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| ONR Project Assessment Report  Sizewell B Periodic Shutdown 2023 – Consent to start-up the reactor following refuelling outage 18 |



ONR Project Assessment Report

Sizewell B Periodic Shutdown 2023

Report Title: Consent to start-up the reactor following refuelling outage 18

[Status]

# Executive summary

**Consent to start-up the reactor under Licence Condition 30(3)**

**Permission requested**

EDF Energy Nuclear Generation Limited (EDF NGL), the holder of nuclear site license number 63 for Sizewell B power station, has requested that the Office for Nuclear Regulation (ONR) grants consent to start-up the reactor following its periodic shutdown, as required by licence condition 30(3) of its nuclear site license.

**Background**

Sizewell B’s operating cycle lasts approximately 18 months after which it is required to shut down so that it can be refuelled. When refuelling is undertaken, some of the fuel assemblies (around one-third) are replaced with new ones. The existing fuel assemblies are returned to the core in a rearranged array to ensure optimum fuel utilisation.

To continue to operate safely and reliably, the reactor plant requires regular examination, inspection, maintenance and testing (EIMT). The specific requirements for EIMT are captured in the plant maintenance schedule, made under licence condition (LC) 28 (at Sizewell B, this terminology is not used, and the licensee instead refers to “surveillance programmes” which satisfy the same requirements). Continuous improvement also requires plant upgrades to be implemented where deemed to be reasonably practicable. Although some of these activities can safely take place when the reactor is operating at power, many of them require the reactor to be shut down. The refuelling outages at Sizewell B provide the opportunity for undertaking such activities.

The requirement to shut down periodically for the purposes of EIMT is captured in LC 30. LC 30(1) states that “when necessary for the purpose of enabling any examination, inspection, maintenance or testing of any plant or process to take place, the licensee shall ensure that any such plant or process shall be shut down in accordance with the requirements of its plant maintenance schedule referred to in Condition 28”. LC 30(3) further states that “The licensee shall, if so specified by ONR, ensure that when a plant or process is shut down in pursuance of paragraph 1 of this condition it shall not be started up again thereafter without the consent of ONR.”

In licence instrument number 4 of nuclear site licence number 63, dated 27 March 1996, ONR specified that the licensee shall seek its consent to start-up a reactor at Sizewell B power station whenever it is shutdown under LC 30(1).

The reactor at Sizewell B was shut down on 17 February 2023 for its eighteenth refuelling outage (RO18). With refuelling and all required EIMT now complete, EDF NGL has applied to ONR for consent to restart the reactor, as required by LC 30(3) and LI 4.

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

The main requirements ONR seeks to confirm during a periodic shutdown are:

* The EIMT requirements specified in the station’s maintenance schedule in support of LC 30 have been complied with;
* EIMT has been carried out by Suitably Qualified and Experienced Persons, with an appropriate level of supervision and quality assurance in place commensurate with the equipment’s safety function; and
* Safety issues identified during the reactor outage have been adequately addressed with suitable and sufficient justification provided to allow a regulatory judgement to be made that start-up of the reactor is safe and will remain safe until the next periodic shutdown.

The documentation produced by the licensee for RO18 and the EIMT of structures, systems and components important to nuclear safety have been inspected and assessed by ONR specialist inspectors in:

* Fuel and Core
* Civil Engineering
* Electrical Engineering
* Mechanical Engineering
* Structural Integrity
* Control and Instrumentation
* Chemistry
* Radiation Protection

During RO18, the licensee has also carried out plant improvements and some non-routine inspections. These activities have also been considered by ONR specialist inspectors during their inspection and assessment activities.

**Matters arising from ONR's work**

There are no outstanding issues of significance preventing start-up of the reactor. ONR intervention findings during the periodic shutdown have been recorded in the respective inspection records and reported to the licensee. All matters have now been addressed to allow consent to start-up the reactor. There remain some minor residual issues to be addressed after reactor start-up and these will be followed up through routine regulatory business.

**Conclusions**

ONR’s inspection and assessment of RO18 confirms that the licensee has carried out EIMT in accordance with the requirements of its maintenance schedule. The work has been conducted to the required quality standards by competent personnel. The plant improvements and non-routine inspections carried out during RO18 have also been considered by ONR inspectors to ensure these aspects support start-up of the reactor. No outstanding issues of significance have been identified by the licensee or ONR that prevent start-up of the reactor following RO18.

**Recommendation**

I recommend that ONR issues Licence Instrument 561, giving consent to start-up the reactor following the RO18 periodic shutdown.

# List of abbreviations

ALARP As low as reasonably practicable

ASME American Society of Mechanical Engineers

C&I Control and Instrumentation

CNSS Civil Nuclear Security and Safeguards

CST Condensate Storage Tanks

EC Engineering Change

EIMT Examination, Inspection, Maintenance and Testing

EOSR Early Outage Safety Review

FSWOL Full Structural Weld Overlay

INA Independent Nuclear Assurance

INSA Independent Nuclear Safety Assessment

LC Licence Condition

LI Licence Instrument

EDF NGL EDF Energy Nuclear Generation Limited

NSSS Nuclear Steam Supply System

ONR Office for Nuclear Regulation

PSSR Pressure Systems Safety Regulations

RCA Radiation Controlled Area

RCP Reactor Coolant Pump

RO18 Refuelling Outage 18

RPV Reactor Pressure Vessel

SCC Stress Corrosion Cracking

SSC Structures, Systems and Components

SQEP Suitably Qualified and Experienced Persons

SZB Sizewell B

WRS Weld Residual Stress

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# Permission requested

1. EDF Energy Nuclear Generation Limited (EDF NGL), the operator and licensee of Sizewell B (SZB) nuclear power station, has requested the Office for Nuclear Regulation (ONR) (Ref. [1]) grant consent to start-up the reactor after its 2023 periodic shutdown for refuelling outage 18 (RO18). The request is in accordance with the licensee’s arrangements made under Licence Condition (LC) 30(3).
2. This report describes how ONR has regulated the periodic shutdown, the matters considered, decisions made and the basis for giving consent to start-up the reactor.

# Background

1. Sizewell B is a single pressurised water reactor incorporating a nuclear steam supply system (NSSS) based on a Westinghouse standard four loop design. The NSSS comprises of enriched uranium fuel assemblies contained within a steel reactor pressure vessel (RPV) with four associated coolant loops each connected in parallel to the RPV. Each cooling water loop has its own reactor coolant pump (RCP), steam generator and interconnecting pipework. The primary cooling circuit is closed and pressurised by a single pressuriser vessel which is maintained part filled with water and part with steam in equilibrium. The secondary coolant side is isolated from the primary system by the steam generator tubes that produce steam which is passed to two 630MW turbine generators producing a nominal 1260MW of electricity.
2. SZB’s operating cycle lasts approximately 18 months, after which it is required to shut down so that it can be refuelled. When refuelling is undertaken, some of the fuel assemblies (around one-third) are replaced with new ones. The existing fuel assemblies are returned to the core in a rearranged array to ensure optimum fuel utilisation.
3. To continue to operate safely and reliably, the reactor plant requires regular examination, inspection, maintenance and testing (EIMT). The specific requirements for EIMT are captured in the plant maintenance schedule, made under LC 28 (at Sizewell B, this terminology is not used, and the licensee instead refers to “surveillance programmes” which satisfy the same requirements). Continuous improvement also requires plant upgrades and inspections to be implemented where deemed to be reasonably practicable. Although some of these activities can safely take place when the reactor is operating at power, many of them require the reactor to be shut down. The refuelling outages at Sizewell B provide the opportunity for undertaking such activities. During RO18 some plant improvements and non-routine inspections will be undertaken.
4. The requirement to shut down periodically for the purposes of EIMT is captured in LC 30(1). LC 30(3) further states that “The licensee shall, if so specified by ONR, ensure that when a plant or process is shut down in pursuance of paragraph 1 of this condition it shall not be started up again thereafter without the consent of ONR”. In licence instrument (LI) number 4 of nuclear site licence number 63, dated 27 March 1996 (Ref. [2]), ONR specified that the licensee shall seek its consent to start-up the reactor at Sizewell B power station whenever it is shutdown under licence condition 30(1).
5. The reactor at Sizewell B was shut down on 17 February 2023 for RO18. With refuelling and all required EIMT now complete, EDF NGL has applied to ONR for consent to restart the reactor, as required by LC 30(3) and LI 4.

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

1. The purposes of ONR inspection and assessment activities during a periodic shutdown are to establish that:

* The EIMT requirements specified in the station’s maintenance schedule in support of LC 30 have been complied with.
* EIMT has been carried out by suitably qualified and experienced persons (SQEP), with an appropriate level of supervision and quality assurance in place commensurate with equipment’s safety function.
* Safety issues identified during the reactor outage have been adequately addressed with suitable and sufficient justification provided to allow a regulatory judgement to be made that start-up of the reactor is safe and will remain safe until the next periodic shutdown.

1. Some plant improvements and non-routine inspections have also been completed during RO18. These include:

* Tie-in and commissioning of new Condensate Storage Tanks (CSTs)
* Full Structural Weld Overlay (FSWOL) of the pressurizer nozzles.
* Stress Corrosion Cracking (SCC) inspections of unisolable pipework in the reactor coolant system. These inspections take account of operational experience in France where SCC has been identified in safety injection welds during inspections of the French reactor fleet.
* Control rod drive mechanism thermal sleeve inspections. This follows thermal sleeve failures identified during refuelling outage 17.

1. ONR needs to be content that these plant improvements and non-routine inspection activities support granting of the consent to start-up. These aspects also required ONR assessment and inspection during the outage.
2. Based on the scope of work identified in the outage intentions document, I judged it proportionate to obtain advice from the following ONR specialisms:
   * Fuel and Core
   * Civil Engineering
   * Electrical Engineering
   * Mechanical Engineering
   * Structural Integrity
   * Control and Instrumentation (C&I)
   * Radiation Protection
   * Chemistry
   * Site and project inspection oversight
3. The inspection activity carried out by ONR can be summarised as follows:

* Assessment of the licensee’s readiness to commence the outage through:
  + Attendance at the outage intentions meeting
  + Observation of the licensee’s pre-outage training programme (LC 9 inspection)
* Engineering inspection and assessment of maintenance, modifications and other work during the outage covering the following areas:
  + Fuel and Core
  + Civil engineering
  + Electrical engineering
  + Mechanical engineering
  + Structural integrity
  + C&I
  + Chemistry
* Assessment of the safety management of the outage including:
  + Early outage safety review (EOSR)
  + Radiological protection
  + LC 8 (warning notices) inspection
* Oversight of the licensee’s response to emergent issues
  + Control rod drive mechanism fault
  + Inspection of American Society of Mechanical Engineers (ASME) Class 1 valves
* Consideration of the licensee’s overall performance at the start-up meeting.

## Assessment of the licensee’s readiness to commence RO18

### Outage intentions meeting

1. EDF NGL’s planned outage work programme was outlined in the outage intentions document (Ref. [3]). This was examined by ONR inspectors in preparation for the outage intentions meeting which was held on 13 October 2022 (Ref. [4]). The meeting was attended by the nominated site inspector, the RO18 project inspector, a structural integrity inspector and a radiation protection inspector.
2. At the outage intentions meeting, EDF NGL set out its intended scope of work, identifying the EIMT requirements as well as other work to be carried out in support of safety. The outage intentions document also identified the SZB approach for managing safety (both nuclear and non-nuclear) and quality during the outage which was to be delivered by processes set out in corporate and local arrangements.
3. The ONR inspectors present did not raise any specific issues relating to the content of the outage intentions document but sought clarification on some minor issues which were subsequently satisfactorily addressed by EDF NGL.

### Observation of the licensee’s pre-outage training programme.

1. During refuelling outages, large numbers of contractors are brought onto site to undertake the necessary outage activities. The nominated site inspector therefore undertook a LC 9 (instructions to persons on the site) compliance inspection. This is reported in reference [5].
2. The inspector sampled the training courses required for unescorted access to the site, the radiation-controlled area (RCA) and the containment building.
3. The inspector was satisfied that persons coming to site for RO18 will only be allowed unescorted access to the site or the containment building if they have been provided with appropriate information regarding:

* the risks and hazards associated with the site in general and the RCA and containment building in particular;
* the precautions to be observed in connection with those risks and hazards; and
* the action to be taken in the event of an accident or emergency on the site.

## Engineering assessments

### Fuel and core

1. Reference [6] reports the findings of the fuel and core assessment of the Cycle 19 core reload safety case.
2. The inspector found that:

* an appropriate level of evidence has been provided by EDF NGL to demonstrate compliance with its fuel design criteria and fuel safety case requirements for Cycle 19;
* adequate evidence has been presented that the Sizewell B Cycle 19 core design is compliant with limits on neutronic and kinetic parameters;
* the effects of the modified fuel design on thermal hydraulic safety margins have been adequately accounted for in fault analysis calculations;
* two outstanding actions associated with regulatory issue 3444, associated with the risk of criticality due to a core misloading event and with the modelling of fuel clad ballooning in a loss of coolant accident, have been adequately addressed for the purpose of this safety case; and
* the fuel inspection activities proposed for RO18 are suitable.

1. The inspector concluded that the claims, arguments and evidence presented show that the risks associated with the proposal are ALARP and the inspector judged the Cycle 19 reload safety case to be adequate.
2. The inspector made three recommendations in their assessment. These are:

* Recommendation 1: That EDF NGL should provide to ONR a satisfactory proposal to review the control of past fuel safety case requirement changes and, if necessary, improve the control of future such changes.
* Recommendation 2: That EDF NGL should provide to ONR a justification for fuel and core component operability prior to loading the core for Sizewell B Cycle 19.
* Recommendation 3: That the ONR Project Inspector provides consent for EDF NGL to proceed with the restart of the Sizewell B reactor following RO18, subject to:
  + satisfactory completion of Recommendation 2; and
  + a satisfactory outcome from a pre-outage LC22 inspection.

1. Recommendation 1 is not required to be addressed prior to start-up and a regulatory issue (RI 11231) has been raised to track this finding.
2. The inspector subsequently undertook a LC 22 inspection (Ref. [7]) which concluded that that EDF NGL has adequately implemented its arrangements for new fuel receipt and inspection for RO18. A justification for fuel and core component operability has been provided by EDF NGL and the inspector is content with the justification provided by EDF NGL (Ref. [8]). Recommendation 2 and the caveats to recommendation 3 have therefore been addressed and the inspector is content for ONR to grant consent to start-up the reactor (Ref. [8]).

### Civil engineering

1. Reference [9] reports the findings of a civil engineering LC 23 and LC 28 inspection during RO18.
2. The inspector targeted the leak tightness of the containment penetrations and other aspects of the primary containment boundary such as the floor drain sumps and liner.
3. The inspector:

* was able to trace operational limits and conditions to relevant safety cases, and into more detailed surveillance requirements.
* judged EDF NGL to be adequately implementing their maintenance and surveillance routines in respect of the civil engineering aspects of the primary containment.

1. The civil engineering inspector considered EDF NGL's existing arrangements and their implementation in respect of LC 23 and LC 28 to be adequate for the civil engineering aspects targeted. The inspector concludes that they have no objection to start-up of the reactor from a civil engineering perspective.

### Electrical engineering

1. Reference [10] reports the findings of an electrical engineering LC 28 inspection during RO18.
2. The inspection targeted the electrical engineering structures, systems and components (SSCs) that were being maintained during RO18.
3. From the sample inspected, the inspector judged that EDF NGL suitably demonstrated the implementation of their arrangements. This included inspection and observation of the actual condition of the station’s electrical SSCs, progress against the station’s RO18 plan, management of emergent issues and completion of work order cards, in accordance with LC **28.**
4. The inspector considered that there were no issues identified from electrical work activities which would prevent ONR granting consent for Sizewell B to return to service.

### Mechanical engineering

1. Reference [11] reports the findings of a mechanical engineering LC 28 inspection during RO18.
2. The inspection targeted RO18 EIMT activities associated with the:

* polar crane
* emergency boration system
* auxiliary feedwater turbine system
* motor operated valves programme

1. The inspector was satisfied that from a mechanical engineering perspective the LC28 arrangements in place for RO18 are appropriate. The inspector supports ONR granting consent to start-up the reactor.

### Structural integrity

1. References [12] and [13] report the findings from structural integrity inspection and assessment during RO18.
2. The inspection and assessment activity targeted compliance with LC28 and the Pressure Systems Safety Regulations (PSSR). Additionally, the adequacy of modifications and non-routine inspections during RO18 were considered.
3. The findings from structural integrity assessment and inspection during RO18 include:

* The inspection programme has been carried out in line with the expectations of ONR’s safety assessment principle EMT.6 (Engineering Principles: Maintenance, Inspection and Testing - Reliability Claims) in the assessment and sentencing of inspection results. Any defects or non-conformances are being dealt with appropriately;
* The inspector is satisfied with the work witnessed during manufacture of the replacement CSTs;
* The inspector has reviewed the extended operability assessment in light of increased weld residual stress (WRS) and is content to support continued operation until the end of 2023. The inspector will continue to monitor production of an updated safety case through a regulatory issue (RI-7708 refers);
* The application of the FSWOL to the pressuriser nozzles is progressing in accordance with the requirements of the safety case;
* The inspection and sentencing procedures are sufficient to provide an appropriate level of assurance of thermal sleeve integrity for the next operating period. The inspector considers that the wear rates identified in the thermal sleeves support return to service and continued operation until the next refuelling outage (RO19);
* The inspector is satisfied with the SCC inspection programme that EDF NGL has put in place in terms of the capability of the techniques and extent of coverage. The inspector is content for Sizewell B to return to service based upon the inspection programme not identifying any SCC defects; and
* The justification for continued operation which considers pipework modelling load discrepancies for the safety injection lines has been reviewed. The inspector considers the arguments and evidence support continued operation until completion of a revised analysis and safety case. A regulatory issue has been raised to track this (RI-11282 refers).

1. The inspector concludes that they are satisfied that Sizewell B is following the ASME Boiler and Pressure Vessels Code and has complied with LC 28 and PSSR during the periodic shutdown.
2. The inspector recommends that, from a structural integrity perspective, there is no objection to ONR issuing the Licence Instrument to grant consent for start-up of Sizewell B Nuclear Power Station, following the 2023 periodic shutdown. However, this is contingent on the RO18 Project Inspector receiving the following:

* To demonstrate satisfactory completion of the steam system inspection programme and completion of the work of the Structural Integrity Panel, the Independent Nuclear Safety Assessment (INSA) certificate for the return to service engineering change (EC370406) should be submitted to ONR as part of EDF NGL's application for consent to return to service.
* To demonstrate satisfactory completion of the PSSR inspections, a return to service statement from the competent person should be submitted to ONR as part of EDF NGL's application for consent to return to service.
* To demonstrate satisfactory completion and commissioning of the new CSTs the final hand over certificate should be submitted to ONR as part of EDF NGL's application for consent to return to service.
* To demonstrate satisfactory completion of the FSWOL to the seven pressuriser nozzles the final hand over certificate should be submitted to ONR as part of EDF NGL's application for consent to return to service.
* Prior to giving consent for the start-up of Sizewell B Power Station the Project Inspector should consult with structural integrity specialist inspectors to confirm that there have been no emergent issues from the inspection programme that would prevent RTS.

1. The licensee has subsequently submitted the INSA statement for the RTS EC (Ref. [14]) and return to service statements from the PSSR competent person (see Section 3.9). For the CSTs and FSWOL, not all final handover certificates are available at the time of writing this PAR. However, where final handover certificates are not available the licensee has provided interim handover certificates which recognise the work that remains to be completed prior to return to service. I am content that the licensees’ processes will ensure this is completed prior to start-up and the licensee has committed to provide the final handover certificates to ONR. Additionally, INA are tracking the issue of the final HoCs and will require these prior to issue of their concurrence Part B. I have further consulted with the structural integrity inspector who has confirmed that they are not aware of any emergent issues which would impact their recommendation for ONR to grant consent to start-up the reactor.

### Control and instrumentation

1. Reference [15] reports the findings of a C&I LC 28 inspection during RO18.
2. The inspection targeted RO18 EIMT activities associated with:

* reactor safety circuits including
  + primary protection system
  + high integrity control system
  + control rod drive system
  + reactor vessel level indication system
  + calibration and testing of reactor protection equipment
* flux mapping system
* polar crane
* refuelling machine

1. The inspection found that the commitments made in the Sizewell B RO18 outage intentions document for C&I equipment and systems important to nuclear safety had been satisfied for the work complete at the time of the inspection. The inspector was generally of the opinion that the standards of work were adequate and consistent with the standards expected from C&I SQEP.
2. The inspector considered the reactor safety systems examined to be in good order, well maintained with good tracking of any failures and well supported by the original equipment manufacturer. Some areas for improvement were identified regarding plant maintenance instructions to provide greater clarity of requirements and/or data recording but the inspector considered these to be minor in nature
3. With regard to the polar crane and refuelling machine maintenance activities, the inspection found shortfalls regarding procedural use and adherence, control of test equipment and clarity of plant maintenance instructions. The inspector has noted that the polar crane and potentially the wider fuel route equipment remains one of the more challenging aspects in relation to EIMT for C&I systems. The inspector will follow this up as a separate activity in conjunction with the Sizewell B nominated site inspector.
4. For the shortfalls identified, the inspector did not consider that these shortfalls posed an immediate or significant risk to nuclear safety or need to be addressed before start-up of the reactor. Two regulatory issues have been raised to address the shortfalls identified during the inspection (RI-11336 and RI-11337 refer) and this will be followed up as routine regulatory business.
5. Overall, the inspection did not identify any significant issues in relation to the C&I equipment and systems that would prevent ONR from issuing a consent to allow Sizewell B to return to normal operating service.

### Chemistry

1. Reference [16] reports the findings of a chemistry LC 23 and LC 28 inspection during RO18.
2. The inspection targeted off-load chemistry control, compliance with chemistry limits and conditions and significant chemistry related outage activities.
3. The inspector was content that chemistry-relevant limits and conditions (operating rules) for outages are captured in Sizewell B's suite of technical chemistry technical standards and implemented through station operating instructions. Further, the inspector considered that Sizewell B was demonstrating effective control with these limits and conditions.
4. The inspector was also content that the steam generator blowdown system, condensate chemical addition and condensate polishing plant were in suitable condition to maintain compliance with chemistry operating rules.
5. The inspector concludes that from a chemistry perspective there are no objections to the return to service of Sizewell B from RO18.

## Outage safety management

### Early Outage Safety Review

1. I joined the licensee’s internal nuclear assurance (INA) team on their EOSR (Ref. [17]).
2. The EOSR looked at work area standards and working practices and the purpose of is to:

* Assist station management in reducing or eliminating undesirable behaviours and conditions which could have an adverse impact on outage success.
* Identification of performance shortfalls in the early stages of an outage.
* Identify any fleet issues for resolution in the longer term.

1. The EOSR focused on nuclear safety (e.g., protected plant, defence in depth) and conventional health and safety (e.g., lifting operations, working at height). A hot debrief was given to the station lead team at the end of each day.
2. At the end of the EOSR, feedback was given on positive observations, areas to enhance oversight, areas for improvement and fleet level considerations. There were some minor issues identified and there was positive engagement between the INA team and the station lead team.

### Radiological protection

1. A radiation protection inspection (Ref. [18]) was undertaken during RO18. That inspection considered if the outage work was being conducted in compliance with the Ionising Radiations Regulations 2017 and LC 18 (radiological protection).
2. The inspector found adequate arrangements were in place for RO18. No matters of safety significance were identified and no issues that would impact granting consent to start-up the reactor.

### LC 8 inspection

1. The nominated site inspector undertook a LC 8 (warning notices) inspection during RO18 (Ref. [19]). This focused on confirming the legibility and accuracy of emergency signage in containment
2. The inspector sampled the accessible areas within containment (except the gantry and polar crane) and confirmed that:

* Emergency escape route signage was visible (i.e. not obscured by equipment brought into containment) and legible (i.e. the escape route could be clearly identified).
* The escape route indicated was the most expedient one.

## Emergent issues

1. During RO18 there were some routine notifications to ONR in compliance with LC 7. None of these were significant and the licensee responded with appropriate levels of investigation and targeted learning briefs. One of these incidents merits further discussion in the context of granting consent to start-up the reactor (see Section 3.4.1).

### Control rod drive equipment fault

1. During a reduction in reactor power for RO18 Sizewell B experienced a control rod freeze during which the control rods failed to move under auto or manual control. During this fault, the licensee has confirmed that this did not affect the capability of the control rods to drop and shut down the reactor, should it have been necessary. This was reported to ONR in compliance with LC 7.
2. The licensee has carried an investigation into the cause of this fault and ONR inspectors have discussed the investigation findings with the licensee. We are satisfied that EDF NGL has identified a plausible cause for the control rod fault and identified suitable procedural mitigations that will be implemented prior to start-up to reduce the risk of this recurring. ONR specialist inspectors from C&I and fuel and core are therefore content for consent to be granted to start-up the reactor (Refs. [8] and [15]).
3. Some further minor actions remain to be completed but these are not significant enough to prevent granting consent to start up the reactor and these actions will be tracked through a regulatory issue (RI-11336 refers) and routine regulatory engagement.

### Inspection of ASME Class 1 valves

1. During RO18, some safety Class 1 valves were disassembled for maintenance. Although visual inspections were completed prior to re-assembly these examinations were not fully compliant with ASME Section XI requirements. These examinations are of valve bolting (VT-1) and the valve internal surfaces (VT-3).
2. The licensee has retrospectively completed the valve bolting (VT-1) examinations and there is now no shortfall. For the examination of the internal valve surfaces (VT-3), a justification of equivalent inspections has been made by the licensee. This justification is presented in the return to service EC (Ref. [14]) and ONR structural integrity inspectors are content that the completed inspections have achieved the intent of the ASME Section XI requirements (Ref. [12]).

## Start-up meeting

1. The start-up meeting (Ref. [20]) was held on 22 March 2023 and was chaired by the station technical and safety support manager with presentations from the outage programme leads. ONR’s attendance at the start-up meeting consisted of the operating reactors sub-division superintending inspector, the nominated site inspector, the RO18 project inspector and a structural integrity inspector.
2. A briefing pack was submitted in advance of the meeting with verbal updates provided during the meeting. In advance of the meeting there was a plant walkdown which included inspecting the areas where significant RO18 work packages has been completed or were ongoing. No issues that would prevent the start-up of the Sizewell B reactor were identified, noting that there remained a recognised amount of inspection and assessment work to complete.

## Start-up letter

1. The station director has asked ONR for consent to start-up the reactor under LC 30(3) (Ref. [1]). The station director has set out those activities still to be undertaken prior to start-up. These are controlled through the site’s mode change process and will be reviewed by the site’s operational safety review committee prior to start-up to confirm the fitness-for-service of the plant and endorse return to service. This is usual practice for the return to service of Sizewell B following an outage.

## Maintenance schedule exceptions list

1. The licensee’s request for ONR’s consent to start-up Sizewell B following RO18 states that the EIMT specified in the outage intentions document is now complete, with the exceptions detailed in attachment 2 to Reference [1] and that these will be completed before, or as part of, return to service. Based on the evidence from ONR’s interventions and assessments, I am content that the licensee has complied with their plant maintenance schedule requirements.

## Return to service justification

1. The licensee’s justification to return Sizewell B to service following the in-service inspections and associated assessments is set out in EC 370406 (Ref. [14]). It confirms that the In-Service Inspections (ISI) undertaken in RO18 have been appropriately carried out, assessed and accepted and that any repairs and adjustments necessary for the safe return to service of the reactor have been carried out. This is supported by the INSA approval statement (Ref. [14])
2. The licensee’s justification for return to service following inspection of the control rod drive mechanism thermal sleeves and SCC inspections is provided in separate justifications. The outcome of these inspections has been discussed in Section 3.2.5.

## PSSR competent person

1. The PSSR competent person has confirmed, in attachment 4 of Reference [1], that the written schemes of examination have been satisfactorily completed and the plant is considered to be acceptable to return to service. This is subject to Trevi-testing of main steam relief valves during return to service and the completion of satisfactory plant walkdowns at normal operational temperatures and pressures.

## Station INA concurrence

1. INA has provided a statement supporting the application for consent, attachment 9 of Reference [1], which confirms that, based on their assessment activities so far, there are no issues which they are aware of that would prevent their agreement to start-up.

## Civil nuclear security and safeguards

1. In addition to the nuclear safety assessments identified, I sought the opinion of ONR’s Sizewell B site security inspector, to understand if there were any aspects of the periodic shutdown that may impact on ONR’s decision to give consent to start-up the reactor. The security inspector confirmed (Ref. [21]) that there were no objections or issues that would impact on this.

## Engagement with other governmental agencies

1. Before giving consent, it is established practice to notify other competent regulatory authorities of ONR’s intention to ensure there are no specific objections that may compromise other regulatory requirements. The Environment Agency site inspector has been informed that ONR intend to issue a LI giving consent to the start-up of the reactor and they confirmed that they had no objections (Ref. [22]).

# Matters arising from ONR’s work

1. I am content that the work of greatest significance to nuclear safety has been completed and assessed or inspected by ONR’s specialist assessors, and the outstanding work can be adequately managed by the licensee’s due process, overseen by INA through their concurrence process.
2. There are no outstanding matters arising from the inspection and assessment work carried out by ONR that would prevent granting consent to start-up the reactor after RO18.
3. Residual issues that do not prevent ONR granting consent to start-up the reactor will be followed up through normal regulatory business.

# Conclusions

1. The Sizewell B periodic shutdown, RO18, has been undertaken in accordance with the requirements of the work scope outlined within the outage intentions document.
2. The licensee has followed its arrangements in undertaking the periodic shutdown, culminating in the Sizewell B station director writing to ONR requesting consent to start-up the reactor. His letter stated that, subject to the completion of the remaining outage activities, he was satisfied that the reactor was fit for return to service and sufficient procedures were in place to assure safe operation through to the next periodic shutdown.
3. The licensee’s internal regulator, INA, has provided a statement that confirms that it foresees no issues that would prevent the provision of their concurrence part B report in due course to support the return to service of the reactor following its periodic shutdown.
4. The PSSR competent person has confirmed that they are content for the reactor to start up.
5. ONR inspectors have sampled the safety management and engineering activities throughout the shutdown and judged them to be adequate. All inspectors either support, or have no objection to, issuing consent to start-up the reactor. All actions raised during their inspections and assessments have been satisfactorily addressed or have acceptable plans for resolution.
6. I consider that the licensee delivered a shutdown that was safely managed and completed the required safety related work activities. I am therefore satisfied that the licensee’s justification to start-up the reactor and operate for a further period is adequate, and consent to start-up the reactor can be granted.

# Recommendations

1. I recommend that ONR issues Licence Instrument 561, giving consent to start-up the Sizewell B reactor.

# References

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| [1] | *NGL, SZB 50900R, Request for Consent to Start-up the Reactor under LC 30(3), ONRW-2019369590-2304.* |
| [2] | *ONR, SZB 75704N Requirement for a consent to start up a reactor. 27 March 1996, 2016/173892.* |
| [3] | *NGL, Outage Intentions Document, Refuelling Outage 18, 2023 Statutory Outage, SZB/OZR/288, ONRW-2019369590-90.* |
| [4] | *ONR-OFD-CR-22-561, Sizewell B Refuelling outage 18 (RO18) – Outage Intentions Meeting, ONRW-2019369590-82.* |
| [5] | *ONR, IIS-51251, LC9 Outage Inspection.* |
| [6] | *ONR, AR-01042, Fuel and Core Assessment of the Cycle 19 Core Reload Safety Case, Issue 1, ONRW-2126615823-274.* |
| [7] | *ONR, IR-52014, LC22 Compliance Inspection Focusing on Receipt Inspections for New Fuel and RCCAs for Sizewell B Cycle 19.* |
| [8] | *ONR, E-mail titled "Review of fuel operability report and SZB return to service (F&C perspective)", 23/03/2023, ONRW-2019369590-2070.* |
| [9] | *ONR, IR-52057, Civil Engineering RO18 Compliance Inspection.* |
| [10] | *ONR, IR-52177, Electrical engineering inspection of Sizewell B planned refuelling outage work activities18.* |
| [11] | *ONR, IR-52183, LC28/LC30 SZB Outage Mechanical Inspection.* |
| [12] | *ONR Assessment Report, AR-01049, Sizewell B Nuclear Power Station: Assessment of Structural Integrity in Support of the Restart Following the 2023 Periodic Shutdown, ONRW-2126615823-543.* |
| [13] | *ONR, IR-52090, Structural Integrity LC28 RO18 Outage Inspection.* |
| [14] | *NGL, EC370406 and supporting INSA statement, RO18 - Return to service justification following in service inspection, ONRW-2019369590-2267.* |
| [15] | *ONR, IR-52659, Sizewell B Reactor Outage 18 (RO18) Control & Instrumentation (C&I) Inspection.* |
| [16] | *ONR, IR-52158, Sizewell B RO18 Chemistry Intervention.* |
| [17] | *ONR-OFD-CR-22-887, Sizewell B – Refuelling Outage 18 – INA Early Outage Safety Review.* |
| [18] | *ONR, IR-52073, SZB RO18 IRR/LC18 Inspection.* |
| [19] | *ONR, IIS-51250, LC8 outage inspection.* |
| [20] | *ONR-OFD-CR-22-959, Sizewell B – Refuelling Outage 18 – Start-Up Meeting, ONRW-2019369590-2073.* |
| [21] | *E-mail from ONR SZB security inspector, RE: SZB Consent to re-start, 17/04/2023, ONRW-2019369590-2301.* |
| [22] | *E-mail from Environment Agency Site Inspector, RE: Sizewell B - Notice of No Objection to grant consent to start-up following RO18, 12/04/2023, ONRW-2019369590-2220.* |