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| ONR Project Assessment Report  Heysham 1 – Periodic Shutdown R1 027 2023 |



ONR Project Assessment Report

**Project Name**: Heysham 1

**Report Title**: Periodic Shutdown R1 027 2023

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

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# Executive Summary

**Title**

Heysham 1, Periodic Shutdown R1 027 2023

**Permission requested**

EDF, Energy Nuclear Generation Limited the ‘licensee of Heysham 1 nuclear power station, has written to the Office for Nuclear Regulation (ONR) asking for consent to start-up reactor 1 after completing its 2023 periodic shutdown.

**Background**

The nuclear site licence for Heysham 1 requires the licensee to periodically shutdown any plant or process to enable examination, inspection, maintenance and testing (EIMT) to take place. ONR has specified that the licensee must obtain consent from them before the start-up of a reactor after it is shutdown, which takes place every three years for an Advanced Gas-Cooled Reactor (AGR), as specified in the maintenance schedule preface.

ONR gave consent to start-up reactor 1 after its last periodic shutdown on 31 December 2020 (Licence Instrument 631) and it was therefore required to shutdown on or before 31 December 2023. The 2023 periodic shutdown, identified as 027, started on 2 October 2023, with a planned duration of 69 days.

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

The documentation produced by the licensee for the periodic shutdown and the EIMT of structures, systems and components important to nuclear safety has been assessed by ONR specialist inspectors in: graphite, structural integrity, electrical engineering, control & instrumentation, mechanical engineering, civil engineering and chemistry.

ONR’s inspection and assessment during the shutdown has focused on confirming that:

* The EIMT requirements specified in the station’s maintenance schedule in support of LC30 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 equipment’s safety function.
* 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.

The Environment Agency has been consulted and does not object to ONR issuing a Licence Instrument granting consent for reactor 1 to start-up following its periodic shutdown. ONR civil nuclear security has also been consulted and have no security concerns regarding the start-up of reactor 1.

**Matters arising from ONR's work**

There are no outstanding issues preventing the return to service of Heysham 1 reactor 1. 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 reactor 1. Some minor residual issues will be followed-up through routine business.

**Conclusions**

ONR’s inspection and assessment of the Heysham 1 reactor 1 2023 periodic shutdown 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. No outstanding issues of significance have been identified by the licensee or ONR that prevent the start-up of reactor 1 following its periodic shutdown.

**Recommendation**

ONR issue Licence Instrument 641, granting consent to start-up Heysham 1 Reactor 1 after the 027 periodic shutdown.

Table : List of abbreviations

| Term/Acronym | Description |
| --- | --- |
| AGR | Advanced Gas-Cooled Reactor |
| ALARP | As low as reasonably practicable |
| APEX | Appointed Examiner |
| BCU | Boiler Closure Unit |
| CNSS | Civil Nuclear Security (ONR) and Safeguards |
| EC | Engineering Change |
| EIMT | Examination, Inspection, Maintenance or Testing |
| ESS | Emergency Seawater System |
| FME  GAP | Foreign Material Exclusion  Graphite Assessment Panel |
| HOW2 | (Office for Nuclear Regulation) Business Management System |
| HYA | Heysham A |
| INA | Independent Nuclear Assurance |
| INSA | Independent Nuclear Safety Assessment |
| KWRC | Keyway Root Crack |
| LC | Licence Condition |
| OAP | Outage Assessment Panel |
| ONR | Office for Nuclear Regulation |
| PCPV | Pre-stressed Concrete Pressure Vessel |
| PSSR | Pressure Systems Safety Regulations 2000 |
| R1 | Reactor 1 |
| SQEP | Suitably qualified and experienced persons |
| SSC | Structure, System and Component |

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# Permission Requested

1. EDF has asked ONR [1] for consent to start-up Heysham 1 (HYA) reactor 1 (R1) in accordance with its arrangements under Licence Condition (LC) 30: periodic shutdown.

# Background

1. The HYA nuclear site licence requires any plant or process to be shutdown in accordance with the requirements of the plant maintenance schedule (referred to in Licence Condition 28) for the purpose of examination, inspection, maintenance or testing (EIMT) to take place.
2. The HYA maintenance schedule preface (an approved document under LC 28 (4)) specifies that periodic reactor shutdowns take place every three years. ONR has specified under LC 30 (3) that the licensee requires ONR’s consent to start-up a reactor after its shutdown in compliance with LC 30 (1).
3. ONR gave consent to start-up R 1 after its last periodic shutdown on 31 December 2020 (Licence Instrument 631) and it was therefore required to shutdown on or before 31 December 2023. The 2023 periodic shutdown, identified as 027, started on 2 October 2023, with a planned duration of 69 days.
4. The licensee’s outage intentions document [2] sets out the scope of plant inspections, EIMT requirements, plant and pressure circuit inspection strategy and other work to be carried out in support of safety. It also identifies 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 plan ONR’s regulation of the outage involved detailed inspections and assessments by several specialist inspectors along with more general inspections undertaken by the project inspector. ONR’s inspections and assessments 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.
* 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
* chemistry

1. The inspections and assessments have been undertaken in accordance with ONR Technical Inspection and Assessment Guidance. The following sections provide summaries of the inspection and assessment findings for each technical discipline which have informed the recommendation to grant consent to start-up HYA R1.

## Graphite structural integrity

1. Reference [3] reports the findings of ONR’s graphite structural integrity inspection and assessment of the HYA R1 027 periodic shutdown.
2. The inspector targeted the licensee’s examination and inspection of the HYA R1 graphite core and peripheral bricks.
3. The scope of the licensee’s inspection activities consisted of:

* inspection of a minimum of 20 fuel channels, visually and dimensionally;
* trepanning of a minimum of 30 graphite specimens, with a target of 36 samples;
* visual inspection of one control rod channel; and
* eddy current inspection of 6 channels.

1. The fuel channel inspections found one full height axial crack which was sentenced as a Keyway Root Crack (KWRC). This is the first KWRC observed across the reactors at HYA and Hartlepool, although such cracking has been predicted and expected to occur at this stage in the life of these units. Prior to the outage, ONR had engaged with the licensee on the implications of KWR cracking at HYA, hence the observation was within the pre-outage forecast and not unexpected.
2. The inspector noted that the return to service engineering change (EC) documents were not complete at the time of their assessment. The inspector recommended that the project inspector confirms that the Independent Nuclear Safety Assessment (INSA) statements for EC 373746 has been made available by the licensee and is in agreement with the views in the EC.
3. The project inspector has received and is content with this information (refer to sections 3.8.8)
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 ONR granting consent for HYA R1 to return to service.

## Steels structural integrity

1. Reference [4] reports the findings of ONR’s steels structural integrity inspection and assessment of the HYA R1 027 periodic shutdown.
2. The inspector targeted the adequacy of the inspections of welds, metallic reactor internal structures and components, essential cooling water system, pipe hangers and thermal movement survey and compliance with Pressure Systems Safety Regulations (PSSR) 2000.
3. The inspector was satisfied with the proposed inspection programme; that inspections had been undertaken in line with the outage intentions document and that assessment and sentencing of inspection results had followed corporate procedures. The inspector is satisfied that changes to the inspection scope have been sentenced appropriately and in accordance with the licensee’s arrangements.
4. The inspector recommended that ONR should grant consent for start-up of HYA R1, subject to ONR receiving the following information to demonstrate:

* The periodic shutdown inspection programme and sentencing of actions through the OAP has been completed satisfactorily. The INSA certificate for the return to service EC, submitted 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.
* The inspections not covered by the Appointed Examiner and third-party PSSR Competent Person have been completed satisfactorily. The return to service EC 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 subsequently received and is content with this information (refer to sections 3.8.7, 3.8.10 and 3.8.11).

## Electrical engineering

1. Reference [5] reports the findings of ONRs electrical engineering inspection of the HYA R1 027 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, 400 kV and 23 kV system, generators and unit transformers, unit aux transformers, essential supplies systems, switchboards, cooling water pump motors, temporary electrical supplies.
* Maintenance schedule activities specifically related to: gas circulators; essential supplies systems; reactor shutdown sequencing equipment/post trip sequencing equipment.
* A review of the station's:
  + SSCs examination, inspection, maintenance and test schedule;
  + progress against the station’s R1 2023 statutory outage plan;
  + significant emergent electrical engineering issues, where applicable, and any resultant resolution;
  + completed R1 2023 statutory outage work activity documentation;
  + activity deferrals, where applicable; and
  + R1 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 ONR granting consent for HYA R1 to return to service.

## Control and instrumentation

1. Reference [6] reports the findings of ONR’s control and instrumentation inspection of the HYA R1 027 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 logic system;
* Gas circulators;
* Data processing and control system;
* Make-up water treatment plant / chloride ingress protection system / condensate polishing plant;
* Pressure vessel cooling water system; and
* In-core and boiler thermocouples.

1. The inspector was satisfied that the activities sampled had either been satisfactorily completed or were on schedule to be completed satisfactorily based on the information provided.
2. The inspector raised a level 4 regulatory issue relating to obsolescence management of chloride ingress protection system conductivity probes, and identified a small number of minor maintenance record keeping shortfalls. The inspector did not consider that these posed an immediate or significant risk to nuclear safety or needed to be addressed before R1 returns to service.
3. Overall, the inspector did not identify any significant C&I issues and supported ONR granting Consent for HYA R1 to return to service.

## Mechanical engineering

1. Reference [7] reports the findings of ONRs mechanical engineering inspection of the HYA R1 027 periodic shutdown.
2. The inspector targeted the following systems and equipment being maintained during the outage:

* secondary shutdown system;
* tertiary shutdown system;
* gas circulator jacking oil pump;
* gas circulator liner weld inspection;
* reactor gas safety relief valves; and
* desiccant dryer.

1. The inspector identified some minor issues and judged that they were being adequately addressed by the licensee, and no further action was required.
2. The inspector was satisfied that the licensee had adequately demonstrated its mechanical Engineering EIMT implementation and arrangements.
3. The inspector did not identify any issues that would prevent ONR granting consent to allow HYA R1 returning to service.

## Civil engineering

1. Reference [8] reports the findings of ONR’s civil engineering assessment of the HYA R1 027 periodic shutdown.
2. The inspector targeted the surveillances, inspections and tests of certain key safety related components of the R 1 Pre-stressed Concrete Pressure Vessel (PCPV), reported in the Appointed Examiner’s (APEX) report, including:

* concrete surface condition (including PCPV support walls);
* tendon and wire winding anchorages;
* vertical tendon and circumferential wire winding residual load;
* assessment of the pre-stressing strand;
* settlement and tilt survey;
* review of embedded strain gauge readings;
* review of vessel concrete temperatures;
* review of reactor coolant leakage;
* review of pressure vessel cooling water leaks;
* top cap deflection survey; and
* Boiler Closure Unit (BCU) review of instrumentation data and remote access inspections.

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-11793) to track the completion of the outstanding work identified in the APEX statutory report.
2. The inspector was content to support granting a consent for the return to service of HYA R1 PCPV for the next operating period.

## Chemistry

1. Reference [9] reports the findings of ONR’s chemistry inspection of the HYA 027 periodic shutdown.
2. The inspector targeted significant outage activities for systems required to control chemistry, specifically those associated with the Gas Bypass Plant and the Condensate Polishing Plant.
3. The inspector did not identify any issues that would prevent ONR granting consent to allow HYA R1 returning to service.

## Project inspection

1. Throughout the R1 027 periodic shutdown ONR’s project inspector engaged with the licensee to maintain awareness of the progress of the shutdown activities and emergent issues. The project inspector observed the licensee’s daily outage meetings and held a weekly oversight meeting with the licensee’s outage lead team.

### Events and emergent issues

1. At the start of the outage following the reactor blowdown, the gaseous activity monitoring system showed no indications of failed fuel and the reactor was declared failure free. Further monitoring indicated the presence of fission products slightly above normal expectations and subsequent testing identified two stringers with indications of failed fuel. In this instance, the monitoring results presented differently from those of previous fuel failures, hence the latent identification.
2. ONR judged that the licensee’s response and management of the failed fuel was appropriate and that it this was not significant with respect to granting consent to start-up. The site inspector will follow-up against incident report INF-3408 (HYA R1 failed fuel indications).
3. Inspections conducted during the outage identified partial occlusion in the intended pipework for the tie-in of the new Emergency Seawater System (ESS) to seawater culvert 1. This led to a loss of confidence in this existing culvert 2 tie-in and led to the ESS being declared unavailable. The ESS is a part of the station’s capability to support the five-day mission time for an extended loss of grid event.
4. The licensee disconnected the existing culvert 2 tie-in pending further inspection and/or installation of a new connection. On the culvert 1 side, an alternative tie-in has been implemented that does not rely on old pipework. The availability of the ESS is a condition of the reactor mode change controls that the station has in place prior to commencing start-up. The ONR site inspector will also be maintaining oversight of this, under regulatory issue RI-10984.

### Early outage safety review

1. ONR observed the early outage safety review [10] conducted by the licensee’s Internal Nuclear Assurance (INA) team.
2. The review focused on nuclear safety and involved observation of outage related activities and daily outage meetings, and interviews with licensee and contract staff.
3. The review identified four areas for improvement associated with:

* protected plant;
* lifting operations;
* vehicle / pedestrian segregation; and
* foreign material exclusion (FME) control.

1. The station lead team responded positively to the findings and committed to implement appropriate corrective actions.

### LC26 compliance inspection

1. Reference [11] reports the findings of the LC26 (control and supervision of operations) compliance inspection, conducted by the nominated site inspector and project inspector during the HYA 027 periodic shutdown.
2. The inspection targeted the continuity of control and supervision between the day shift and night shift and sampled a selection of handovers, briefs, shift logs and station documentation.
3. ONR is satisfied that the briefs and handovers observed were conducted with a high standard of professionalism and in accordance with HYA’s arrangements. No issues were identified that would prevent HYA R1 from returning to service.

### Start-up meeting

1. The start-up meeting [12] was held on 20 November 2023 and was chaired by the Strategic Outage Manager. The licensee presented a summary of the outage safety and technical performance. No issues that would prevent the start-up of R1 were identified.

### Start-up letter

1. The Station Director has applied for ONR’s consent to start-up HYA R1 under LC 30(3) [1]. The Station Director has confirmed that subject to completion the activities which can only be performed on-load or during start-up that the reactor and associated plant is safe to start-up.

### Maintenance schedule exceptions list and safety justification

1. The licensee has confirmed [13] that all the required 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, and compliance activities that have been deferred [14]. The licensee has scheduled the deferred activities to an in air refuelling outage in 2024 and all will be completed within their planned maintenance schedule periodicities.

### Return to service justification

1. The licensee’s justification to restart HYA R1 following the in-service inspections and associated assessments is set out in EC 372562 [15]. It confirms that, the inspection programme has been successfully completed and the reactor is fit for return to service, this is supported by the INSA approval statement [16].

### Graphite core inspections

1. The licensee’s justification to restart HYA R1 following the graphite core inspections is set out in EC 373746 [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 (GAP) has confirmed that the results are within the accepted boundaries of the graphite safety case.

### APEX statement on 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 on reactor penetrations examination

1. The licensee has reported the outcome of the HYA R1 PCPV penetrations thorough examination [20], required by the PSSR written scheme of examination. The penetrations were assessed as being in an immediately satisfactory condition to support continued operation for the maximum interval permitted by the written scheme.

### 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.

### INA concurrence

1. The licensee’s Independent Nuclear Assurance (INA) have provided oversight of the outage through the concurrence process. INA will issue a concurrence statement when 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. ONR’s 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 decision to grant consent to start-up HYA R1. The inspector [23] has not identified any issues that would impact on the decision to grant consent to start-up HYA R1.

### Engagement with other Governmental Agencies

1. Before issuing a Licence Instrument it is established practice to notify other competent regulatory authorities of ONR’s intentions to ensure that there are no specific objections that may compromise other regulatory requirements. The Environment Agency site inspector was informed that ONR intended to grant consent to the restart of HYA R1 and confirmed [24] that they had no objections.

# Matters Arising from ONRs Work

1. There are no outstanding matters arising from the inspection and assessment work carried out by ONR.

# Conclusions

1. Based on the evidence gathered, ONR is satisfied that:

* The EIMT requirements specified in HYAs 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.
* 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. ONR is 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 ONR in the 28-day report, or in specific documents that are not required prior to granting consent.
2. In conclusion, ONR has not identified any matters that would prevent granting consent for HYA R1 to start-up after the 027 periodic shutdown.

# Recommendations

1. ONR issue Licence Instrument 641, granting consent to start-up Heysham 1 R 1 after the 027 periodic shutdown.

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|  |  |
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| [4] | *Heysham 1 reactor 1 027 periodic shutdown, Assessment of Structural Integrity in Support of the Restart of Reactor 1 following the 2023 Periodic Shutdown, ONRW-2126615823-1337.* |
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