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| ONR Project assessment report  Sizewell B Periodic Shutdown 2024 – Consent to start-up the reactor following refuelling outage 19 |



ONR Project assessment report

**Project name**: Sizewell B Periodic Shutdown 2024

**Report title**: Consent to start-up the reactor following refuelling outage 19

**Dutyholder/Applicant**: EDF Energy Nuclear Generation Limited (EDF NGL)

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# 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 licence number 106 for Sizewell B power station, has requested that we grant consent to start-up the reactor following its periodic shutdown, as required by licence condition 30(3) of said nuclear site licence.

**Background**

Sizewell B’s operating cycle lasts approximately 18 months, after which it is required to shutdown 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. Whilst some of these activities can safely take place when the reactor is operating at power, many of them require the reactor to be shutdown. The refuelling outages at Sizewell B provide the opportunity for undertaking such activities.

The requirement to shutdown 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”. We have specified that the licensee shall seek our consent to start-up the reactor at Sizewell B power station whenever it is shutdown under LC 30(1).

The reactor at Sizewell B was shutdown on 11 October 2024 for its nineteenth refuelling outage (RO19). With refuelling and all required EIMT now complete, the licensee has applied to us for consent to start-up the reactor.

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

The main requirements we seek 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 RO19 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
* Structural Integrity
* Control and Instrumentation

During RO19 the licensee has also carried out a non-routine inspection of the core barrel. This has also been considered by relevant 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. Our 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 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 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 non-routine inspection carried out during RO19 has also been considered by our inspectors to ensure these aspects support start-up of the reactor. No outstanding issues of significance have been identified by the licensee or ourselves that prevent start-up of the reactor following RO19.

**Recommendation**

We recommend that Licence Instrument 563 is issued, giving consent to start-up the reactor following RO19.

Table 1: List of abbreviations.

|  |  |
| --- | --- |
| Term/Acronym | Description |
| ALARP | As low as reasonably practicable |
| C&I | Control and Instrumentation |
| EC | Engineering Change |
| EDF NGL | EDF Energy Nuclear Generation Limited |
| EIMT | Examination, Inspection, Maintenance and Testing |
| EOSR | Early Outage Safety Review |
| INA | Independent Nuclear Assurance (who are NGL’s internal regulator) |
| INSA | Independent Nuclear Safety Assessment |
| LC | Licence Condition |
| LC 18 | Radiological Protection |
| LC 26 | Control and Supervision of Operations |
| LC 28 | Examination, Inspection, Maintenance and Testing |
| LC 30 | Periodic Shutdown |
| LI | Licence Instrument |
| NSSS | Nuclear Steam Supply System |
| ONR | Office for Nuclear Regulation |
| OPEX | Operational Experience |
| PSSR | Pressure Systems Safety Regulations |
| PWR | Pressurised Water Reactor |
| RI | Regulatory Issue |
| RO19 | Refuelling Outage 19 |
| RPV | Reactor Pressure Vessel |
| SSC | Structure, system and component |
| SQEP | Suitably Qualified and Experienced Persons |
| SZB | Sizewell B |
| TG1 | Turbine Generator 1 |
| TG2 | Turbine Generator 2 |

Table of contents

[Executive summary 4](#_Toc183434045)

[1. Permission requested 10](#_Toc183434046)

[2. Background 10](#_Toc183434047)

[3. Assessment and inspection work carried out by ONR in consideration of this request 11](#_Toc183434048)

[3.1. Assessment of the Licensee’s Readiness to Commence RO19 12](#_Toc183434049)

[3.1.1. Outage intentions meeting 12](#_Toc183434050)

[3.2. Outage Inspections and Assessments 13](#_Toc183434051)

[3.2.1. Fuel and Core 13](#_Toc183434052)

[3.2.2. Structural Integrity 13](#_Toc183434053)

[3.2.3. Control and Instrumentation 14](#_Toc183434054)

[3.2.4. Maintenance Standards 15](#_Toc183434055)

[3.3. Outage Safety Management 15](#_Toc183434056)

[3.3.1. Early Outage Safety Review 15](#_Toc183434057)

[3.3.2. Radiological Protection 16](#_Toc183434058)

[3.4. Start-Up Meeting 16](#_Toc183434059)

[3.5. Start-up Letter 17](#_Toc183434060)

[3.6. Return To Service Justification 17](#_Toc183434061)

[3.7. PSSR Competent Person 17](#_Toc183434062)

[3.8. Station INA Concurrence 17](#_Toc183434063)

[3.9. Civil Nuclear Security and Safeguards 18](#_Toc183434064)

[3.10. Engagement with other Governmental Agencies 18](#_Toc183434065)

[4. Matters arising from ONR’s work 18](#_Toc183434066)

[5. Conclusions 18](#_Toc183434067)

[6. Recommendations 19](#_Toc183434068)

[References 20](#_Toc183434069)

# Permission requested

1. EDF Energy Nuclear Generation Limited (EDF NGL), the operator and licensee of Sizewell B (SZB) nuclear power station, has requested us to (Ref. [1]) grant consent to start-up the reactor after its 2024 periodic shutdown for refuelling outage 19 (RO19). The request is in accordance with the licensee’s arrangements made under Licence Condition (LC) 30(3).
2. This report describes how we have 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 (PWR) 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, 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 shutdown 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 SZB, 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. Whilst some of these activities can safely take place when the reactor is operating at power, many of them require the reactor to be shutdown. The refuelling outages at SZB provide the opportunity for undertaking such activities. During RO19 a non-routine plant inspection of the core barrel was undertaken following the identification of core barrel defects at Robinson Unit 2 PWR, in the United States.
4. The requirement to shutdown 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”. We have specified that the licensee shall seek our consent to start-up the reactor at SZB whenever it is shutdown under licence condition 30(1).
5. The reactor at SZB was shutdown on 11 October 2024 for RO19. With refuelling and all required EIMT now complete, the licensee has applied for our consent to start-up the reactor.

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

1. The purposes of our 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; 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.

1. For start-up of the reactor we also need to be content with the adequacy of safety cases that support the consent, such as those justifying return to service following the core barrel inspection. These aspects also required assessment and inspection during the outage.
2. Our inspection and assessment work for RO19 was targeted on:

* non-routine outage work;
* aspects where regulatory intelligence suggests there may be a need for an inspection; and
* EIMT on structures, system and components (SSC’s) whose failure to deliver a safety function presents the most serious risks when the reactor is operational.

1. Based on this and the scope of work identified in the outage intentions document, we judged it proportionate to obtain advice from the following specialisms:
   * fuel and core
   * structural integrity
   * control and instrumentation (C&I)
   * site and project inspection oversight
2. Additionally a radiation protection inspector undertook an outage inspection to establish if the licensee’s statutory outage work programme was being conducted in compliance with the Ionising Radiations Regulations 2017.
3. Our inspection activity carried out can be summarised as follows:

* Assessment of the licensee’s readiness to commence the outage;
* Inspection and assessment of EIMT and safety cases required for reactor start-up;
* Assessment of the safety management of the outage; and
* Consideration of the licensee’s overall performance at the start-up meeting.

## Assessment of the licensee’s readiness to commence RO19

### Outage intentions meeting

1. The licensee’s planned outage work programme was outlined in the outage intentions document (Ref. [2]). This was examined by our inspectors in preparation for the outage intentions meeting which was held on 29 May 2024 (Ref. [3]). The meeting was attended by our RO19 project inspector.
2. At the outage intentions meeting, the licensee 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. We sought clarification on a number of minor issues which were subsequently satisfactorily addressed by the licensee.

## Outage inspections and assessments

### Fuel and Core

1. Reference [4] reports the findings of the fuel and core assessment of the cycle 20 core reload safety case. The review focussed on specific aspects of the cycle 20 core configuration that differ from previous cycles supporting the licensee’s claim that the generic safety case remains adequately bounding.
2. The inspector had no concerns with the licensee’s methodology or overall conclusions and they considered some assumptions to be conservative but adequately reflect industry best practices.
3. The inspector is content for ONR to grant consent to start-up the reactor (Ref. [5]).

### Structural Integrity

1. References [6], [7] and [8] report the findings from structural integrity inspection and assessment activities during RO19. The inspection and assessment activity targeted compliance with LC 28, the Pressure Systems Safety Regulations (PSSR) and assessment of safety cases required for return to service. The justification for returning to service with the international core barrel operating experience (OPEX) is discussed in Section ‎3.2.2.1.
2. The findings from structural integrity assessment and inspection activities during RO19 include:

* The inspector is satisfied that the inspections have been undertaken in line with the 2024 outage intentions documents, and that SZB have followed corporate procedures in the assessment and sentencing of inspection results and any defects or non-conformances are being dealt with appropriately;
* The inspector is satisfied that PSSR inspections and repairs are being adequately controlled in accordance with the licensee’s processes;
* The claims, arguments and evidence presented in the safety cases required for restart provide a robust justification for continued operation; and
* Inspection results for the core barrel, control rod drive mechanism thermal sleeves and stress corrosion cracking demonstrate an acceptable condition of plant for return to service.

1. Overall, the inspector judges that the licensee has undertaken sufficient inspection and assessment to support the safe return to service from a structural integrity perspective for the next operational period.
2. The inspector has no objections from a structural integrity perspective to ONR granting consent for start-up of SZB following RO19 (Ref [8]), subject to us receiving a number of documents.
3. The attachments to reference [1] contain the documentation that addresses the caveat on the recommendation. The structural integrity inspector has also confirmed there are no emergent issues that would prevent us granting consent to start-up the reactor (Ref. [9]).

#### Assessment of core barrel return to service safety case

1. During RO19 the licensee undertook a non-routine inspection of the SZB core barrel. This was a response to international OPEX from Robinson Unit 2 PWR where defects had been found in the core barrel during an inspection outage. This OPEX presents a potential challenge to structural integrity claims on the core barrel made within the SZB safety case.
2. The licensee justified continued operation to RO19 through reference [10], a category 1 safety case that was submitted to ONR for review and consideration under the licensee’s LC 22 arrangements. During RO19 an inspection of the core barrel upper girth weld and upper flange weld was carried out and inspection team members included those that had identified the defects at Robinson PWR. The inspections revealed no reportable indications and no evidence of in-service degradation for either weld. Therefore, SZB have submitted a justification to operate to RO21 (Ref. [11]) when a comprehensive inspection of the core barrel will take place. The inspection results and the arguments made in Refence [10] are used to underpin this justification for the continued operation of SZB.
3. Our inspectors from structural integrity and fault studies have considered references [10] and [11]. The inspectors have no objections to granting consent to start-up the reactor (Refs [8], [12], [13] and [14]). As the international OPEX from Robinson Unit 2 continues to develop there is a need to ensure the case for continued operation remains robust and risks are reduced ALARP. These aspects will be followed up as routine regulatory business following the return to service of SZB (RI-12280 will track this).

### Control and Instrumentation

1. Reference [15] reports the findings of a C&I LC 28 inspection during RO19. The inspectors sampled EIMT related activities on C&I equipment and systems important to nuclear safety.
2. They found the activities sampled to have been satisfactorily completed or on schedule to be completed. The inspector considered that the C&I system engineers had a good understanding of the systems and equipment they were responsible for and could clearly articulate the detail of the maintenance tasks sampled.
3. The inspector considered the plant operating conditions and lighting levels to provide an adequate working environment for maintainers and the inspector did not identify any significant signs of age-related degradation with respect to the items of C&I equipment examined.
4. During the inspection minor shortfalls were identified in the standard of housekeeping in the polar crane gantry area. This will be followed up as routine regulatory business (RI-12299 will track this).
5. Our inspector supports ONR granting consent to allow SZB to return to service.

### Maintenance standards

1. Reference [16] reports the findings of an RO19 outage inspection on maintenance standards by the nominated site inspector and the outage project inspector.
2. The inspection targeted RO19 outage maintenance activities being carried out by the licensee’s employees and its contract partners. The inspection focussed on compliance with LC 28 and LC 26.
3. The inspection sampled and observed aspects including:

* Start of shift and pre-job briefings
* Work pack documentation (including work order cards, maintenance instructions and safety documents)
* Workplace standards
* Test Equipment
* Field supervision
* Quality standards

1. Overall, the inspection judged that the licensee has adequately implemented its arrangements for compliance with LC 26 and LC 28. No issues were identified that would prevent us granting consent to Start-up.

## Outage safety management

### Early Outage Safety Review

1. The outage project inspector and a nuclear site health and safety inspector joined the licensee’s internal nuclear assurance (INA) team on their early outage safety review (EOSR) (Ref. [17]).
2. The purpose of the INA led EOSR is to identify performance shortfalls in the early stages of an outage to enable station management to reduce or eliminate undesirable behaviours and conditions which could have an adverse impact on outage safety.
3. 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.
4. The INA team identified three areas for improvements and three observations for improvement.  These included:

* Controls on plant important for nuclear safety defence in depth
* Controls on removed gratings and handrails to prevent injury
* Control of fire loading

1. The issues identified were accepted by the station lead team and commitment was given to act on them. 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 RO19. 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 RO19. No matters of safety significance were identified and no issues that would prevent granting consent to start-up the reactor.

## Start-up meeting

1. The start-up meeting (Ref. [19]) was held on 5 November 2024 and was chaired by the station technical and safety support manager with presentations from the outage programme leads. Our attendance at the start-up meeting consisted of an operating reactors sub-division superintending inspector, the nominated site inspector, the RO19 project inspector and an operating reactors security 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 of key outage work areas. There were no issues identified that would prevent the start-up of the SZB reactor noting that the licensee had EIMT activities to complete and our assessment activities remained ongoing.

## Start-up letter

1. The station director has asked for our 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 SZB following an outage.

## Return to service justification

1. The licensee’s justification to return SZB to service following the in-service inspections and associated assessments is set out in EC 373565 (Attachment 5 of reference [1]). It confirms that the In-Service Inspections undertaken in RO19 have been appropriately carried out, assessed and accepted and that any repairs and adjustments necessary for the safe return to service of the reactor and turbine generator 2 (TG2) have been completed. This is supported by the INSA approval statement (Attachment 5 of reference [1])
2. TG1 remains on outage at the time of granting consent to start-up the reactor and is excluded from the version of EC 373565 that has been provided with reference [1]. The licensee intends to subsequently update EC373565 to justify return to service of TG1. We are content that this that this does not affect our decision to grant consent to start-up the reactor.

## 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 for the nuclear island and TG2. 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.
2. As TG1 remains on outage the report from the PSSR competent person for TG1 is not available due to outstanding examinations. We are content that this aspect does not affect our decision to grant consent to start-up the reactor.

## 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 significant issues of concern.

## Civil Nuclear Security and Safeguards

1. In addition to the nuclear safety assessments identified, we sought the opinion of our SZB site security inspector, to understand if there were any aspects of the periodic shutdown that may impact on our decision to give consent to start-up the reactor. The security inspector confirmed (Ref. [20]) that they have no objections to granting consent to start-up the reactor.

## Engagement with other governmental agencies

1. Before giving consent, it is established practice to notify other competent regulatory authorities of our intention to ensure there are no specific objections that may compromise other regulatory requirements. The Environment Agency site inspector has confirmed that they have no objections to us granting consent to start-up the reactor (Ref. [21]).

# Matters arising from ONR’s work

1. There are no outstanding matters arising from our inspection and assessment work carried that would prevent granting consent to start-up SZB after RO19.
2. Residual issues that do not prevent us from granting consent to start-up the SZB reactor will be followed up through normal regulatory business.

# Conclusions

1. The SZB periodic shutdown, RO19, 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 SZB station director writing to us requesting consent to start-up the reactor. The letter stated that subject to the completion of the remaining outage activities, the station director 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. Our inspectors have sampled the safety management and engineering activities throughout the outage and judged them to be adequate. All inspectors either support, or have no objection to, issuing consent to start-up the reactor.
6. We consider that the licensee delivered an outage that was safely managed and completed the required safety related work activities. We are 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. We recommend that Licence Instrument 563 be issued, giving consent to start-up the Sizewell B reactor.
2. We recommend informing EDF NGL that our review and consideration of the following EC has been completed and that EDF NGL may implement the EC in accordance with their own arrangements

* EC 373769, Justification for Continued Operation of the RPV Core Barrel to RO19 Following OPEX of Core Barrel Cracking at Robinson, Rev 0 Version 5 (see PR-01702)

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|  |  |
| --- | --- |
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| [21] | *E-mail from EA Site Inspector, RE: Sizewell B - Notice of No Objection to ONR granting consent to start-up following RO19, 21/11/2024, ONRW-2019369590-14912.* |
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