUCS water storage plant shall be AVAILABLE as specified in NSR Table 5.3.2-1.

AVAILABILITY Requirements for Alternative BUCS Water Storage Plant

Plant item	Required Status
RFW tank 7 and 8 supply routes	At least one route AVAILABLE from RFW tank 7 and 8
RFW tank 7	AVAILABLE with a water level not less than 2 metres
RFW tank 8	AVAILABLE with a water level not less than 2 metres
RFW tank 9	AVAILABLE with a water level not less than 2.8 metres
RFW transfer pumps	Two pumps AVAILABLE, each capable of transferring at least 10 kg/s from RFW tank 9 into RFW tanks 7 and 8

16. NGL's submissions include a summary of the modified BUCS.⁽²⁾ The BUCS has been constructed on an elevated site, which contains treated boiler quality water that will be gravity fed to the BUCS pumps without operator action. This tank has been designed, constructed, inspected and tested to show the structural integrity is acceptable and the tank is fit for its claimed safety duty. The foundations of the new main BUCS conform to appropriate standards and therefore the tank is expected to withstand loads associated with an infrequent seismic event. The supply water level indications and alarms are provided via float switches and radar instruments in the external standpipe and tank.
17. In the scenario of post-trip cooling, the required feed water flow rate decreases as the decay heat decreases. As a result the operators must regulate the feed water flow to ensure that the BUCS can fulfil its post-trip cooling safety function for at least 24 hours. The flow limits implemented are the same as those currently specified at Hinkley Point B and summarised as follows:
- The first four hours flow is limited to 10kg/s per reactor where this is normally implemented by feeding two quadrants at 5kg/s.
 - The next 20 hours flow is limited to 5kg/s per reactor where this is normally implemented by feeding two quadrants at 2.5kg/s.

This level of feed requires a volume of 1008m³ to be available. The low level alarm is raised requiring prompt action by an operator at a volume of 1104m³ (equating to a water height of 5.99m) and the low low level alarm is raised at 1008m³ at a height of 5.51m. LCO 5.3.2 has been updated specifying the minimum water level in the main BUCS tank of 6m; this provides a margin to the minimum water level specified in the safety case limit of 5.5m.

18. The addition of the alternative BUCS and respective supply routes from the feed water systems are specified in the NSR Table 5.3.2-1. Should the main BUCS tank be unavailable, the configurations of the RFW tanks as described in Table 5.3.2-1 can be made available to supply feed water to the reactor for post-trip cooling. The licensee's analysis further acknowledges that RFW tank 7, RFW tank 8 and RFW tank 9 and the associated pipework and valves have demonstrated that the systems would remain functional following an infrequent seismic event.⁽⁷⁾
19. The licensee's analysis of the alternative BUCS plant arrangements to meet the safety case limits and the margin to this limit is provided by LCO 5.3.2, which ensures that adequate water can be supplied to the BUCS from the RFW tanks. The minimum water level requirements in the RFW tanks in the updated NSR provides stock of 431m³ in each of RFW tank 7 and RFW tank 8 and 537m³ in RFW tank 9 which gives a total of 1399m³, which is greater than the 1008m³ required for more than 24 hours of post-trip reactor cooling.
20. Overall, I am satisfied that the proposed changes to NSR 5.3.2 are demonstrably underpinned by appropriate nuclear safety justification for the post-trip reactor system configurations. I am further satisfied that the configurations are appropriately conservative compared to the extant LCO.

4.2 Alignment to NSR Revision 6

21. I have compared the proposed amendments to Revision 5 ⁽⁵⁾ within the EC against the draft text within NSR 5 Revision 6 ⁽⁶⁾; I have confirmed that the text in Revision 6 is consistent with the EC in each of the elements of the NSR that have been amended.

4.3 Independent Nuclear Safety Assessment and Nuclear Safety Committee

22. NGL's INSA Approval Statement ⁽³⁾ confirms that the arguments behind the changes to the NSR have been presented in the closing EC 333274 ⁽⁷⁾ and are consistent with the proposed changes to NSR 5 requirements. It is of note that the change to the NSR itself was separated from EC 333274, to ensure the nuclear safety benefits gained by bringing the BUCS tank into service were not unduly delayed. I am satisfied that the INSA assessment was undertaken to the appropriate rigour.
23. I judge that there has been adequate consideration ⁽⁴⁾ from the Nuclear Safety Committee, to an extent commensurate with a Category 2 modification (Engineering Change) under arrangements made under LC22(1).

5 CONCLUSIONS

24. I have judged that each of the five assessment parameters has been satisfactorily addressed. I am satisfied, based on the areas of the submission examined, that appropriate nuclear safety justification has been presented by the licensee to demonstrate sufficient levels of conservatism between the proposed NSR 5 Revision 6 and the extant LCOs.

6 RECOMMENDATIONS

25. I recommend that the ONR Deputy Chief Inspector signs Licence Instrument No. 553 and thus Approve NGL's request under Licence Condition 23(5) to amend NSR 5, replacing Revision 5 with Revision 6.

7 REFERENCES

1. TRIM 2016/102446 (NSL HNB50504R) LETTER FROM EDF NGL: REQUEST FOR APPROVAL UNDER LICENCE CONDITION 23(5) OF AMENDMENT TO NUCLEAR SAFETY REQUIREMENTS – 26 FEBRUARY 2015.
2. TRIM 2016/102466 (EC 354418) HUNTERSTON B - NSR 5 APPROVAL UNDER LC23(5) – PROPOSED NSR CHANGES – 26 FEBRUARY 2015
3. TRIM 2016/77485 HUNTERSTON B - NSR 5 APPROVAL UNDER LC23(5) - INSA CERTIFICATE – 7 JANUARY 2015
4. TRIM 2016/77514 HUNTERSTON B – NSR 5 APPROVAL UNDER LC23(5) – NSC MINUTES – JANUARY 2015
5. TRIM 2016/102484 HUNTERSTON B – NSR 5 APPROVAL UNDER LC23(5) ISSUE 5 – MAY 2014
6. TRIM 2016/102370 HUNTERSTON B – NSR 5 APPROVAL UNDER LC23(5) ISSUE 6
7. TRIM 2016/81202 (EC 333274) HUNTERSTON B – NSR 5 APPROVAL UNDER LC23(5) - ENGINEERING CHANGE