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| ONR Project assessment report  Heysham 2 – reactor 7 periodic shutdown S13R7 |



ONR Project assessment report

**Project name**: Heysham 2

**Report title**: reactor 7 periodic shutdown S13R7

**Dutyholder/Applicant**: EDF Energy Nuclear Generation Limited

**Authored by**: Project Inspector, ONR

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# Executive summary

**Title**

Heysham 2 reactor 7, periodic shutdown S13R7

**Permission Requested**

EDF Energy Nuclear Generation Limited (the licensee) has asked us for consent to start-up Heysham 2 reactor 7 after the S13R7 periodic shutdown.

**Background**

The nuclear site licence for Heysham 2 requires the licensee to shutdown any plant or process for the purpose of Examination, Inspection, Maintenance or Testing (EIMT) in accordance with the requirements of the plant maintenance schedule. The maintenance schedule preface specifies that reactor periodic shutdowns (referred to by the licensee as statutory outages) take place after a maximum period of three calendar years from consent to start-up after the previous periodic shutdown.

We gave consent to start-up reactor 7 after its last periodic shutdown on 9 September 2021. Therefore, it was required to shutdown on or before 9 September 2024. However, in order to avoid a conflict with the Sizewell B periodic shutdown, we gave our agreement to extend the operating period of reactor 7 until no later than 9 February 2025. Reactor 7 was shutdown on 13 January 2025 for its periodic shutdown (denoted as S13R7) with a planned duration of 85 days.

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

The documentation produced by the licensee for the S13R7 periodic shutdown and the EIMT of structures, systems and components important to nuclear safety have been assessed and inspected by our specialist inspectors in graphite integrity, structural integrity, electrical engineering, control and instrumentation, mechanical engineering and civil engineering.

The Environment Agency was consulted and did not have any objections to us granting consent for reactor 7 to start-up. Our civil nuclear security were also consulted and had no security concerns regarding the start-up of Reactor 7.

**Matters arising from ONR's work**

There are no outstanding matters arising from our assessment and inspection activities.

**Conclusions**

Our assessment and inspections of the Heysham 2 reactor 7 have concluded that:

* the EIMT requirements specified in plant maintenance schedule in support of LC30 have been complied with;
* the EIMT has been carried out by suitably qualified and experienced persons, with an appropriate level of supervision and quality assurance commensurate with the equipment’s safety function; and
* safety issues identified by the licensee during the shutdown have been adequately addressed with suitable and sufficient safety justification that the relevant safety case limits and conditions are not challenged.

We are content that all necessary work has been completed, subject to those activities that must be delayed until the reactor is pressurised or will be carried out during the restart. The remaining information will be reported to us in the 28-day report, or in specific documents that are not required prior to granting consent.

In conclusion, we have not identified any matters that would prevent us from granting consent for Heysham 2 reactor 7 to start-up after the S13R7 periodic shutdown.

**Recommendation**

We should issue licence instrument 644 under LC 30 (3) for nuclear site licence number 60, to give consent to start-up Heysham 2 reactor 7 after the S13R7 periodic shutdown.

Table 1: List of abbreviations.

| Term/Acronym | Description |
| --- | --- |
| ALARP | As low as reasonably practicable |
| APEX | Appointed Examiner |
| EC | Engineering Change |
| EIMT | Examination, Inspection, Maintenance or Testing |
| HYB | Heysham 2 |
| INA | Independent Nuclear Assurance |
| INSA | Independent Nuclear Safety Assessment |
| KWR | Keyway Root |
| LC | Licence Condition |
| ONR | Office for Nuclear Regulation |
| PCPV | Pre-stressed Concrete Pressure Vessel |
| PSSR | Pressure Systems Safety Regulations 2000 |
| R7 | Reactor 7 |
| SQEP | Suitably Qualified and Experienced Persons |
| SSC | Structure, System and Component |

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# Permission requested

1. EDF Energy Nuclear Generation Limited (the licensee) has asked for our [1] consent to start-up Heysham 2 (HYB) reactor 7 (R7) in accordance with its arrangements under Licence Condition (LC) 30, periodic shutdown.

# Background

1. The nuclear site licence for HYB requires the licensee to shutdown any plant or process for the purpose of Examination, Inspection, Maintenance or Testing (EIMT) in accordance with the requirements of the plant maintenance schedule (referred to in LC 28). The HYB maintenance schedule preface (an approved document under LC 28 (4)) specifies that reactor periodic shutdowns (referred to by the licensee as statutory outages) take place after a maximum period of three calendar years from consent to start-up after the previous periodic shutdown.
2. We gave consent to startup R7 after its last periodic shutdown on 9 September 2021. Therefore, it was required to shutdown on or before 9 September 2024. However, in order to avoid a conflict with the Sizewell B periodic shutdown, we gave our agreement to extend the operating period of R7 until no later than 9 February 2025.
3. R7 was shutdown on 13 January 2025 for its periodic shutdown (denoted as S13R7) with a planned duration of 85 days. The licensee’s outage intentions document [2] set out the scope of plant inspections, EIMT requirements, plant and pressure circuit inspection strategy and other work that will be carried out in support of safety. It also identified the licensee’s arrangements for managing safety and quality during the shutdown.

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

1. In accordance with the regulatory permissioning strategy (PR-01869), our regulation of the outage involved detailed assessments and inspections by specialist inspectors and oversight by the project inspector. Our assessments and inspections have focused on confirming 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 the equipment’s safety function; and
* safety issues identified by the licensee during the shutdown have been adequately addressed with suitable and sufficient safety justification provided to allow a regulatory judgement to be made in support of restart of the reactor.

1. Based on the scope of work identified in the outage intentions document, advice from the following disciplines was sought:

* graphite structural integrity
* steel structural integrity
* electrical engineering
* control and instrumentation
* mechanical engineering
* civil engineering

1. The assessments and inspections were undertaken in accordance with our technical assessment and inspection guidance. The following sections provide summaries of the assessment and inspection findings for each technical discipline which have informed our recommendation to grant consent to start-up HYB R7.

## Graphite integrity

1. Reference [3] reports the findings of our graphite structural integrity assessment and inspection of the HYB S13R7 periodic shutdown.
2. The inspector considered the implications of the licensee’s fuel channel inspection results and whether they could challenge the relevant graphite safety case limits.
3. The scope of the licensee’s inspection activities consisted of:

* visual and dimensional inspection of a minimum of 25 fuel channels;
* trepanning of a minimum of 24 graphite specimens, with a target of 30 samples;
* visual and dimensional inspection of one control rod channel;
* inspection of three faces of the peripheral shield wall; and
* inspection of six channels with the eddy current inspection tool.

1. The inspections found 91 full height axial cracks, 89 of which were keyway root (KWR) initiated and two were bore initiated. In the inspectors opinion, the findings suggest that the licensee’s predictive model (CrackSim) may be underpredicting the reactor core state as the inspection results were at the high-end of expectations. However, the inspector was content that the current safety case analyses remain bounding and its claims can be respected for a further period of operation until the next planned inspection. The inspector has raised a level 3 regulatory issue (ONR-12467) to address confidence in the licensee’s ability to forecast the accumulation of graphite fuel brick cracking.
2. The inspector noted that the return to service engineering change documents (EC) were not complete at the time of their assessment. The inspector recommended that project inspector confirms that the Independent Nuclear Safety Assessment (INSA) statements for the return to service EC and graphite inspections EC have been made available by the licensee and are in agreement.
3. The project inspector has received and is content with this information (refer to sections 3.12 and 3.13).
4. The inspector was content that the findings of the graphite inspections did not challenge the existing graphite safety case and had no objection to us granting consent to start-up HYB R7.

## Structural integrity

1. Reference [4] reports the findings of our steels structural integrity assessment of the HYB S13R7 periodic shutdown.
2. The inspector targeted the licensee’s component life assessments, reactor internals inspections, gas circulator inspections, decay heat boiler flash vessel flange failure, water hammer, materials and weld inspections, corrosion, flow assisted corrosion, sea water systems, restraints and hangers and compliance with the Pressure Systems Safety Regulations 2000 (PSSR).
3. The inspector was satisfied that the licensee was adequately controlling and monitoring the inspection programme; and that the inspections had been undertaken in compliance with the outage intentions document and reactor internals proposals document.
4. The inspector was content that the licensee was complying with corporate procedures for the selection, assessment and sentencing of component inspections and subsequent results.
5. The inspector noted that some assurances were not available at the time of their assessment and recommended that we should also obtain the following information to demonstrate that:

* the periodic shutdown inspection programme and sentencing of actions through the outage assessment panel has been completed satisfactorily. The licensee should submit the INSA certificate for the return to service EC report as part of the licensee’s application for consent to return to service;
* the PSSR inspections have been completed satisfactorily and no concerns have been raised. The licensee should submit a return to service statement from the third-party Competent Person as part of the licensee’s application for consent to return to service; and
* the inspections not covered by the Appointed Examiner and third-party PSSR Competent Person have been completed satisfactorily. The return to service Engineering Change report must include a statement from the licensee’s second party PSSR Competent Person supporting the fitness for return to service.

1. The project inspector has received and is content with this information (refer to sections 3.12, 3.15 and 3.16).
2. In addition the inspector recommended that the project inspector should obtain confirmation from the structural integrity inspector that no emergent issues, relating to structural integrity, have been identified since completion of this assessment report that would prevent HYB R7 from returning to service. The project inspector has confirmed [5] the specialist inspector has confirmed that there are no outstanding issues that would prevent HYB R7 returning to service.
3. The specialist inspector judged that the licensee had undertaken sufficient inspection and assessment, from a structural integrity perspective, to fulfil the arrangements laid down by LC 28 and did not raise any objections to us granting consent to start-up HYB R7.

## Electrical engineering

1. Reference [6] reports the findings of our electrical engineering inspection of the HYB S13R7 periodic shutdown.
2. The inspector targeted the electrical engineering structures, systems and components (SSCs) that were being maintained, and sampled the following:

* inspection and observation of the actual condition of SSCs including; 400 kV equipment, generators and unit transformers, essential supplies systems, protection systems and uninterruptable power supplies;
* maintenance schedule activities specifically related to: gas circulators; essential supplies systems; variable frequency convertor and variable speed drive; and
* a review of the station's:
  + SSCs examination, inspection, maintenance and test schedule;
  + progress against the station’s S13R7 statutory outage plan;
  + significant emergent electrical engineering issues, where applicable, and any resultant resolution;
  + completed S13R7 statutory outage work activity documentation;
  + activity deferrals, where applicable; and
  + S13R7 statutory outage scheduled electrical engineering changes, where applicable.

1. The inspector was satisfied with the condition of the electrical equipment observed, the management of emergent issues and completion of maintenance records. The inspector did not identify any significant shortfalls with the implementation of the established arrangements for LC 28 in relation to the planned electrical work undertaken as part of the periodic shutdown.
2. The inspector did not identify any issues that would prevent us granting consent to start-up HYB R7.

## Control and instrumentation

1. Reference [7] reports the findings of our control and instrumentation inspection of the HYB S13R7 periodic shutdown.
2. The inspection sampled control and instrumentation related EIMT activities associated with the following systems and equipment:

* safety circuits;
  + guardlines;
  + neutron flux detectors;
* control rod control system;
* reactor post trip sequencing equipment;
* secondary shutdown system;
* gas circulators;
* chloride ingress protection system;
* nuclear safety related thermocouples; and
* data processing and control system.

1. The inspector was satisfied that the activities sampled had been satisfactorily completed and based on the information provided, that the outstanding EIMT activities would be completed satisfactorily.
2. The inspector raised a level 4 regulatory issue (RI-12478) relating to the recording of as found condition codes. The inspector did not consider that this posed an immediate or significant risk to nuclear safety or needed to be addressed before R7 returns to service.
3. Overall, the inspector did not identify any significant issues and supported us granting consent to start-up HYB R7.

## Mechanical engineering

1. Reference [8] reports the findings of our mechanical engineering inspection of the HYB S13R7 periodic shutdown.
2. The inspector targeted the following areas based on their contribution to nuclear safety:

* gas circulators;
* circulator auxiliary cooling systems;
* main boiler isolation valves; and
* reactor gas safety relief valves.

1. The inspector identified a minor shortfall in compliance with the licensee’s corporate guidance on the management of fasteners. However, they did not consider this to be a return to service issue, and raised a level 4 regulatory issue (RI-12441) to track the licensee’s actions through routine regulatory engagements.
2. Overall, the inspector was satisfied that the licensee had adequately demonstrated its mechanical engineering EIMT implementation and arrangements. The inspector did not identify any issues that would prevent us granting consent to start-up HYB R7.

## Civil engineering

1. Reference [9] reports the findings of our civil engineering assessment of the HYB S13R7 periodic shutdown.
2. The inspector targeted the surveillances, inspections and tests of safety related components of the HYB R7 Pre-stressed Concrete Pressure Vessel (PCPV), reported in the Appointed Examiner’s (APEX) report, including:

* concrete surface condition visual inspection;
* pre-stressing anchorage visual inspections;
* tendon load testing;
* pre-stressing tendon strand inspections;
* pre-stressing tendon strand material testing and tensile testing;
* settlement and tilt survey;
* top cap deflection survey;
* PCPV support bearing visual inspections;
* APEX reviews of the following measurements and activities:
  + embedded strain gauge readings;
  + vessel concrete temperature measurements;
  + reactor coolant leakage; and
  + PCPV leaks.

1. The inspector did not find any significant shortfalls in the surveillances and inspections reported by the appointed examiner. However, the inspector raised a level 4 regulatory issue (RI-12460) associated with the licensee’s PCPV leak management oversight and governance arrangements.
2. The inspector was content to support granting consent to start-up HYB R7 for the next operating period.

## Early outage safety review

1. We observed the early outage safety review [10] conducted by the licensee’s internal nuclear assurance team. The review focused on nuclear safety and involved observation of outage related activities and daily outage meetings, and interviews with licensee and contract staff.
2. The review identified three areas for improvement associated with:

* access / egress and dropped objects;
* testing of portable electrical equipment and pre-use checks; and
* quality of work packs and procedural use and adherence

1. In addition, two opportunities for improvement were identified associated with:

* defence in depth meeting; and
* operational focus meeting

1. The HYB management team responded positively to the findings and committed to implement appropriate corrective actions.

## Events and emergent issues

1. Two events with the potential to challenge nuclear safety have been reported during the outage in accordance with the licensee’s arrangements under LC 7, incidents on the site.
2. During the planned post trip loss of grid testing, the loss of a 415V essential uninterruptable power supply resulted in the loss of supply to the 7C gas circulators, which because of continuing decay heat boiler feed to the quadrant resulted in water hammer in the decay heat boiler system. This caused a gasket failure of a flange joint and the subsequent steam leak in the vicinity. The steam leak was significant enough to require a complete shutdown of the decay heat system and entry into an immediate technical specification action condition for non-compliance with shutdown cooling mode 1. An event recovery organisation was set-up for initial investigation and repair.
3. This event was reported in incident report INF-4781, which was followed-up by the nominated site inspector, with support from electrical engineering and structural integrity specialists. The site inspector was content with the licensee’s response and management of the event, and will monitor progress through the incident reporting process.
4. During the ‘in air’ window, elevated reactor vessel moisture levels were detected. In addition, ‘yellow’ staining was observed in the sub boiler annulus during a thermal shield inspection.
5. The licensee’s investigations have concluded that the deposit arose from a mal-operation of the boiler dry-out operation and/or the purge air system. This resulted in a mixture of boiler water, corrosion products and purge air drier elements, entrained in the purge air pipework have being introduced into the reactor vessel. The licensee’s analysis found that the material is compatible with the reactor and does not challenge the existing safety case.
6. This event was reported in incident report INF-4909, which was followed-up by the nominated site inspector, with support from chemistry, graphite integrity, structural integrity and fuel and core specialists who were satisfied with the licensee’s conclusions. The site inspector was content with the licensee’s response and management of the event, and will monitor progress through the incident reporting process.
7. During reassembly of the turbine generator 7 ‘y’ side top half intermediate pressure inlet steam pipe, one of the fasteners sheared, at approximately half of the specified torque setting.
8. In response, the licensee established an event recovery organisation and entered its safety case anomalies process. The licensee’s investigations attribute the failure to mal-operation of heating equipment during installation/removal/re-tightening, leading to elevated temperature resulting in a vulnerable microstructure in the fastener. This caused a cleavage fracture which was initiated from a pre-existing crack.
9. The licensee’s safety justification [11] is supported by a technical assurance note [12] and industrial safety risk assessment [13]. These have been reviewed by our structural integrity inspector who is satisfied [5] with the licensee’s response and has no objection to HYB R7 returning to service.

## Start-up meeting

1. The start-up meeting [14] was held on 12 March 2025 and was chaired by the Technical and Safety Support Manager. The licensee presented a summary of the outage safety and technical performance. No issues that would prevent the start-up of R7 were identified.

## Start-up letter/request to start

1. The station director has requested our consent to start-up HYB R7 under LC 30(3) [1]. The station director has confirmed that with the exception of activities required for start-up, all maintenance, operational training and recommissioning activities have been adequately completed to enable R7 to be returned to service safely.

## Maintenance schedule exceptions list and safety justification

1. The licensee has confirmed [15] that all the required maintenance schedule examinations, inspections, maintenance and testing are complete, with the exception of work requiring the reactor to be at power, controlled under the licensee’s arrangements.

## Return to service justification

1. The licensee’s justification to restart HYB R7 following the in-service inspections and associated assessments is set out in EC 374145 [16] which is supported by the INSA approval statement [13]. It confirms that, R7 is in an acceptable condition for return to service and subsequent period of operation.

## Graphite core inspections

1. The licensee’s justification to restart HYB R7 following the graphite core inspections is set out in EC 376641 [17] which is supported by the INSA approval statement [18]. It confirms that the inspection of the graphite core has been completed in accordance with the requirements of the outage intentions document and the graphite assessment panel has confirmed that the results are within the accepted boundaries of the graphite safety case.

## Appointed examiner statement - concrete pre-stressed pressure vessel

1. The Appointed Examiner has confirmed [19] that the required maintenance schedule inspections for the PCPV have been completed and that it is satisfactory for return to service subject to normal in-service surveillance.

## Appointed examiner statement - reactor penetrations examinations

1. The licensee has reported the outcome of the HYB R7 PCPV penetrations thorough examination [20], required by the PSSR written scheme of examination. The penetrations were assessed as being in a satisfactory condition, with no significant challenges to integrity identified and suitable for continued service.

## Appointed examiner statement – PSSR

1. The licensee has submitted a statement with respect to the inspections performed in accordance with PSSR during the shutdown from their independent third party PSSR Competent Person [21] (Bureau Veritas). The statement confirms that there are no changes to plant operating conditions or reductions in inspection intervals as referenced in the written schemes of examination.

## Independent nuclear safety

1. The licensee’s Independent Nuclear Assurance (INA) have provided oversight of the outage through their concurrence process. INA will issue a concurrence statement when they are satisfied that the outage activities have been adequately conducted and, as far as can be established, the associated risks to start-up and continued operation are acceptable and ALARP.
2. INA have confirmed [22] that there are no issues that present a threat to start-up or continued operation, noting that the concurrence statement cannot be issued until work requiring the reactor to be at full power has been completed. The licensee’s arrangements provide a suitable hold point in the start-up process to confirm the concurrence statement has been provided.

## Civil nuclear security

1. Our civil nuclear security site inspector has been consulted, to understand if there were any aspects of the periodic shutdown that may have an impact on the decision to grant consent to start-up HYB R7. The inspector [23] has not identified any issues that would impact on the decision to grant consent to start-up HYB R7.

## Engagement with other governmental agencies

1. Before issuing a Licence Instrument it is established practice to notify other competent regulatory authorities of our intentions to ensure that there are no specific objections that may compromise other regulatory requirements. The Environment Agency site inspector was informed that we intended to grant consent to the restart of HYB R7 and confirmed [24] that they had no objections.

# Matters arising from ONR’s work

1. There are no outstanding matters arising from our assessment and inspection activities.

# Conclusions

1. Based on the evidence gathered, we are satisfied that:

* the EIMT requirements specified in the maintenance schedule in support of LC30 have been complied with;
* the EIMT has been carried out by SQEPs, with an appropriate level of supervision and quality assurance commensurate with the equipment’s safety function; and
* safety issues identified by the licensee during the shutdown have been adequately addressed with suitable and sufficient safety justification that the relevant safety case limits and conditions are not challenged.

1. We are content that all necessary work has been completed, subject to those activities that must be delayed until the reactor is pressurised or will be carried out during the restart. The remaining information will be reported to us in the 28-day report, or in specific documents that are not required prior to granting consent.
2. In conclusion, we have not identified any matters that would prevent granting consent for HYB R7 to start-up after the S13R7 periodic shutdown.

# Recommendations

1. We should issue licence instrument 644 under LC 30 (3) for nuclear site licence number 60, to give consent to start-up Heysham 2 reactor 7 after the S13R7 periodic shutdown.

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|  |  |
| --- | --- |
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| [3] | *Heysham 2 reactor 7 S13R7 periodic shutdown, Structural Integrity Assessment of the Graphite Core Inspection Findings, AR-1641, ONRW-2126615823-5994.* |
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| [5] | *ONR structural integrity inspectors advice on Heysham 2 Reactor 7 periodic shutdown S13R7 - email dated 9 April 2025, ONRW-2019369590-19468.* |
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| [12] | *DA\_FEGO\_EA\_25\_029\_revA Technical Assurance Note Implications of HYB U7 IP Stud Failure for Fleetwide Conventional Safety, ONRW-2019369590-19403.* |
| [13] | *HB/REPS/SS108 TG7 IP inlet flange ‘Y’ side upper sheared fastener Industrial Safety Risk Assessment, ONRW-2019369590-19404.* |
| [14] | *Heysham 2 reactor 7 S13R7 periodic shutdown, Appendix 1 - S13R7 Start Up Meeting Minutes, ONRW-2019369590-18897.* |
| [15] | *Heysham 2 reactor 7 S13R7 periodic shutdown, Appendix 2 - MS Completion Certificate, ONRW-2019369590-18898.* |
| [16] | *Heysham 2 S13R7 (R7 2025) Statutory Outage Approval of Inspection Results, EC 374145, ONRW-2019369590-19314.* |
| [17] | *Justification for Return to Service of Heysham 2 Reactor 7 Following the Graphite Core Inspections at the 2025 Periodic Shutdown, EC 376641, ONRW-2019369590-18905.* |
| [18] | *Justification for Return to Service of Heysham 2 Reactor 7 Following the Graphite Core Inspections at the 2025 Periodic Shutdown, EC 376641, INSA Approval Statement, ONRW-2019369590-18906.* |
| [19] | *Heysham 2 reactor 7 S13R7 periodic shutdown, Appendix 5 - HYB R7 2025 PCPV MS Completion Certification, ONRW-2019369590-18900.* |
| [20] | *Heysham 2 reactor 7 S13R7 periodic shutdown, Appendix 6 - HYB R7 Thorough Exam 2025 CP Letter (NT) to SD (MC), ONRW-2019369590-18901.* |
| [21] | *Heysham 2 reactor 7 S13R7 periodic shutdown, Appendix 7 - Appointed Examiner Statement PSSR - 2025 Statutory Outage S13R7 - Bureau Veritas Letter, ONRW-2019369590-19134.* |
| [22] | *Heysham 2 reactor 7 S13R7 periodic shutdown, Appendix 11 - S13R7 INA Memo 2025, ONRW-2019369590-18902.* |
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