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Heysham 2 Reactor 7 Periodic Shutdown 2018

**EDF Energy Nuclear Generation Limited (NGL) – Heysham – Consent under Licence
Condition 30(3) to start-up Heysham 2 Reactor 7 following periodic shutdown.**

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EXECUTIVE SUMMARY

Title

EDF Energy Nuclear Generation Limited (NGL) – Heysham – Consent under Licence Condition 30(3) to start-up Heysham 2 Reactor 7 following periodic shutdown.

Permission Requested

NGL, the licensee of Heysham 2 power station, has requested that the Office for Nuclear Regulation (ONR), grants consent to start-up Reactor 7 following its periodic shutdown as required under Licence Condition (LC) 30(3) of nuclear site licence number 60.

Background

Heysham 2 is comprised of two operating Advanced Gas-cooled Reactors, known as Reactor 7 and Reactor 8. To continue to operate safely and reliably; systems, structures and components important to safety require regular and systematic examination, inspection, maintenance and testing. Whilst some of these activities can take place when the reactor is at power, many of them require it to be shut down. In addition, the licensee also undertakes plant safety improvements where these are deemed to be reasonably practicable. The licensee's arrangements require that periodic shutdowns, as required by LC 30(1), are carried out triennially at each reactor at Heysham 2. On completion of a periodic shutdown the reactor concerned cannot be started up without consent from ONR under LC 30(3).

During the Reactor 7 periodic shutdown 2018 which commenced on 4 May 2018, the licensee has conducted:

- Examinations, inspections, maintenance and testing activities in accordance with the maintenance schedule;
- Inspections to support the station safety case;
- Work to comply with statutory requirements;
- Remedial work to rectify plant adverse conditions; and
- Plant safety improvements where these are deemed to be reasonably practicable.

Where inspection work revealed the potential for an adverse plant condition, the licensee has assessed the inspection results in accordance with its arrangements and taken appropriate remedial action as necessary prior to reactor start-up.

Towards the end of the periodic shutdown, the Heysham 2 Station Director wrote to ONR requesting consent to start-up Reactor 7. In that letter, the Station Director confirmed that all maintenance required for start-up would be completed.

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

ONR inspectors have sampled the licensee's arrangements for controlling and completing the examination, inspection, maintenance and testing (EIM&T) requirements of the maintenance schedule, and other plant modifications of nuclear safety significance, as identified within the licensee's outage intentions document. This has included attending the significant outage planning and progress meetings, assessment of safety documentation and inspections at Heysham 2 to evaluate samples of the licensee's EIM&T activities.

The regulatory interventions carried out by ONR have not identified any issues of safety significance which remain unresolved in relation to the licensee's safety case for the start-up

and operation of Reactor 7 until the next periodic shutdown, allowing ONR consent to start-up the reactor under LC 30(3) to be recommended as described within this report.

Matters arising from ONR's work

The licensee has confirmed to ONR that the requisite periodic shutdown related work has been successfully completed and that all actions identified by ONR for resolution prior to consent have been addressed. The actions agreed for the longer term have been included in the relevant station processes, and will be tracked to completion within its arrangements or through the ONR regulatory issues database to ensure completion.

Following the identification of the non-fitment of four retention studs during the installation of the man access penetration inner shield plug towards the end of the outage, ONR scrutinised the work done by NGL to justify the safe operation of the plant and the efficacy of the quality management arrangements. ONR considered that the licensee has produced an adequate safety justification and demonstrated suitable assurance that there was not a systemic failure of the quality systems during the outage. ONR therefore considered that issues relating to this event had been adequately addressed and would not prevent the granting of the Consent to restart.

All matters preventing the granting of consent to start-up that arose from the work undertaken by ONR inspectors have been adequately resolved in relation to the Heysham 2 Reactor 7 periodic shutdown 2018.

Conclusions

Following assessment and inspection of matters arising in relation to the Heysham 2 Reactor 7 periodic shutdown 2018, ONR is satisfied that the licensee's justification to start-up the reactor and operate for a further period is adequate; consequently, consent to start-up the reactor can be granted.

Recommendation

It is recommended that, in accordance with the request from the licensee, ONR should grant Consent under LC 30(3) attached to Nuclear Site Licence No.60 for Reactor 7 at Heysham 2 nuclear power station to start-up following the 2018 periodic shutdown, and Licence Instrument 619 be issued and released to the licensee to permit this outcome.

LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
APEX	Appointed Examiner
C&I	Control and Instrumentation
CR	Condition Report
CW	Cooling Water
DSEAR	Dangerous Substances and Explosive Atmosphere Regulations 2002
EC	Engineering Change
EIMT	Examination, Inspection, Maintenance and Testing
EPPE	Essential Protection Plant Equipment
HTBASS	High Temperature Behaviour of Austenitic Stainless Steels
HUV	Half Unit Valve
INA	Independent Nuclear Assurance
INSA	Independent Nuclear Safety Assessment
IRR17	Ionising Radiations Regulations 2017
ISI	In-Service Inspection
KRC	Keyway Root Cracking
LI	Licence Instrument
LC	Licence Condition
MAP	Man Access Penetration
MS	Maintenance Schedule
NGL	EDF Energy Nuclear Generation Limited
NICIE2	New In-Core Inspection Equipment
OAP	Outage Assessment Panel
OCC	Outage Control Centre
OID	Outage Intentions Document
ONR	Office for Nuclear Regulation
PAR	Project Assessment Report
PCPV	Pre-stressed Concrete Pressure Vessel
PIMI	Plant Item Maintenance Instruction
PSSR	Pressure Systems Safety Regulations 2000
PTSE	Post Trip Sequencing Equipment
PU&A	Procedural Use and Adherence
QA	Quality Assurance
QC	Quality Control
RCA	Radiation Controlled Area
RCS	Reactor Check Sheet
RP	Radiological Protection
RTR	Rapid Trending Review
RTS	Return To Service
SACI	Significant Adverse Condition Investigation
SQEP	Suitably Qualified and Experienced Person
WOC	Work Order Card

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1 PERMISSION REQUESTED

1. EDF Energy Nuclear Generation Limited (NGL), the operator and licensee of Heysham 2 power station, has written (Reference 1) to the Office for Nuclear Regulation (ONR) requesting consent under Licence Condition (LC) 30(3) to start-up Reactor 7 on completion of its periodic shutdown (also known as its statutory outage). This Project Assessment Report (PAR) presents ONR's consideration of this request and recommends that consent is given to start-up Reactor 7 through issuing Licence Instrument (LI) 619.

2 BACKGROUND

2.1 GENERAL

2. The nuclear site licence issued to NGL for Heysham 2 requires the Licensee to periodically shut down plant under LC30. This is to enable examination, inspection, maintenance and testing to take place in accordance with the requirements of the Plant Maintenance Schedule (MS) under LC28. At Heysham 2, reactor periodic shutdowns are undertaken triennially as specified in the MS Preface, which is an Approved document under LC28(4). NGL also undertook work during the shutdown associated with the requirements of Pressure Systems Safety Regulations 2000 (PSSR), previous commitments, and plant safety improvements/ modifications.
3. ONR had specified (Reference 2) that the Licensee required consent from ONR under LC30(3) to start-up Reactor 7 following a periodic shutdown. The previous consent to start-up Reactor 7, Heysham 2 LI 588 (Reference 3), was dated 29 April 2015. Prior to the shutdown ONR had agreed to a six day extension to the Reactor 7 three year operating period under LC30(2) through LI 615 dated 19 April 2018 (Reference 4).
4. The Heysham 2 Reactor 7 periodic shutdown 2018 commenced on 4 May 2018.

2.2 OUTAGE PLANNING AND MANAGEMENT

2.2.1 Reactor outage intentions

5. NGL's planned outage work programme was outlined in the Heysham 2 outage intentions document (OID) (Reference 5). This was examined by ONR specialist inspectors and the nominated site inspector in preparation for the outage intentions meeting held on 7 December 2017 (Reference 6).
6. During the Reactor 7 periodic shutdown 2018 NGL would be conducting:
 - Examinations, inspections, maintenance and testing activities in accordance with the MS;
 - Inspections to support the station safety case;
 - Work to comply with statutory requirements;
 - Remedial work to rectify plant adverse conditions; and
 - Plant safety improvements where these are deemed to be reasonably practicable.
7. The notable packages of work to be undertaken were:
 - Inspections of the graphite peripheral shielding bricks;
 - Reactor vessel entry to:
 - Install a modification to the GH02 In-Service Inspection (ISI) standpipe extension sleeve;

- Conduct non-destructive testing of the boiler pipework;
 - Remove a sample of the boiler pipework for off-site examination and testing;
 - High voltage protection scheme replacement; and
 - Steam main support bracket (grey beam) replacement.
8. In common with the rest of the NGL fleet, an island approach was adopted to plan and manage the outage activities. This approach co-located relevant personnel for each island (planning, engineering, operations and maintenance) in the Outage Control Centre (OCC). The following island teams were deployed:
- Boiler – Steam and feed pipework and valves;
 - ISI – In vessel inspection and sampling of graphite and steel;
 - Protection, electrical and data processing systems;
 - Reactor – Gas circulators, safety relief valves and pre-stressed concrete pressure vessel (PCPV);
 - Sea water – Cooling water and sea water systems;
 - Turbine and feed; and
 - Vessel entry – GH02 and boiler inspections.

2.2.2 Licensee's outage management

9. The outage has been managed in accordance with the requirements of NGL's integrated company practice BEG/ICP/OPS/009 'Outage Management Process'.
10. In line with NGL's arrangements, a team of Independent Nuclear Assurance (INA) inspectors, and outage staff from other stations, conducted a rapid trending review (RTR) during the second week of the outage, observed by the ONR nominated site inspector (Reference 7). The RTR identified points of positive feedback as well as highlighting areas for improvement during the outage.
11. A mid-outage meeting was held on 7 June 2018, the purpose of which was to allow NGL and ONR to review the progress and developments with the periodic shutdown (Reference 8). A start-up meeting was held on 27 June 2018 for NGL to demonstrate it had adequately met the requirements of the maintenance schedule, dealt with emergent issues, identified any additional actions to be completed and demonstrated the safety of Reactor 7 for the next operational period (Reference 9).
12. On 2 July 2018, the Heysham 2 Station Director wrote to ONR requesting consent to start-up Reactor 7 on completion of the periodic shutdown (Reference 1). NGL will convene an Operational Safety Review Committee prior to start-up to review the fitness for service of the plant and endorse return to service.
13. NGL's own internal regulator, INA, independently supports the request to start up the reactor following the outage as it is satisfied that the reactor is in a fit state to be restarted and that the associated risks are both tolerable and ALARP.
14. INA sought assurance that the material state of the plant was acceptable to support safe operation and that activities undertaken during the outage were conducted with due regard for nuclear safety through a series of assessment activities detailed in their Concurrence Part A (Reference 10). The Concurrence Part B, (Reference 11) has been received in which INA considers that there are no issues with respect to the requirements of the Concurrence Part A and provided Concurrence for start-up and subsequent operation of Heysham 2 Reactor 7 within the constraints of the current safety case.

15. NGL produced a return to service Engineering Change (EC) (Reference 12) that approves the results of inspections completed in the outage inspection programme. INA has issued an Independent Nuclear Safety Assessment approval statement (Reference 13) for this EC.
16. The Pressure Systems Safety Regulations (PSSR) competent persons (for the Prestressed Concrete Pressure Vessel (PCPV), the reactor penetrations and the balance of plant) have each confirmed that they are content for Reactor 7 to start up (References 14, 15 and 16).
17. Following ONR's issue of its consent to allow Heysham 2 Reactor 7 to return to service, during the reactor start-up and raising to full power, there will be further tests and inspections which can only be conducted at this time. The results of these, and other inspections conducted during the shutdown which required further analysis, will be published in a document known as the '28 day report'.

2.2.3 ONR's intervention management process

18. ONR business management process within the Operating Facilities Division requires that a task sheet is produced for activities exceeding five staff days work. The task sheet provided the background to the proposed intervention, the anticipated outcomes, duration, and prioritisation and listed the ONR specialisms assigned to the project and the intervention strategy.
19. The ONR activities in support of the NGL outages for 2018/19 are articulated in task sheet TS045 (Reference 17). The task sheet was endorsed by the Operating Reactors sub division board.
20. The scope of the interventions and assessments was determined by conducting reviews of:
 - Scope of work for the outage as indicated by the OID;
 - Previous outage reports and actions;
 - Recent regulatory attention;
 - OPEX and outstanding issues recorded in the regulatory issues database;
 - Specialism specific areas of interest; and
 - Other areas of interest which could only be assessed during an outage period
21. The following ONR specialisms were identified as required for the Heysham 2 Reactor 7 outage 2018 project:
 - Structural integrity
 - Graphite
 - Mechanical engineering
 - Electrical engineering
 - Control and instrumentation systems
 - Civil engineering
 - Radiological protection
 - Conventional health and safety
 - Fire safety
 - Site inspection oversight
22. ONR's process for delivering a permissioning project requires preparation of a PAR to support the permissioning decision by the Delegated Authority. The PAR is informed by the intervention findings of the inspectors assigned to the project to allow the Delegated Authority to consider issuing Consent for the restart of the reactor.

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

23. The work undertaken by ONR can summarised as follows:

- Engineering assessments of maintenance, modifications and other work during the outage covering the following areas:
 - Structural integrity
 - Graphite core integrity
 - Mechanical engineering
 - Electrical engineering
 - Control and instrumentation
 - Civil engineering
- Assessment of the safety management of the outage including:
 - Radiological protection
 - Conventional health and safety
 - Outage management.
- Response to emergent issues
- Attendance at start-up meeting

24. An inspection of the fire safety management is due to be conducted as the station completes its outage activities to review the clear up processes and return to normal operation. This inspection will not affect the decision to grant the consent to restart Reactor 7 and any shortfalls found will be managed through the routine regulatory processes.

3.1 ENGINEERING ASSESSMENTS

3.1.1 Structural integrity

25. Reference 18 presents ONR's assessment of the structural integrity related aspects and assesses the adequacy of the inspections of welds, metallic reactor internal structures and components, main cooling water system, pipe hangers and thermal movement survey in line with LC28; and compliance with the PSSR regulations undertaken during Heysham 2 Reactor 7 2018 periodic shutdown.

26. The main focus for this outage from a structural integrity perspective, was delivery of the programme of in-vessel work conducted through manned vessel entry. The focus of these in-vessel activities was the long-term repair of the GH02 standpipe but in addition, NGL had proposed and prepared for a number of other in vessel activities related to structural integrity. This includes inspections of boiler components as part of their High Temperature Behaviour of Austenitic Stainless Steels (HTBASS) programme to confirm the level of degradation on components potentially susceptible to a long term damage mechanism known as carburisation.

27. The majority of this work was successful, and no significant degradation was found. Pre-emptive and opportunistic inspections on one set of components, the bifurcations, did not gain any interpretable results; this possibility had been recognised prior to the inspection. The damage predicted on these components was low and there was no evidence of degradation from boiler tube leaks etc, and the lack of interpretable results did not change the existing safety case. The inspector did not consider that the lack of results should affect his decision to recommend restart of Reactor 7 from a structural integrity perspective.

28. The inspector conducted a site visit during the periodic shutdown to confirm the adequacy of the work conducted by the licensee to comply with LC 28, examination, inspection, maintenance and testing. Based on a review of the outage scoping documents for items that the inspector considered important for safety, the following aspects were identified to sample during the site visit:
- steam and feed system inspections
 - main cooling water system inspections
 - reactor internal remote visual inspections (steel components)
 - pipe hanger and restraint inspections
 - flow accelerated corrosion inspections
29. The inspector reviewed the operation of the Outage Assessment Panel (OAP) which assessed and sentenced the findings of the inspections conducted during the outage. The OAP was the body through which acceptance for return to service of each component was considered. The inspector attended one of the meetings and reviewed the minutes of the weekly meetings. From the information sampled, the inspector was satisfied that the inspection programme was being adequately monitored and controlled by the OAP. The inspector was also content that the OAP was providing adequate oversight of the outage activities.
30. During a post-activity review on the completion of closing up the reactor manway access NGL identified that 4 out of 24 retention studs had not been fitted to the inner shield plug during installation. This is further discussed in the emergent issues section.
31. Based upon the sampling undertaken on the remainder of the activities and the evidence presented, the inspector judged that the licensee had undertaken sufficient inspection and assessment to support the safe return to service of Heysham 2 Reactor 7 from a structural integrity perspective.

3.1.2 Graphite core integrity

32. Reference 19 provides the findings of the ONR graphite core integrity assessment of the graphite core inspections of Heysham 2 Reactor 7 during the 2018 periodic shutdown and supporting documentation provided by NGL. The assessment also reviewed the ECs relating to the cracks discovered in the peripheral shield wall bricks at Heysham 2 Reactor 8 and Torness Reactor 1 and 2.
33. NGL's intended scope of the graphite inspections during the periodic shutdown was:
- Inspection of a minimum of 16 fuel channels both visually and dimensionally using the New In-Core Inspection Equipment (NICIE2);
 - Trepanning of a minimum of 24 graphite specimens with a target of between 30 - 36 and an upper limit of 42;
 - Visual inspection of one control rod channel; and
 - Inspection of a minimum of 9 out of 16 faces of the peripheral shield wall with an upper target of 13 faces.
34. During the outage the inspector conducted an intervention on site to inspect the adequacy of the licensee's examinations and inspections of the graphite core. At the time of the intervention, the graphite inspection team had completed all 16 fuel channel inspections and the inspections of the graphite peripheral shield walls were ongoing. Overall, from the activities sampled during the intervention the inspector considered that NGL was complying with LC 28 in respect of the graphite core inspections and attributed an ONR rating of 'green' – adequate – for this intervention.

35. During the initial inspections using the NICIE2 the licensee identified that it had been incorrectly set up. The set-up of the equipment was corrected, the channel re-inspected and the cause of the error was investigated by NGL. The ONR inspector considered it was positive that NGL identified this error immediately after the channel inspection was completed and carried out a re-inspection of the channel with the correct settings. This provided confidence that the licensee's verification process had been timely and effective.
36. During the periodic shutdown, NGL inspected and measured the bore of sixteen fuel channels and one control rod channel, as per the Maintenance Schedule requirements. During these inspections, one new full circumferential crack was observed in a newly inspected fuel channel. No full height axial crack has been found. The brick and channel distortions measured were small. The inspector considered that the results of the inspections did not challenge the assumptions of the safety case.
37. To date, keyway root cracking (KRC) has only been observed in the Hinkley Point B and Hunterston B reactor cores. According to NGL's latest forecasts using a new model, the earliest that parts of the Heysham 2 and Torness cores are predicted to undergo keyway root cracking is 2022 based on the current core burn-up rates. The inspector considered that the estimate for the time of KRC provided by the new model was more likely to be reasonable than previous materials models developed by NGL. However, it was important that the inspection strategy is such that earlier KRC onset can be detected before limits on the number of cracked bricks are challenged.
38. The graphite trepanning retrieved thirty-one samples from the core which met the MS requirements of a minimum of twenty-four samples. The inspector considered that this was a good achievement for the graphite inspection team and will provide significant extra data to support graphite weight loss predictions. The weight loss and materials properties data derived from the trepanned specimens will not be available for several months.
39. The inspector reviewed the results obtained from the latest trepanning campaign during the Heysham 2 Reactor 8 outage 2016. The latest graphite weight loss forecasts by NGL estimated that the graphite weight loss limit will not be reached before 2022 at the earliest. Therefore, the inspector considered that at the current time there was an acceptable margin between the level of graphite core weight loss and the limits in the safety case.
40. During the outage, NGL achieved their target inspections and completed 11 out of 16 faces of the peripheral shield walls, which satisfied the MS requirements. Overall, NGL considered that the cracking observed in Heysham 2 R7 was broadly consistent with that seen in Torness R2 2015, Heysham 2 R8 2016 and Torness R1 2017 but noted that the number of cracks found at Heysham 2 R7 was significantly less than in the other reactors.
41. The inspector considered that the inspection findings from the Heysham 2 R7 peripheral bricks did not challenge the claims and arguments in the safety case. However, continued inspection will be necessary to demonstrate that there is no significant deterioration in the condition of the peripheral wall at all four Heysham 2 / Torness reactors.
42. Overall, the inspector judged that the graphite core inspections results were within the bounds of NGL's safety case and did not present any impediment to return to service of Heysham 2 R7. The inspector had no objection to recommending that consent was given to return Heysham 2 Reactor 7 back to service.

3.1.3 Mechanical engineering

43. Reference 20 provides the findings of the ONR inspection undertaken to provide regulatory confidence in the mechanical engineering aspects of the licensee's arrangements during the planned safety related activities through the shutdown. The inspection sampled and examined three planned shutdown activities:
- 7B cooling water (CW) pump/motor/gearbox 6 yearly overhaul
 - Mechanical upgrade of all 24 boiler feed control half unit valves (HUVs)
 - Gas circulator removal, shutter tube inspection and replacement
44. The refurbishment of the 7B CW pump and components was being undertaken by a group of contractors and through the use of comprehensive quality plans the inspector was content that the licensee demonstrated that a system was in place ensuring that a clear auditable trail exists from the specified EIMT requirements, to the work instructions.
45. Following an unusually high number of boiler HUV gland leaks the licensee decided to modify all 24 HUVs during the shutdown. The inspector examined the EC justifying the modification work and sampled the work order cards and supporting documents for conducting the work. The inspector considered these provided a full and comprehensive record of activities carried out under the sampled work order cards and demonstrated that activities were done in accordance with written instructions.
46. The inspector examined the quality plans and sampled the work order cards for the gas circulator 01 and 10 exchanges. The inspector considered these documents were appropriately completed and met ONR's expectations, demonstrating that activities were undertaken in accordance with written instructions together with a clear auditable trail from the EIMT requirements through to completion of the activities.
47. The inspector conducted a plant walkdown, including the main activities of interest, and concluded that operations within the areas walked were well organised and that satisfactory levels of housekeeping and foreign material exclusion arrangements were displayed.
48. From a mechanical engineering standpoint, the inspector was content with the way in which the licensee was conducting its statutory shutdown work programme and considered that there was no actual or emerging evidence that should prevent the licensee bringing Reactor 7 back to power in due course. There were no significant recommendations that the inspector considered would prevent ONR granting consent allowing the licensee to return Reactor 7 to power following its 2018 statutory shutdown.

3.1.4 Electrical engineering

49. Reference 21 presents the findings of the ONR electrical engineering inspection conducted during the outage. The inspection sampled the electrical work being undertaken as part of the Reactor 7 statutory outage, including:
- Reactor 7 Generator Transformer
 - Reactor 7 Unit Transformer
 - Reactor 7 Essential Supplies Building including:
 - Gas circulator circuit breakers
 - Unit auxiliary switch board 7
 - Variable frequency convertor circuit breakers

- Post trip logic equipment
 - Protection scheme replacement
50. During the Reactor 7 post trip processes a minor issue was found with auxiliary contactor of a circuit breaker associated with post trip sequencing equipment (PTSE) having high resistance contacts. This issue was anticipated and was resolved immediately following trip initiation with PTSE subsequently continuing to complete its required duty. Following previous operational experience of high resistance contacts, enhanced maintenance had been scheduled on all of the circuit breaker auxiliary contactors. The first time the enhanced maintenance was due to be undertaken on this particular auxiliary contactor was during the Reactor 7 periodic shutdown and the potential issue was therefore anticipated with appropriate resolution measures planned if required.
51. All other Reactor 7 electrical plant and equipment had responded and operated as expected post trip.
52. The electrical activities identified in the OID were considered to be of routine nature and that the progress made was as planned and anticipated, with maintenance activities being currently undertaken on 11kV air-circuit breakers; switchboards; protection relays; post trip logic equipment. No emergent issues of significance had been identified from the activities undertaken to date and NGL advised that it anticipated that all planned electrical related work activities would be completed as intended and that there was no intention to defer any.
53. There were a number of relatively significant electrical related modifications being undertaken that were non-routine; the replacement of the 400kV protection equipment; provision of enhanced instrumentation chassis earthing; replacement of two variable frequency convertors with variable speed drives.
54. From the advice, discussions, explanations and the sample inspected, the inspector was satisfied that; the classification of the engineering changes was appropriate; previous operational experience had been reviewed and used to inform implementation; the implementation of the replacement included an appropriate level of testing, commissioning and verification.
55. The inspector considered that based on the targeted interventions there were no issues identified from the electrical work activities which would prevent ONR granting Consent for Reactor 7 to return to service. This was subject to the completion of the planned EIMT activities, the implementation of the detailed modifications and the completion of emergent electrical work.

3.1.5 Control and instrumentation

56. Reference 22 provides the findings of the ONR control and instrumentation (C&I) inspection conducted during the outage. The main focus of the inspection was to verify that relevant work activities had been carried out in relation to C&I equipment and systems important to safety in order to confirm that they remained fit for their intended purpose at Heysham 2.
57. The following areas were covered during the outage C&I inspection:
- Reactor safety circuits, including:
 - Neutron flux detectors and related electronics testing;
 - Main guardlines maintenance and testing;
 - Diverse guardlines maintenance and testing;

- Channel outlet gas temperature and quadrant protection equipment thermocouples testing;
 - Post trip sequencing equipment (PTSE) maintenance and testing;
 - Essential protection plant equipment (EPPE) maintenance and testing;
 - Engineering changes;
 - Recent INF1 reports; and
 - Cyber security arrangements.
58. During the inspection a plant walkdown covered the following areas:
- Reactor safety room (guardlines and safety circuitry);
 - Data processing and control system;
 - Quadrant protection equipment rooms in 7C;
 - Essential Supply Building (PTSE train X and Y);
 - Turbine building; and
 - High voltage protection room.
59. During the inspection, the inspector found examples of good ageing and obsolescence management. The inspector observed the plant areas and equipment cubicles inspected were clean, tidy and free from foreign materials which provided evidence that good housekeeping practices were being followed.
60. The staff demonstrated a good level of knowledge of the systems they were responsible for and an adequate appreciation of the nuclear safety implications of related failures. Examples of good leadership and nuclear safety culture were apparent from the discussions with the recently appointed protection and electrical group head.
61. Based on the discussions during the outage and the sampling of laptops used for maintenance and testing activities on the data processing and control system, the inspector noted positive management of cyber security risk.
62. Shortly before the start of the outage, NGL identified that smart phase relays had been used as replacements for non-smart relays in some of the Hopkinson valves used in the PTSE. This issue is discussed further in the emergent issues section below.
63. During the outage NGL identified that there were quality and configuration issues with some Mors Smitt relays used in the EPPE and PTSE systems. This is discussed further in the emergent issues section below.
64. Based on the sample inspection of the C&I aspects of the Heysham 2 R7 2018 statutory outage, the inspector found that the station showed the application of good practice in addressing LC28 (Examination, inspection, maintenance and testing) activities in relation to C&I equipment.
65. On the basis of the ONR inspections of the C&I aspects of the Heysham 2 R7 2018 statutory outage and following suitable and sufficient resolution of the nuclear safety issues associated with the Mors Smitt relays and Hopkinson valve phase relays, the C&I inspector considered that from a C&I perspective, ONR could grant Consent for Reactor 7 at Heysham 2 to return to service.

3.1.6 Civil engineering

66. Reference 23 provides the findings of the ONR civil engineering assessment of the statutory examination report for the pre-stressed concrete pressure vessel (PCPV) produced by the Appointed Examiner (APEX) for Heysham 2 Reactor 7. The report recorded NGL's progress with the statutory surveillances, inspections and tests on the

pre-stressed concrete pressure vessel as prescribed in the station Maintenance Schedule.

67. The APEX concluded that the PCPV was satisfactory for return to service, subject to normal in-service surveillance, until the next scheduled statutory examination due in 2021. The Appointed Examiner's conclusion was subject to the satisfactory completion of some outstanding activities prior to return to service; the pressure vessel cooling water flow checks. The inspector considered that the outstanding information was not critical to his judgement in respect of re-start of the reactor.
68. The APEX judged the general appearance of the accessible PCPV and support structure concrete surfaces to be good, with no evidence of any significant crack development that was of concern. Based on discussions with the APEX, the information presented and a site inspection, the inspector judged that the PCPV concrete was in an acceptable condition for the next three years of operation.
69. The tendon anchorage loads were checked for a 1% sample at each end of the tendons (i.e. 38 anchorages out of 3,744 at the upper anchorage and the same number at the lower anchorage but on different tendons). Based on the tendon load test results presented, together with the trend analysis undertaken by the APEX, the inspector judged that the pre-stressing tendons in the PCPV will continue to provide the required level of pre-stress for the next three years of operation.
70. The Maintenance Schedule requires that two strands selected by the APEX are withdrawn from a minimum of 4 tendons every 3 years (i.e. 8 strands in total). The withdrawn strands are subject to an inspection by the APEX or his nominated representative and samples are selected for metallurgical examination and mechanical testing. The inspector reviewed the metallurgical examination report for the sampled strands and noted that no significant defects or corrosion was found.
71. The PCPV is supported on a number of laminated elastomeric bearing pads which are not routinely inspected as part of the Maintenance Schedule requirements. The licensee has undertaken a recent fleet-wide review of the PCPV bearing pads and an inspection of a sample of the PCPV bearing pads on the Reactor 7 PCPV was undertaken in December 2017. The inspector reviewed the inspection findings and noted that the visible parts of the bearings inspected were in good condition, with no significant defects or degradation observed. A more extensive sample was taken on both reactors at Torness and reached similar conclusions regarding the condition of the bearings. As the bearings at Torness are similar in design to those at Heysham 2 and subject to similar exposure conditions, the inspector judged that the bearing pads at Heysham 2 are in adequate condition for the next period of operation.
72. Based on the areas sampled, the inspector did not find any significant shortfalls in the surveillances and inspections reported by the Appointed Examiner and did not identify any concerns regarding the integrity of the pre-stressed concrete pressure vessel for Reactor 7. The pre-stressing surveillances demonstrated that the vessel had an adequate margin of pre-stress in excess of the design minimum.
73. From assessment of the results of the surveillances and inspections, inspection on site, discussions held with the APEX, and acceptance of the judgements made by the APEX, from the civil engineering perspective the inspector was content to support the return to service of the Reactor 7 pre-stressed concrete pressure vessel for the next operating period of three years.

3.2 SAFETY MANAGEMENT

3.2.1 Radiological Protection

74. Reference 24 presents the findings of the ONR radiological protection assessment of NGL's radiological protection (RP) and risk management arrangements in effect during the statutory outage of Heysham 2 Reactor 7. The assessment sought to establish the Licensee's ongoing readiness to undertake its maintenance and inspection activities in compliance with the Licensee's policies, procedures and guidance, under the Ionising Radiations Regulation 2017 (IRR17).
75. A review of RP arrangements included:
- RP aspects of the Heysham 2 R7 Statutory Outage Intentions Document
 - Review of the Pre-Outage ALARP Report and Vessel Entry ALARP Report
 - Overall RP arrangements for staff and contractors during the outage
 - Suitability of Radiation Work Permits and Local Rules
 - Man access arrangements for vessel entry
 - Contingency plans for vessel entry work
 - Contingency plans for open vessel pile cap operations
 - Arrangements for providing adequate contamination monitoring of persons and areas
 - RP resources and implementation of arrangements
 - Control and supervision of RP support contractors
 - Vessel entry complex arrangements
76. During the outage a reactor vessel entry was scheduled and the inspector conducted an inspection of NGL's vessel entry contractor, Doosan Babcock's, Gateshead simulator facility for vessel-entry training prior to the vessel entry work starting. The inspector found that the facility and the training to be comprehensive and judged that NGL's investment in the training facility was likely to make a significant contribution to a reduction in individual and collective doses.
77. To support the intervention, an inspection of the following Radiation Controlled Area (RCA) areas was carried out:
- Quadrant A X2 Gas Circulator
 - Valve Control Room
 - Bypass Gas Plant Valve Room
 - Active Laboratories
 - Auxiliary Blowdown Area
 - Secondary Shutdown Room
 - Pile Cap
 - Vessel Entry Complex (including Control Room and Materials Control)
78. The inspector highlighted a range of good practices during the inspection and identified a number of observations and areas for improvement which were discussed with the station head of RP.
79. The reactor vessel entry activities were completed with a dose burden which was more than 5% lower than that predicted in the Vessel Entry ALARP report.
80. Overall the radiological protection inspector was content with the Licensee's conduct of its statutory outage work programme and with its level of compliance against their associated radiological protection policies and procedures. The inspector did not identify any issues that would prevent ONR granting a Consent, under licence

condition 30 of the Licensee's nuclear site licence, allowing the Licensee to return Reactor 7 to power in due course.

3.2.2 Conventional health and safety

81. Reference 25 presents the findings of the ONR intervention to provide regulatory confidence in the management of conventional health and safety (CHS) hazards present at Heysham 2 during its outage, including setting to work and control of contractors.
82. A walk-down of a number of radiation controlled areas (RCA) and non-RCA locations was undertaken to sample outage activities underway at the time of the visit and inspect the management arrangements in place.
83. The inspector looked at setting to work and the role of work specifiers. Although the system of planning jobs is complex, the inspector found that the work specifiers knew their roles well. The pre-job briefs that the inspector attended were of high quality. The inspector observed effective arrangements for how the site collated the information from condition reports (CRs) and used the data to inform health and safety plans and priorities. The inspector noted that a lot of work had been done to produce the roof register to assist in planning work at height and it appeared to be fit for purpose.
84. The inspector considered that the setting to work, health and safety management standards were good in general and therefore, an inspection rating of 'Green – Acceptable' was applied to the intervention.
85. The inspector also conducted a follow up intervention looking at Dangerous Substances and Explosive Atmosphere Regulations (DSEAR) compliance and identified a shortfall requiring attention. This was being addressed through routine regulatory processes and was outwith the outage activities and did not affect the granting of the consent to restart.

3.2.3 Outage management.

86. The outage project inspector conducted inspections (Reference 26) to observe the implementation of the outage management arrangements deployed under LC30, periodic shutdown. The inspector focussed on the operation of the OCC and the various daily outage meetings and briefs.
87. Throughout the outage there are a series of meetings held on a daily basis which manage the outage activities and review emergent issues. The inspector observed a sample of these:
 - Outage planners meeting
 - Daily look ahead and defence in depth meeting
 - OCC outage morning brief
 - Daily screening meeting
88. In all of the meetings, the inspector observed open discussions on the various outage activities and suitable challenge raised where required. There was evidence of appropriate contingency planning for potential problems identified at discovery milestones, e.g. fuel failure; but none were found.
89. The inspector attended the mid-outage meeting which Heysham 2 conducted to review the progress of the outage. The meeting was grouped into two main areas; safety and outage work. Apart from an initial cluster of conventional health and safety events the

outage was considered to be progressing well with no significant technical challenges encountered to date.

90. The inspector considered the mid-outage meeting to be an effective review of the outage progress to date and provided confidence in how the outage was being managed effectively and safety was being maintained.
91. From the sampled inspection of the licensee's outage management arrangements, the inspector observed several areas of good practice and considered that the licensee's arrangements met the requirements of LC30.

3.3 EMERGENT ISSUES

3.3.1 Hopkinson valve phase relays

92. Shortly before the outage, NGL identified, INF1 2018/338, that smart phase relays had been used as replacements for non-smart relays in some of the Hopkinson valves used in the PTSE on both reactors. It was found that the subcontractor engaged to deliver the planned maintenance of the valves had substituted the analogue, non-smart, phase relays with smart type relays, which were software controlled, without notifying NGL. This practice seems to have occurred in a number of instances since 2014.
93. NGL carried out reviews to understand the extent of this practice and the nuclear safety implications. Based on these reviews, NGL considered that a few hundreds of these valves were potentially affected between Heysham 2 and Torness. As part of the internal follow up investigation, NGL also identified weaknesses in the 2008 EC used to justify replacement analogue phase relays (M3PR) due to obsolescence / unavailability of the original relays. NGL conducted further work, EC36635554, to provide additional confidence regarding the environmental and seismic qualification of non-smart analogue replacement relays
94. NGL decided to focus on the safety related valves and replaced the smart phase failure relays with non-smart options by the end of the outage. Where possible, the original relays were reinstated in the safety related valves, taking the relays from non-safety related valves. In case of unavailability of the original relay (e.g. because of challenges in the identification of suitable non-safety donors), the 2008 non-smart replacement relays were used instead. The ONR C&I inspector sampled the new EC substantiating the M3PR relays and found that it provided sufficient confidence to support the PTSE operation at Reactor 7, Reference 22.
95. NGL had initiated their safety case anomaly process to address the issue for Heysham 2 R8 and Torness, and it concluded that it was ALARP to continue operation of Heysham 2 R8 and TOR for approximately 4 months, under an interim justification for continued operation, EC 36635558. Measures have been adopted at Heysham 2 and Torness to mitigate the risks in this period. In the longer term, NGL anticipated that the 2008 justified M3PR non-smart replacement would not be suitable because of relay obsolescence and they have started an optioneering process to identify the best substitute candidate.
96. The inspector considered that for the return to service for Heysham 2 Reactor 7, the station approach was acceptable. The justification for Heysham 2 R8 and Torness continued operation and, more widely, the apparent deficiencies in design configuration control are being followed up separately by ONR.

3.3.2 Mors Smitt relays

97. NGL had identified that quality issues were found on replacement Mors Smitt relays used in the EPPE system. During relay replacement activities, the station identified that the pin configuration of some of the replacement relays differed from that expected and during testing at the station two of the replacement relays were declared failed after a magnet detachment. It was considered that the magnet detachment could cause an unrevealed dangerous failure, possibly affecting some of the safety related functions delivered by the EPPE system. The affected batch of relays had been recalled by the manufacturer for further investigation.
98. The ONR C&I inspector was informed of this issue during their outage inspection as an emergent issue. The licensee confirmed that the EPPE is a class 3 system and, when in operation, the plant would need immediate action in case of EPPE unavailability. Because of the nuclear safety relevance of this system, ONR raised the resolution of this a return to service issue for Heysham 2 R7.
99. The station decided to replace the full batch of affected relays introducing a newly engineered magnet bracket design before return to service of R7 and to conduct testing on the new relays prior to operation. In the investigation on this matter, it also emerged that the material for the magnet bracket had changed from brass to steel without a justification. Further substantiation work will be conducted after the return to service, but NGL had not seen any failure of these relays in relation to the change of material. The inspector considered NGL's approach to be proportionate to the risk and noting the work planned in the longer term, was content that it was not a return to service issue for R7.
100. NGL subsequently identified that these relays could have been installed during maintenance work in the post trip sequencing equipment (PTSE) train X. NGL considered that there was less risk presented by the use of these relays in the PTSE as there was extensive routine testing programme in the PTSE train X maintenance schedule to identify any failures (i.e. self-test twice a day and MS routine test every 15 weeks). NGL also stated that no degradation issues had been identified on these relays in the PTSE train X.
101. The ONR C&I inspector sought further clarification prior to the return to service of Reactor 7, NGL was to confirm that the routine testing on the PTSE train X was suitable and sufficient to identify single failures of this type of relays in the PTSE train X and, if not, define any additional measure to reduce the risk ALARP (e.g. modification to testing arrangements).
102. Following further discussions with NGL and the provision of additional information (Reference 27) the ONR inspector was content that the issue was being adequately managed and had no objection on C&I grounds to ONR giving consent to the restart of Heysham 2 Reactor 7.

3.3.3 Reactor man access penetration inner shield plug unit

103. During a post-activity review on the completion of closing up the reactor manway access penetration (MAP), NGL identified that 4 out of 24 retention studs had not been fitted to the inner shield plug during installation. The inner shield plug consists of a steel drum filled with concrete to a mass of 5.8 tonnes. When secured in position with the locking ring and wedges it forms part of the secondary retention system within the top man access penetration. The omitted studs, located at the cardinal points; N, S, E, and W, are used to secure the locking ring.

104. Investigations by NGL established that a series of minor deviations from the approved procedure had been agreed locally which when aggregated together had resulted in it not being possible to refit four retention studs. Following a change of shift the omitted studs were overlooked and the issue not rectified before the rest of the manway access area was closed up.
105. Initially NGL reviewed the issue and convened an Operational Decision Making (ODM) meeting (Reference 28) to agree the way forward. Based on the information available at the time (Reference 29) and presented at the meeting NGL decided that it would not be proportionate to revisit the shield plug installation and could justify operations with the four studs missing.
106. ONR was initially made aware of the issue through the routine communications with the licensee and sought further clarification and identification of the associated risks. The ONR structural integrity inspector visited Heysham 2 to discuss the issue with relevant station staff and to gather supporting information (Reference 30). The ONR outage project inspector informed the NGL outage management of ONR's concerns and expectations for resolution (Reference 31).
107. Following a review of the documents and evidence presented, ONR considered that the licensee had to provide additional assurances before the start-up consent could be granted. ONR required the licensee to:
 - Reinstall the shield plug to meet the original design intent or provide adequate justification to demonstrate that the shield plug as installed will not affect nuclear safety for continued operations or operations until the next outage for rectification.
 - Review the quality control (QC) and quality assurance (QA) issues associated with the incorrect installation of the shield plug and establish the extent of condition to confirm:
 - The issues were confined to this activity; and
 - There were no further issues on other work conducted by the staff involved.
 - Demonstrate that procedural use and adherence had been adequately ensured and assured during the outage.
108. ONR also sought assurance from the station director and INA that the issue was not evidence of a systemic quality failure.

3.3.3.1 Safety and engineering justification for continued operations with 4 of 24 studs not fitted

109. NGL convened their Operation Safety Review Committee to review the evidence and confirmed the earlier decision not to refit the studs based on their judgement that there was an adequate safety margin on the remaining bolts. Moreover, refitting the bolts would involve significant lifting and handling operations in order to gain access to the top of the inner shield plug to refit the studs (Reference 32). NGL therefore proceeded to produce a category 2 EC to justify continued operations without the four studs fitted (Reference 33).
110. The licensee's justification claimed that there were minimal or no nuclear safety implications from non-fitment of the studs and that no damage or excessive stresses will have been put on the shield plug and studs due to non-adherence to the installation procedure.

111. The EC also raised a commitment to review the procedural documentation; PIMI (plant item maintenance instruction) and RCS (reactor check sheet), to reflect the lessons learnt from refitting the inner shield plug during the outage.
112. Whilst it was ONR's expectation that the shield plug should have been refitted (or robustly demonstrated that the nuclear safety implications were ALARP), NGL demonstrated that the risks associated with accessing then refitting the shield plug were disproportionate to the benefit of having the studs fitted. This consideration was primarily based on the heavy lifting associated with partial assembly of the vessel entry complex and the removal of sections of the pile cap and shielding and the additional dose burden from working in a C2 area close to a reactor penetration.
113. The ONR structural integrity specialist reviewed the EC (Reference 18) and considered that the licensee's claims are supportable and an adequate safety justification had been made for continued operations with the studs omitted. The effort and additional dose to workers to re-install the four retention studs was considered disproportionate to the negligible increase in nuclear safety risk and therefore ONR judged that the risks were therefore ALARP.
114. However, the ONR structural integrity inspector recommended that at, or before, the next outage, the licensee should review whether it remains ALARP to leave the plant in its current state or refit the missing studs and raised an ONR regulatory issue (6498) to track progress on this matter.

3.3.3.2 Quality review

115. NGL conducted a quality review and produced a report (Reference 34) to provide assurance on the MAP closure quality arrangements and the wider implications of work carried out by the same working party. The report also sought to demonstrate how procedural use and adherence (PU&A) had been ensured and assured during the outage.
116. The reactor MAP rebuild activity is identified as QA class 1 grade 1 work which was conducted through the use of work order cards (WOC), plant item maintenance instructions (PIMI) and reactor check sheets (RCS) and assured through the use of a quality plan. The work was managed by suitably qualified and experienced (SQEP) NGL maintenance teams and oversight was provided by SQEP supervisors on both day and night shifts. Engineering oversight was supported through appropriate SQEP engineering personnel.
117. NGL has reviewed the WOCs, RCSs and PIMIs associated with the MAP re-build and did not find any other significant omissions that would impact nuclear safety in relation to execution of this activity.
118. The personnel in the MAP rebuild team had been involved in a variety of tasks throughout the outage, including:
 - Gas circulators – predominantly gas circulator lubrication oil packages
 - Main boiler feed penetration work
 - Reheater penetration work
119. The QA review sampled 78 WOCs associated with the diverse work packages identified and no significant issues were found.
120. The Heysham 2 Maintenance Group Head had spoken with each individual who worked on the inner shield plug. From the discussions he considered that they did not

simply ignore the use of procedures and there were possibly other interface issues which led to a confused situation. These issues will be fully explored and reported within the Significant Adverse Condition Investigation (SACI).

121. The Maintenance Group Head was confident that there were no widespread or endemic concerns regarding the quality of work within his department. The safety culture and open reporting culture within the maintenance department was considered to be very strong.
122. Prior to the outage NGL had identified the MAP dismantle/rebuild activities as one of sixteen areas to receive additional focus during work engineering, spares assessment, quality planning, implementation and surveillance. ONR sought, and received, clarification (Reference 35) on what additional activities had been conducted to improve the quality of the MAP activities. A quality improvement assessment and a number of surveillances had been completed which focussed on the higher risk areas, seals and closure bolts. There was no specific information which related to the inner shield plug but ONR considered that there had been appropriate focus on the MAP activities.
123. Overall ONR is content that the QA review provided additional assurance of the MAP closure quality arrangements and confirmed that no concerns had been identified from the wider work carried out by the personnel from the MAP rebuild work party during the outage, which would have a significant detrimental impact on nuclear safety.
124. The QA review report also sought to demonstrate how PU&A had been ensured and assured during the outage. The report detailed the range of pre-outage and outage arrangements deployed to maintain the quality of the work.
125. From the evidence presented in the review, responses to additional queries and the interactions ONR inspectors had with station staff during the outage, ONR considered that the licensee had adequate arrangements to ensure and assure PU&A during the outage and there was no evidence of a systemic shortfall.

3.3.3.3 Licensee assurance

126. The licensee's independent nuclear assurance organisation, INA, independently supports the application for restart from a Statutory Outage when it is satisfied that the outage activities have been adequately conducted and as far as can be established that the associated risks to start-up and continued operation are both tolerable and ALARP.
127. INA conducted a range of assurance activities (Reference 36) in relation to the inner shield plug studs including; attendance at the relevant ODM and OSRC and reviews of documentation relating to the MAP rebuild work.
128. INA raised concerns with the quality arrangements around the rebuild of the MAP inner shield plug. Upon initial investigation a number of wider questions as to the extent of condition and quality of other work undertaken by members of the NGL maintenance team were also communicated to the station.
129. To gain assurance of the station's response to the issue, INA QA conducted an independent review of the station's review of outage quality arrangements and in particular the rebuild of the man access inner shield plug assembly and the wider extent of condition for the maintenance team involved.

130. The INA QA review considered that the review conducted by Heysham 2 was conducted with the appropriate rigour. Whilst INA identified an area for improvement and a number of opportunities for improvement existed, INA considered there was not a systemic failing in the quality arrangements at Heysham 2.
131. INA conducted an independent safety assessment (INSA) of the safety justification EC (Reference 33). INA sought additional evidence (Reference 37) to support the ALARP justification contained in the EC as it was considered that it did not reflect the information presented and discussed during the OSRC. INA judged that given the low potential increase in risk and the extent of re-work required at the end of the outage, it was ALARP to return R7 to service with the four retention studs missing from the inner shield plug assembly.
132. In addition, INA had 'held' the issue of their Concurrence to support the reactor restart until assurance could be provided from an independent review by INA, INSA, and INA QA. Following review INA was content that the 'modification' was bound by the Cat 2 EC and that there was no systemic quality issue at Heysham 2.
133. ONR has engaged with INA while the MAP inner shield plug stud issue was being addressed and considered that INA provided a robust independent challenge to the licensee's activities. Their assurance work has provided confidence that the decision not to refit the studs was appropriate and ALARP, and that there was not a widespread issue with the quality of work at Heysham 2 during the outage.
134. The Heysham 2 station director has written to ONR (Reference 38) to explain the station's activities in response to the MAP inner shield plug studs issue and to highlight the scrutiny and assurance work. The station director confirmed that a SACI was being carried out which should identify appropriate corrective actions to prevent recurrence.

3.3.3.4 Conclusion

135. The non-fitment of four retention studs during the installation of the man access penetration inner shield plug was identified during a post-activity review and resulted in NGL conducting a range of investigations and reviews. NGL had decided that the safety of continued operations could be justified and was ALARP.
136. ONR advised NGL that a robust safety justification would be required for the missing studs if they were not to be re-fitted. ONR also sought additional assurances on the extent of the event and demonstrate effective procedural use and adherence arrangements during the outage.
137. ONR considered that NGL had produced an adequate justification for continued operations with the studs missing and it would not be ALARP to refit them.
138. The QA review provided suitable confidence that the event was limited in extent and was not evidence of a wider failure of the quality management arrangement during the outage.
139. Throughout the resolution of the issue the Heysham 2 INA team have provided a robust challenge to the station and conducted assurance activities on the safety justification and the QA review. Overall INA were content that this 'modification' was bound by the safety justification and that there was no systemic quality issue at HYB.
140. Following assessment and reviews of the work done by NGL in response to the non-fitment of the inner shield plug retention studs, ONR considered that the licensee has produced an adequate safety justification and provided suitable assurance that there

was not a systemic failure of the quality systems during the outage. ONR therefore considered that issues relating to this event had been adequately addressed and would not prevent the granting of the Consent to restart.

141. The possible wider implications of this issue relating to the underlying causes resulting in gaps in procedural adherence and the adequacy of supervision are subject to NGL's SACI. ONR's nominated site inspector will review NGL's investigation report and consider the need for any further formal regulatory follow-up and action in accordance with ONR's Enforcement Management Model if necessary.

3.4 START-UP MEETING

142. The Start-Up Meeting and a comprehensive plant walk-down were held on 27 June 2018. ONR was represented by the Superintending Inspector, the Nominated Site Inspector and Project Inspector. The meeting was preceded by a plant walk-down which encompassed many of the major work packages conducted during the periodic shutdown including the vessel entry campaign. A number of the work packages were for long term replacement of items; e.g. high voltage protection system and fire resistant fluid plant, to enhance nuclear safety and/or improve reliability through to the plant end of life.
143. Consistently good and positive challenge was observed from the NGL staff and the knowledge and ownership of the plant by each of the system leads was commended.
144. The Start-Up Meeting was chaired by the station Technical and Safety Support Manager and was attended by the same ONR representatives. The purpose of the meeting was for the licensee to demonstrate it had adequately met the requirements of the Maintenance Schedule, dealt with emergent issues and demonstrated the safety of Reactor 7 for the next operational period. The Heysham 2 Reactor 7 2018 Outage Start-Up Report (Reference 39) was provided prior to the meeting and was used as the basis for the presentations and discussions held during the meeting.
145. It was noted that there had been improvements in conventional health and safety following a number of events near the start of the outage. The introduction of 'Safe Start Monday' stand downs was considered to be an effective way of ensuring personal safety awareness during the outage and ONR supports the consideration of continuing this as a routine activity after the end of the outage, albeit at a potentially reduced frequency.
146. During the start-up meeting the Mors Smitt relay issue was discussed and further work was still necessary to address the ONR C&I inspector's restart consent action. A detailed record of the meeting is contained in Reference 9.
147. No further start-up consent actions were identified during the meeting.

4 MATTERS ARISING FROM ONR'S WORK

148. ONR has considered the licensee's request to grant a Consent under LC 30(3) to start-up Heysham 2 Reactor 7 on completion of its periodic shutdown and have taken note of the statements associated with safety contained in the request letter, the findings of the periodic shutdown associated work undertaken by NGL's internal regulator, INA, the statements of the PSSR competent persons and the findings and opinions of ONR specialist inspectors and the nominated site inspector.

149. In Reference 1, the Heysham 2 Station Director stated that an Operational Safety Review Committee would be convened prior to start-up to review the fitness for service of the plant and endorse return to service.
150. INA has provided their concurrence part B (Reference 11) which confirmed that, based on their assessment activities they were content to support the start-up of Reactor 7.
151. The PSSR competent persons have confirmed that their examinations have been satisfactorily completed and the plant was considered to be acceptable to return to service.
152. ONR specialist assessors from the following disciplines undertook inspections to support ONR's permissioning work:
- Structural integrity
 - Graphite
 - Mechanical engineering
 - Electrical engineering
 - Control and instrumentation systems
 - Civil engineering
 - Radiological protection
 - Conventional health and safety
 - Site inspection
153. Each discipline has produced a report that presents the inspection findings, inspector's opinions, judgements and recommendations. A number of recommendations and actions arose from the inspectors' work; none of the outstanding actions have been deemed sufficiently significant for ONR to withhold consent to start-up the reactor and they will be managed by the respective specialist inspectors through routine regulatory processes. All the reports contain either a statement supporting issuing a Consent to start-up the reactor, or note that there is no reason to withhold consent.
154. ONR has consulted with the Environment Agency, to establish if they had any specific objections that would prevent the issuing of LI 619, Consent to start-up Heysham 2 Reactor 7. The Environment Agency confirmed (Reference 40) they do not object to ONR granting consent.

5 CONCLUSIONS

155. The Heysham 2 Reactor 7 periodic shutdown 2018 has been undertaken in accordance with the requirements of the work scope outlined within the OID.
156. The licensee has followed its arrangements in undertaking the periodic shutdown, culminating in the Heysham 2 Station Director writing to ONR requesting consent to start-up Reactor 7. The letter stated that subject to the completion of the remaining outage activities, the licensee was satisfied that Reactor 7 was fit for return to service and sufficient procedures were in place to assure safe operation through to the next periodic shutdown.
157. The licensee's internal regulator, INA, has provided their concurrence part B, which confirmed that, based on their assessment activities they were content to support the start-up of Reactor 7 post its periodic shutdown.
158. The PSSR competent persons have each confirmed that they are content for Reactor 7 to start up.

159. ONR inspectors have sampled the safety management and engineering activities throughout the shutdown and judged them to be adequate, and all support 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.
160. ONR considers that the licensee delivered a shutdown that was safely managed and completed the required safety related work activities.
161. Following assessment and inspection of matters arising in relation to the Heysham 2 Reactor 7 periodic shutdown 2018, ONR is satisfied that the licensee's justification to start-up the reactor and operate for a further period is adequate; consequently, Consent to start-up the reactor can be granted.
162. ONR has prepared Licence Instrument 619, for LC 30(3) Consent, in conjunction with this PAR. The licence instrument is one of the standard formats given within ONR procedures and does not require review by Government Legal Department.

6 RECOMMENDATIONS

163. Recommend that the Superintending Inspector signs this Project Assessment Report to confirm support for the ONR technical and regulatory arguments that justify issuing Heysham Licence Instrument 619.
164. Recommend that the Deputy Chief Inspector signs Heysham Licence Instrument 619, which grants Consent under Licence Condition 30(3) attached to Nuclear Site Licence No.60 to start-up Heysham 2 Reactor 7.

7 REFERENCES

- 1 Heysham 2 - HYB51088R - S11R7 Consent Letter Application, 2 Jul 2018, TRIM 2018/217279
- 2 Heysham 2 - Licence Instrument 11 - HYB70470N - Specification LC30(3) - Requirement for a consent to start up a reactor after LC30(1) shutdown, 25 Mar 1996, TRIM 2016/182843
- 3 Heysham 2 - Licence Instrument Number 588 - Granted Under Condition 30(3) of Schedule 2 Attached to Nuclear Site Licence No.60, 29 Apr 2015, TRIM 2015/159818
- 4 Heysham 2 - Licence Instrument Number 615 - Agreement LC30(2) to the extension of the operating period of Heysham 2 Reactor 7, 19 Apr 2018, TRIM 2018/134513
- 5 Heysham 2 R7 2018 Outage Intentions Document - HB/REPS/OM052, Nov 2017, TRIM 2017/410973
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- 14 Heysham 2 - HYB51088R - Appendix 7 - Certificate of Maintenance Schedule completion for pressure vessel, Jul 2018, TRIM 2018/217292
- 15 Heysham 2 - HYB51088R - Appendix 8 - Written Scheme of Examinations - Heysham 2 Power Station Reactor 7 - CPV Penetration PSSR inspections - Thorough Examination, Jul 2018, TRIM 2018/217295
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- 32 Heysham 2 - OSRC Meeting 251 minutes - Man Access Penetration Inner Shield Plug Retention Studs, 6 Jul 2018, TRIM 2018/228693
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