



PROJECT ASSESSMENT REPORT			
Unique Document ID and Revision No:	ONR-HYB-PAR-16-014 Revision 0	TRIM Ref:	2016/428110
Project:	Heysham 2 Reactor 8 Periodic Shutdown 2016		
Site:	Heysham		
Title:	EDF Energy Nuclear Generation Limited (NGL) – Heysham – Consent under Licence Condition 30(3) to start-up Heysham 2 Reactor 8 following periodic shutdown.		
Licence Instrument No: (if applicable)	LI 610		
Nuclear Site Licence No:	60		
Licence Condition:	30(3)		

Document Acceptance and Approval for Issue / Publication

Role	Name	Position	Signature	Date
Author	[Redacted]	Inspector	[Redacted]	10 Nov 2016
Reviewer	[Redacted]	Principal Inspector	[Redacted]	10 Nov 2016
Accepted by ¹	[Redacted]	Superintending Inspector	[Redacted]	10 Nov 2016
Approval for publication ²	[Redacted]	Superintending Inspector	[Redacted]	0 Nov 2016

Revision History

Revision	Date	Author(s)	Reviewed By	Accepted By	Description of Change
A	08/11/16	[Redacted]	S Kirsopp	n/a	1 st draft for review
B	09/11/16	[Redacted]	S Kirsopp	n/a	2 nd draft incorporating comments
0	10 Nov 2016	[Redacted]		[Redacted]	First accepted issue

¹ Acceptance of the PAR to allow release of LI

² Approval is for publication on ONR web-site, after redaction where relevant

--	--	--	--	--	--

Circulation (latest issue)

Organisation	Name	Date
Office for Nuclear Regulation	<ul style="list-style-type: none"> - Deputy Chief Inspector - Operating Reactors Head - Operating Reactors Assessment Head - Site Inspector - Outage Project Inspector - Civil Nuclear Security - Structural Integrity - Structural Integrity - Graphite - Mechanical Engineering - Electrical Engineering - Electrical Engineering - Control and Instrumentation - Control and Instrumentation - Civil Engineering - LMfS - Quality Management Systems - Radiological Protection - Fire Safety <p>Files: Folder 4.4.2.16878.</p>	
Environment Agency		
Licensee	<ul style="list-style-type: none"> - Heysham 2 Technical and Safety Support Manager - Heysham 2 Independent Nuclear Assurance 	

Heysham 2 Reactor 8 Periodic Shutdown 2016

EDF Energy Nuclear Generation Limited (NGL) – Heysham – Consent under Licence Condition 30(3) to start-up Heysham 2 Reactor 8 following periodic shutdown.

Project Assessment Report ONR-HEYSHAM 2-PAR-16-014
Revision 0
10 November 2016

© Office for Nuclear Regulation, 2016

If you wish to reuse this information visit www.onr.org.uk/copyright for details.

Published 12/16

For published documents, the electronic copy on the ONR website remains the most current publicly available version and copying or printing renders this document uncontrolled.

EXECUTIVE SUMMARY

Title

EDF Energy Nuclear Generation Limited (NGL) – Heysham – Consent under Licence Condition 30(3) to start-up Heysham 2 Reactor 8 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 8 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 to be implemented 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 8 periodic shutdown 2016 which commenced on 16 September 2016, 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 8. 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 inspected a sample of the licensee's arrangements for controlling and completing the examination, inspection, maintenance and testing 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 and visiting site to examine aspects of the implementation of the licensee's arrangements.

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 of Reactor 8, and its operation until the next periodic shutdown.

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.

No matters preventing the granting of consent to start-up arose from the work undertaken by ONR inspectors in relation to the Heysham 2 Reactor 8 periodic shutdown 2016.

Conclusions

Following assessment and inspection of matters arising in relation to the Heysham 2 Reactor 8 periodic shutdown 2016, I am 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 should be issued by ONR.

Recommendation

I recommend 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 8 at Heysham 2 nuclear power station to start-up following the 2016 periodic shutdown, and Licence Instrument 610 be issued to the licensee.

LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
APEX	Appointed Examiner
C&I	Control and Instrumentation
CNS	Civil Nuclear Security (ONR)
EA	Environment Agency
EC	Engineering Change
EIMT	Examination, Inspection, Maintenance and Testing
FRF	Fire Resistant Fluid
HV	High Voltage
HYB	Heysham 2 Power Station
GSRV	Gas Safety Relief Valve
IM	Interstitial Manipulator
INA	Independent Nuclear Assurance
INSA	Independent Nuclear Safety Assessment
IRR99	Ionising Radiations Regulations 1999
LC	Licence Condition
LFE	Learning for experience
LI	Licence Instrument
MS	Maintenance Schedule
NGL	EDF Energy Nuclear Generation Limited
OCC	Outage Control Centre
OID	Outage Intentions Document
ONR	Office for Nuclear Regulation
OPEX	Operational Experience
PCE	Personal Contamination Events
PAR	Project Assessment Report
PCPV	Pre-stressed Concrete Pressure Vessel
PSSR	Pressure Systems Safety Regulations 2000
RCA	Radiological Controlled Area
RTR	Rapid Trending Review
RTS	Return To Service
SQEP	Suitably Qualified and Experienced Person
T/C	Thermocouple
VFC	Variable Frequency Convertor
VSD	Variable Speed Drive

TABLE OF CONTENTS

1	PERMISSION REQUESTED	9
2	BACKGROUND	9
2.1	GENERAL.....	9
2.2	OUTAGE PLANNING AND MANAGEMENT	9
2.2.1	Outage intentions	9
2.2.2	Licensee’s outage management.....	10
2.2.3	ONR’s intervention management process	11
3	ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR IN CONSIDERATION OF THIS REQUEST	11
3.1	ENGINEERING ASSESSMENTS	12
3.1.1	Graphite core integrity	12
3.1.2	Civil Engineering	13
3.1.3	Structural integrity.....	13
3.1.4	Mechanical engineering.....	14
3.1.5	Electrical engineering	15
3.1.6	Control and instrumentation.....	16
3.2	SAFETY MANAGEMENT.....	16
3.2.1	Radiological protection	16
3.2.2	Fire safety	17
3.2.3	Management systems, LC17	17
3.2.4	Organisational capability, LC36	18
3.2.5	Outage management.....	19
3.3	EMERGENT ISSUES.....	19
3.3.1	Support beam stool failure.....	19
3.3.2	Interstitial manipulator	20
3.4	START UP MEETING	21
4	MATTERS ARISING FROM ONR’S WORK.....	21
5	CONCLUSIONS	22
6	RECOMMENDATIONS.....	23
7	REFERENCES	24

1 PERMISSION REQUESTED

1. EDF Energy Nuclear Generation Limited (NGL), the operator and licensee of Heysham 2 power station (HYB), has written (Reference 1) to the Office for Nuclear Regulation (ONR) requesting consent under Licence Condition (LC) 30(3) to start-up Reactor 8 on completion of its periodic shutdown (also known as its statutory outage). This Project Assessment Report (PAR) presents my consideration of this request and recommends that ONR grants consent to start-up Reactor 8 through issuing Licence Instrument (LI) 610.

2 BACKGROUND

2.1 GENERAL

2. The nuclear site licence issued to NGL for HYB 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 HYB's Plant Maintenance Schedule (MS) under LC28. At HYB, reactor periodic shutdowns are undertaken triennially as specified in the MS Preface, which is an Approved document under LC28(4). The licensee 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 8 following a periodic shutdown. The previous consent to start-up Reactor 8, Heysham LI 580 (Reference 3), was dated 21 November 2013 and the Reactor 8 periodic shutdown 2016 commenced on 16 September 2016.

2.2 OUTAGE PLANNING AND MANAGEMENT

2.2.1 Outage intentions

4. NGL's planned outage work programme was outlined in the Heysham 2 Outage Intentions Document (OID) (Reference 4). This was examined by ONR specialist inspectors and the nominated site inspector in preparation for the outage intentions meeting held on 24 March 2016 (Reference 5).
5. During the Reactor 8 periodic shutdown 2016 the licensee 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.
6. The notable packages of work to be undertaken were:
 - High voltage (HV) (400kV) transmission replacement;
 - Fire resistant fluid (FRF) plant replacement; and
 - Graphite peripheral block inspections.
7. Following the effective practice employed during the previous R7 2015 outage, an island approach was to be adopted to plan and manage the outage activities. Co-located in the Outage Control Centre (OCC), the following island teams were deployed:

- Boiler Island;
- Fuel Route and In Service Inspection Island;
- Protection, Electrical and DP Systems Island – including 400kV transmission replacement;
- Reactor Island;
- Sea Water Island; and
- Turbine and Feed Island.

2.2.2 Licensee's outage management

8. The outage has been managed in accordance with the requirements of NGL's integrated company practice BEG/ICP/OPS/009 'Outage Management Process'.
9. In line with NGL's arrangements, a team of Independent Nuclear Assurance (INA) inspectors, NGL's own internal regulator, and outage staff from other stations, conducted a rapid trending review (RTR) during the second week of the outage; this was observed by the ONR nominated site inspector (Reference 6). The RTR identified points of positive feedback as well as highlighting areas for improvement during the outage.
10. NGL held a Mid-Outage Meeting on 13 October 2016, the purpose of which was to allow the licensee and ONR to review the progress and developments with the periodic shutdown (Reference 7). A Start-Up Meeting was held on 2 November 2016 for the licensee to demonstrate it had adequately met the requirements of the MS, dealt with emergent issues, identified any additional actions to be completed and demonstrated the safety of Reactor 8 for the next operational period.
11. On 7 November 2016, the HYB Station Director wrote to ONR requesting consent to start-up Reactor 8 on completion of the periodic shutdown (Reference 1). The licensee confirmed that it 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.
12. INA independently supported the request to start up the reactor following the outage when it was satisfied that the reactor was in a fit state to be restarted and that the associated risks were both tolerable and ALARP.
13. 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 8). A statement to support the request for consent to start up (Reference 9), was provided in advance of the formal concurrence part B statement, in-line with NGL arrangements (SRD/PROC/009).
14. The licensee produced a Return To Service (RTS) Engineering Change (EC) (Reference 10) that approves the results of inspections completed in the outage inspection programme. INA has issued an Independent Nuclear Safety Assessment (INSA) approval statement (Reference 11) for the RTS EC.
15. The PSSR competent persons (for the Pre-stressed Concrete Pressure Vessel (PCPV), the reactor penetrations and the balance of plant) have each confirmed that they are content for Reactor 8 to start up (References 12, 13 and 14).
16. Following ONR's issue of its consent to allow Heysham 2 Reactor 8 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

17. The ONR activities in support of the outage were planned and recorded in the ONR Station Outage Plan for Heysham 2 Reactor 8 Outage 2016 (Reference 15).
18. 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;
 - Operational experience (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.
19. The following ONR specialisms were identified as required for the HYB R8 outage 2016 project:
 - Graphite
 - Civil engineering
 - Structural integrity
 - Mechanical engineering
 - Electrical engineering
 - Control and instrumentation systems
 - Radiological protection
 - Fire safety
 - Management systems
 - Leadership and management for safety
 - Site inspection oversight
20. ONR's process for delivering a permissioning project requires preparation of a Project Assessment Report (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

21. The work undertaken by ONR can summarised as follows:
 - Engineering assessments and inspections of maintenance, modifications and other work during the outage covering the following areas:
 - Graphite core integrity
 - Civil engineering
 - Structural integrity
 - Mechanical engineering
 - Electrical engineering
 - Control and instrumentation
 - Assessment of the safety management of the outage including:
 - Radiological protection
 - Fire safety
 - Management systems
 - Leadership and management for safety
 - Outage management
 - Emergent issues

- Start-up meeting

3.1 ENGINEERING ASSESSMENTS

3.1.1 Graphite core integrity

22. Reference 16 provides the findings of the ONR graphite core integrity assessment of the graphite core inspections of Heysham 2 Reactor 8 during the 2016 periodic shutdown and supporting documentation provided by NGL.
23. NGL's intended scope of graphite inspections was identified by the Graphite Assessment Panel as:
 - Inspection of a minimum of 16 fuel channels both visually and dimensionally using the in-core inspection equipment.
 - Trepanning of a minimum of 24 graphite specimens with a target of between 30 - 36 and an upper limit of 42.
 - Visual Inspection of control rod channel MN86.
24. Following the observation of cracked graphite blocks in the peripheral wall during Torness Reactor 2 periodic shutdown in 2015, NGL committed to performing inspections of the graphite peripheral shield wall during the Reactor 8 2016 periodic shutdown. These inspections were planned for a minimum of 9 out of 16 faces of the peripheral shield wall with an upper target of 13 faces.
25. The inspection of 16 fuel channels in Reactor 8 identified one circumferentially cracked fuel brick, only the second observed crack in a fuel brick in Reactor 8. Generally Heysham 2 and Torness, its sister station, have a low number of early/mid-life cracked fuel bricks compared with Hunterston B, Hinkley Point B, Hartlepool and Heysham 1. These numbers were well below any level that would challenge the safety case and were within NGL's statistical prediction. The core distortion measurements were within expectation and the inspector considered these to be consistent with the expected slow progression of irradiation induced dimensional change.
26. NGL achieved the retrieval of 40 trepanned specimens and these 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.
27. The peripheral block inspection results and draft documentation provided by NGL claimed that the condition of the blocks were within the bounds of the safety case. The ONR inspector considered that NGL's inspection had not revealed any cracks which were of the severity of those observed in Torness Reactor 2. The inspector agreed with NGL's conclusion that the brick gapping was not sufficient to cause a significant bypass of the coolant flow.
28. The ONR inspector compared the NGL inspection findings with the current graphite safety case and assessed them against the relevant safety assessment principles. The inspector considered that the graphite core inspections results were within the bounds of NGL's safety case and do not present any impediment to the return to service of Reactor 8. The ONR inspector supported the issue of the consent for the start-up of Heysham 2 Reactor 8 following its 2016 periodic shutdown.

3.1.2 Civil Engineering

29. Reference 17 provides the findings of the ONR civil engineering assessment of the statutory examination of the pre-stressed concrete pressure vessel (PCPV) of Reactor 8 and other supporting documentation provided by NGL.
30. The scope of the assessment covered the findings of the surveillances, inspections and tests of certain key safety related components including:
 - Visual inspection of concrete surface condition;
 - Visual inspection of pre-stressing anchorages;
 - Tendon residual load tests;
 - Assessment of pre-stressing strand condition;
 - Strand tensile testing;
 - Settlement and tilt survey;
 - Review of embedded strain gauge readings;
 - Review of vessel concrete and liner temperatures;
 - Review of reactor coolant leakage;
 - Review of pressure vessel cooling water leaks;
 - Top cap deflection survey and
 - Bearings.
31. These surveillances, inspections and tests were those under the responsibility of the NGL Appointed Examiner (APEX) and were referenced in the plant Maintenance Schedule (MS). The assessment also included those activities undertaken since the previous periodic shutdown in 2013.
32. The inspector was satisfied with the data presented and the judgements of the APEX in the statement. Some of the inspection data was yet not available for ONR assessment and the inspector noted that it will be presented in the '28 day report'. The inspector therefore accepted the judgement of the APEX pending the issue of the 28 day report.
33. During outage maintenance operations being carried out to the steam pressure relief valves in Quadrant D of Reactor 8, the end support stool to a structural steel beam failed. This event and NGL's recovery are discussed below in the emergent issues section.
34. From the sampling of the results of the surveillances and inspections, engagement with site and acceptance of the judgements made by the Appointed Examiner, the inspector was content to support the return to service of the Reactor 8 pre-stressed concrete pressure vessel for the next operating period of three years.

3.1.3 Structural integrity

35. Reference 18 provides findings of the ONR structural integrity assessment of the licensee's scope and results of the examination, maintenance, inspection and testing of systems, structures and components on Reactor 8 that fulfilled a nuclear safety function.
36. The assessment primarily focussed on the licensee's work covering:
 - The inspections of:
 - Welds;
 - Metallic reactor internal structures and components;
 - Main cooling water system;
 - Pipe hangers.
 - Thermal movement survey

- Compliance with Pressure Systems Safety Regulations (PSSR)
37. During the periodic shutdown the inspector visited the site to confirm the adequacy of the work being conducted by the licensee. Based on the items important to safety the following areas were sampled:
 - 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;
 - Outage assessment panel meetings
 - PSSR examinations
 38. Following damage identified and repair work conducted during previous periodic shutdowns, the inspection report for the peripheral standpipe GH96 was reviewed. The inspector also viewed images of GH96 and considered that in his opinion the standpipe looked in reasonable condition with no signs of damage being observed.
 39. During the Reactor 7 2015 periodic shutdown an issue was identified with the specification of a number of bolts securing the seismic snubber pipe clamps. The similar Reactor 8 bolts had been identified and were inspected and replaced during this periodic shutdown.
 40. The failure of the end support stool of a support beam for the steam main line, see emergent issues below, was reviewed and considered to have no detrimental impact on the steam line.
 41. The inspector was satisfied with the proposed inspection programme, that the inspections had been undertaken in line with the Reactor 8 2016 outage intentions documents and that Heysham 2 had followed corporate procedures in the assessment and sentencing of inspection results. Where changes to the inspection scope had been made, the inspector was satisfied that they had been sentenced appropriately and in accordance with the licensee's arrangements.
 42. Based upon the sampling 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 8 from a structural integrity perspective.

3.1.4 Mechanical engineering

43. Reference 19 provides the findings of the ONR mechanical engineering review conducted during the outage. The review focused on the gas safety relief valves (GSRV) and the boron bead system.
44. The review was directed towards the GSRV maintenance as there had been a recent history of GSRVs lifting heavy, a greater pressure required to lift the seat, during initial outage testing at this and another station. During this outage one of the four valves was found to lift slightly heavy, but within the safety case limits. Following retesting the valve returned to operating within its specified tolerance.
45. The licensee considered the initial out of specification test result to be due to stiction, the initial frictional force required to be overcome to set an object in motion. Following a review of the documentation associated with the test, the inspector was satisfied that the GSRV which initially lifted above its set point in 2013 and 2016 operated within safety case limits and was content that licensee's test procedures provided adequate assurance of the GSRV operation prior to returning the reactor to power.

46. During the inspection of the boron bead injection system, the bead return line was found to have a blockage. The injection of the boron beads is one of the diverse hold down systems, but the bead return line was confirmed to have no nuclear safety function, as the return of the beads is only an operational issue. The boron bead injection line showed no indications of a blockage.
47. Based on the sampling undertaken as part of the review, the inspector was satisfied that activities undertaken under license condition 28 were adequate and therefore supported the return of Heysham 2 Reactor 8 to operation following its 2016 periodic shutdown.

3.1.5 Electrical engineering

48. Reference 20 presents the findings of the ONR electrical engineering inspection conducted during the outage. The inspection considered the electrical work being undertaken as part of the Reactor 8 statutory outage, including:
 - Planned electrical examination, inspection, maintenance and testing (EIMT) activities;
 - Implementation of the detailed modifications;
 - Reactive electrical work emergent from the outage.
49. The inspector reviewed the station's progress against electrical activities, both electrical maintenance and electrical modification, identified in the OID, focussing on generator transformers, variable frequency convertors and electrical switchgear.
50. The inspector observed modification work associated with HV Transmission Project during a plant walk down; preparations being made to install a new 400kV cable and a new 23.5kV load switch disconnecter associated with the new generator transformer. No significant issues had emerged with the scheduled installation work and on plant discussions, explanations and demonstrations enabled the inspector to observe the modification work being undertaken and the active management of the multiple work faces presented during this outage.
51. Two of the faults which had arisen during the outage; on switches and contactors associated with a boiler feed pump and a diesel generator, required changes to the EIMT arrangements to address the effects of ageing and infrequent exercising. These were reviewed and the new maintenance arrangements observed and judged to be adequate.
52. Variable speed drives (VSD), for control of the gas circulator speed post shutdown, had been installed to replace a number of the variable frequency converters (VFC). Following problems during the R715 installations, improved earthing arrangements had successfully resolved the issues. The VSDs provided a diverse method of controlling the gas circulators which should be supportable to end of the station life and freed up spares to support the older VFCs.
53. The inspection confirmed that the planned EIMT and modification activities undertaken during the outage period were appropriate and that electrical plant and equipment was being maintained in accordance with the established arrangements.
54. The inspector considered that based on the targeted intervention, no issues were identified from the electrical work activities that would prevent ONR granting consent for Reactor 8 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.

3.1.6 Control and instrumentation

55. Reference 21 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 HYB.
56. The areas reviewed during the inspection included:
- Data processing system;
 - Safety systems alarms memory replacement;
 - Neutron flux detectors;
 - Channel gas outlet temperature thermocouples;
 - Inlet guide vane instrumentation;
 - Gas circulator instrumentation;
 - In-vessel thermocouple repatching.
57. The inspector found that the data processing systems software modifications and safety systems alarm memory replacement were being suitably managed and documented.
58. The status and re-patching of the channel gas outlet temperature thermocouples (T/C) and reactor in-vessel T/C were being suitably managed and documented. The status (connection/location) and management of neutron flux detection equipment was suitably managed and documented, and arrangements for the examination, inspection, maintenance and testing of the samples reactor safety circuit instrumentation and gas circulator instrumentation were adequate.
59. The inspector found that relevant good practice was generally met, with minor shortfalls identified, when compared with appropriate benchmarks. These shortfalls would be monitored by the C&I inspector through routine regulatory business. On the basis of the inspection of the C&I aspects of the outage, the inspector supported the consent to allow Reactor 8 at HYB to return to normal operating service.

3.2 SAFETY MANAGEMENT

3.2.1 Radiological protection

60. Reference 22 presents the findings of the ONR radiological protection inspection conducted during the outage. The aim of the intervention was to establish whether the licensee's statutory outage work programme was being conducted in compliance with the Ionising Radiations Regulations 1999 (IRR99).
61. The following matters were addressed during the inspection:
- The licensee's statutory outage work programme and its radiological implications.
 - Radiation protection input to outage work planning
 - Planning for radiologically significant outage tasks.
 - Operational dose management.
 - Radiation protection personnel and monitoring equipment provision.
 - Contractor control and supervision.
 - Integration of ALARP management principles with personal radiation exposure restriction and contamination control.
 - Radiological protection training.
 - Radiation survey instrument maintenance and provision.
 - Record-keeping.

- Radiological event investigation and follow-up.
 - Plant inspections of the Radiological Controlled Area (RCA) including the pile-cap/ charge-hall; gas circulator 'hall' and other areas of inspection interest.
62. The licensee's ALARP Committee had for some time recognised that the number of personal contamination events (PCEs) was higher than desirable and that action was needed to reduce the number. A working group had been established six months prior to the outage to focus on reducing the number of PCEs. The licensee had set an outage expectation of less than 3 PCEs per 10,000 entries and achieved 2.5 PCEs per 10,000 entries by the time of the start-up meeting.
63. The inspector's discussions with the licensee's radiological protection staff indicated their strong commitment to effective radiological protection practice and a good level of compliance with the IRR99 was evident during plant inspections.
64. The inspector was content, from a radiological protection perspective, with the licensee's conduct of its statutory outage work programme and with its level of compliance with the IRR99. The inspector supported consent being given, under licence condition 30(3), to allow Reactor 8 to return to normal operating service.

3.2.2 Fire safety

65. Reference 23 provides the findings of the ONR fire safety inspection conducted prior to the outage to confirm that the General Fire Safety provisions on site were adequate and to confirm compliance with the requirements of the Regulatory Reform (Fire Safety) Order 2005 was being achieved.
66. The fire safety measures pertinent to the forthcoming outage were reviewed, this included:
- Management controls and approach to fire safety;
 - Turbine Hall;
 - Auxiliary boiler house;
 - Fire pumping house;
 - Temporary accommodation units (TAUs) provided for the outage contractor;
 - Pre-outage muster demonstration.
67. A number of areas were identified where improvements could be made the current site arrangements and would be followed up by the fire safety inspector through routine regulatory interventions. Overall the inspector found a good level of management and control in relation general fire safety on site.

3.2.3 Management systems, LC17

68. Reference 24 provides the findings of the ONR inspection of the quality management arrangements being applied for the 400kV transmission replacement project. This inspection was conducted immediately prior to the outage while the preparatory work was being conducted.
69. This project was a repeat of the work that was undertaken on the R7 unit in 2015 and it included the replacement of transformer, switchgear, control systems and cabling. Good use had been made of the OPEX and learning from experience (LFE) from the previous installation on R7 unit which led to improved ways of working for the R8 unit. An example of this was the improved document control arrangements and the introduction of a dedicated document controller for the project. There had been good

interaction and dialogue with the contractors to identify all round efficiency improvements.

70. The inspector considered that there were robust project management and project oversight arrangements in place and that there was good integration with the outage planning team. It was noted that the responsible engineer provided robust technical oversight which enabled quality to be built in as the project progressed.
71. There were adequate arrangements in place for controlling interfaces between the contractors. An interface document illustrating the interfaces had been produced which was complemented by a work sequencing document which in turn was linked to the outage plan. The project had a strong interaction with the outage management team and the protection and electrical outage island.
72. Overall, from the activities sampled and the discussions with project staff, the inspector was satisfied that robust project and quality management arrangements were in place for the 400kV programme of work being undertaken during the R8 outage and were considered adequate to permit a return to service of the unit.

3.2.4 Organisational capability, LC36

73. Reference 6 details the outcome of an LC36 compliance inspection on “Organisational Capability” which was undertaken by an ONR leadership and management for safety inspector. This compliance inspection was designed to complement the rapid tending review being undertaken by NGL’s internal regulator, INA, and focused on the station’s outage organisation.
74. Based upon the evidence sampled during the inspection, the inspector considered that the station demonstrated that:
 - The licensee’s arrangements for LC36 align with corporate processes;
 - Awareness of fatigue had been raised, training provided and expectations set regarding excess hours;
 - Monitoring, accountability and HR support were established to support the outage;
 - The Station was self-identifying non-conformance with the derogation process;
 - There was learning from previous outages at both Station and Fleet level and evidence that changes had been made.
75. The working time directive requirements were reviewed near the end of the outage. The licensee reported that the hours worked by staff were a lot better controlled compared to previous outages, 61 occurrences requiring derogations compared to 323 required for the R7 2015 outage.
76. It was noted that the event recovery for the interstitial manipulator, see below, required a significant amount of unplanned work. How this was managed and its impact on worker fatigue was reviewed (Reference 25) and found to have been appropriately managed through the use other station, fleet and contract partner staff. No derogations were required for staff involved in this work.
77. The inspector considered that the arrangements and their associated implementation for LC36 for the sample undertaken met with the required standards and reflected relevant good practice.

3.2.5 Outage management

78. Over the duration of the outage the nominated site inspector observed the operation of the outage control centre (OCC) and a variety of the outage management meetings including:
- OCC island briefs;
 - Morning safety brief;
 - OCC morning briefs;
 - Plant manager's brief;
 - Central Control Room end of shift brief;
 - Peripheral brick assessment panel.
79. The nominated site inspector conducted an unannounced inspection which examined the licensee's arrangements with respect to how the Station's control and supervision, LC 26, of Reactor 8 statutory outage activities was managed during the silent hours of operations, see Reference 26.
80. The inspection sampled the following areas:
- Outage Coordination Centre
 - Gas circulator maintaining on Reactor 8 Bravo Quadrant
 - Pile Cap activities
 - Turbine Hall
 - Central Control Room
81. The inspector observed several activities being undertaken by Heysham 2 staff, contract partners and third party contractors. From observations and engagements with the individuals concerned the inspector identified one minor shortfall relating to confined space working arrangements in a gas circulator penetration. The station took immediate action to address this minor shortfall and shared the learning with the rest of the station.
82. The inspector judged that based on the sampled inspection, the implementation of the arrangements for LC26 met with the required standards.
83. During the outage the nominated site inspector had regular dialogue with the Technical, Safety and Support Manager and Station Director to discuss the routine station activities, general outage progress and safety performance (Reference 27).

3.3 EMERGENT ISSUES

3.3.1 Support beam stool failure

84. During outage maintenance operations being carried out to the steam pressure relief release valves in Quadrant D of Reactor 8, the stub support stool to a structural steel beam, which supported the main steam line via a pipe hanger, failed. Although the failure led to a drop in level in the end of the beam the steam main continued to be supported by the hanger and did not move. The incident was subject to an event recovery process in accordance with NGL's arrangements. NGL reported that no-one was injured in the incident.
85. Reference 28 details the intervention conducted by the ONR civil engineering specialist into the support stool failure event. The purpose of the intervention was to undertake follow-up enquiries into the incident in order for ONR to obtain further information regarding:
- The nature of the incident and its possible causes.

- Modifications to the steelwork required to undertake the planned maintenance activities.
 - Likelihood of the incident occurring at other stations
 - The adequacy of NGL's response.
86. Following the incident, NGL inspected similar beams in the other three quadrants and considered that all three stub support stools had also effectively failed due to distortion, although not to the extent the bracket in D quadrant had deformed. NGL stated that it was considered that the stool section was a poor design. A replacement stool section was designed and installed in each quadrant of Reactor 8, allowing the damaged stools to be removed.
87. Due to the similarity of design, Reactor 7 was inspected and no collapse of any of the support stools was found. When the reactors are in their operational configuration a cross linking beam provides additional support which prevents the collapse of the support stool. NGL have made a commitment to replace the equivalent steel support stools on Reactor 7 and on the two reactors at Torness Power Station as soon as reasonably practicable.
88. The ONR structural integrity inspector was satisfied from discussions with station personnel that there had been no significant impact on the main steam pipework attached to the steelwork. The inspector also reviewed documentation which underpinned their claims, including a report which considered the consequences of single hanger failure in a quadrant. This was considered adequate by the ONR structural integrity inspector.
89. The ONR inspectors requested that NGL provide confirmation that the structural steelwork was adequate and capable of supporting the operational steam main pipework for both operational and hazard loading prior to consent being given for Reactor 8 start up.
90. A contributory factor in the stool failure was considered to be the removal of a cross linking piece of steelwork to enable access for maintenance activities. The civil engineering inspector has required NGL to demonstrate that all temporary modifications to the structural steelwork are adequately controlled in accordance their arrangements. This will be followed up on completion of the periodic shutdown.
91. The licensee has provided a formal statement based on engineering judgment from an experienced SQEP member of the Civil Design Group that the structural steelwork was adequate, Reference 29; the ONR inspectors considered this to be adequate, References 30 and 31, and supported the consent for the start-up of Reactor 8.

3.3.2 Interstitial manipulator

92. During the outage, the interstitial manipulator (IM) used to perform a number of the internal inspections became inoperable and was unable to be removed from the penetration. The licensee entered its event recovery process to enable the IM to be removed from the penetration.
93. Whilst the direct impact of this event was operational, the reactor could not be started up with IM in place; there were however implications on the remaining inspections being conducted on the reactor. The event recovery was monitored to ensure that the peripheral block inspections and graphite trepanning samples were completed to achieve the minimum requirements of the safety case.
94. During the event recovery the fall-back option was for a manned vessel entry to release the IM. An ALARP decision was made based on dose, time and cost. The

station undertook a conservative approach and considered it prudent that preparations were progressed should the vessel entry be required.

95. The IM was eventually recovered through the use of tools attached to a second manipulator. The event will now be investigated to establish the cause of the failure and to identify actions to help prevent a recurrence.
96. The number of graphite inspections completed met the safety case requirements but some of the vessel/penetration inspections were not completed and deferred until the next outage. Overall this was considered to be a well-managed event recovery and there was no impact on nuclear safety.

3.4 START UP MEETING

97. The Start-Up Meeting was held on 2 November 2016. Prior to this meeting there was a comprehensive plant walk-down on 1 November 2016. ONR was represented by the Superintending Inspector, the Site Inspector and Project Inspector. The plant walk-down was preceded by a presentation on the IM event recovery and the peripheral brick cracking inspections. The walk down encompassed many of the major work packages conducted during the periodic shutdown. A number of the work packages were for long term replacement of items; e.g. FRF plant replacement and 400kV transmission replacement, to enhance nuclear safety and/or improve reliability through to the plant end of life.
98. It was noted that a considerable amount of planning and LFE had gone into this outage to ensure the outage activities were optimised and well controlled.
99. We observed consistently good and positive challenge from the NGL staff and the knowledge and ownership of the plant by each of the system leads was commended.
100. The Start-Up Meeting was chaired by the station Technical and Safety Support Manager and was again 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 8 for the next operational period. The Heysham 2 Reactor 8 2016 Outage Start-Up Report, Reference 32, was provided prior to the meeting and was used as the basis for the presentations and discussions held during the meeting.
101. During the start-up meeting the failed support stool was discussed and the wording of the start-up consent action was confirmed. The required assessments were being produced at would be provided as part of the consent request package. A detailed record of the meeting is contained in Reference 33.
102. No further actions were identified during the meeting.

4 MATTERS ARISING FROM ONR'S WORK

103. I have considered the licensee's request to ONR to grant a consent under LC30(3) to start-up Heysham 2 Reactor 8 on completion of its periodic shutdown. To inform my work I 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 advice of ONR specialist inspectors and the ONR site inspector.
104. The licensee 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.

105. INA has provided a concurrence statement (Reference 9) which confirmed that based on their assessment activities so far, there were no issues which they were aware of which would prevent their provision of the concurrence part B prior to start up.
106. The PSSR competent persons (for the nuclear island and the conventional island) have confirmed that their examinations have been satisfactorily completed and the plant was considered to be acceptable to return to service.
107. ONR specialist assessors from the following disciplines undertook inspections and assessments to support ONR permissioning RTS:
 - Graphite
 - Civil engineering
 - Structural integrity
 - Mechanical engineering
 - Electrical engineering
 - Control and instrumentation systems
 - Radiological protection
 - Fire safety
 - Management systems
 - Leadership and management for safety
108. Each discipline has produced a report that presents the inspection findings, inspector's opinions, judgments and recommendations. A single action requiring resolution before granting of consent was raised, relating to the support stool failure, this has been satisfactorily resolved.
109. A number of recommendations arose from the inspectors' work which will be addressed through routine regulatory business. All the reports contain either a statement supporting issuing consent to start-up the reactor, or note that there is no reason to withhold consent.
110. I consulted with other relevant regulators, Environment Agency (EA) and Civil Nuclear Security (CNS), to establish if either had any specific objections that would prevent ONR from issuing LI 610, consent to start-up Heysham 2 Reactor 8. Both the EA (Reference 34) and CNS (Reference 35) confirmed they do not object to ONR granting consent.

5 CONCLUSIONS

111. The Heysham 2 Reactor 8 periodic shutdown 2016 has been undertaken in accordance with the requirements of the work scope outlined within the OID.
112. 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 8. His letter stated that he was satisfied that there were no safety issues associated with return to service of Reactor 8 and that any emergent issues which required safety justifications would be sufficiently dealt with as part of the Engineering Change Process.
113. The licensee's internal regulator, INA, has provided a concurrence statement that confirmed that they have no issues that would prevent the provision of the concurrence part B report in due course to support the return to service of Reactor 8 following its periodic shutdown.
114. The PSSR competent persons have each confirmed that they are content for Reactor 8 to start up.

115. 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. The single consent action raised during the inspections has been satisfactorily addressed.
116. I consider that the licensee delivered a shutdown that was safely managed and completed the required safety related work activities.
117. Following assessment and inspection of matters arising in relation to the Heysham 2 Reactor 8 periodic shutdown 2016, I am 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.
118. I have prepared Licence Instrument 610, for LC 30(3) consent, in conjunction with this PAR.

6 RECOMMENDATIONS

119. I 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 610.
120. I recommend that ONR issues Licence Instrument 610, which grants consent under Licence Condition 30(3) attached to Nuclear Site Licence No.60 to start-up Heysham 2 Reactor 8.

7 REFERENCES

- 1 NGL - HYB51053R Request for Consent for Start-up Reactor 8 under LC 30(3), 7 Nov 2016, TRIM 2016/434295
- 2 Heysham 2 - Licence Instrument 11 - HYB70470N - Specification LC30(3) - Requirement for a consent to start up a reactor after LC30(1) shutdown, 25 March 1996, TRIM 2016/182843
- 3 Heysham 2 - Licence Instrument 580 - Consent under Licence Condition 30(3) to start up Heysham 2 Power Station Reactor 8 following the 2013 periodic shutdown, 21 Nov 2013, TRIM 2013/431833
- 4 Heysham 2 - HB-REPS-MO025 - Outage Intentions Document - Unit 8 2016 (R816) Statutory Outage, March 2016, TRIM 2016/119561
- 5 NGL – CNRP – Contact Record - 15-377 - Heysham 2 R8 2016 Outage Intentions Meeting, 24 March 2016, TRIM 2016/137270
- 6 NGL - OFP - Intervention Record - 16-132 - Heysham 2 Reactor 8 Statutory Outage 2016 - Licence Condition Compliance Inspection of LC36 and Rapid Trending Review, Sept 2016, TRIM 2016/389315
- 7 NGL - OFP - Contact Record - 16-387 - Heysham 2 R8 2016 Mid-Outage Meetings, 12-13 Oct 2016, TRIM 2016/412669
- 8 Heysham 2 - SRD/REP/CON/HYB/011A - INA concurrence (part A) for R816 statutory outage, July 2016, TRIM 2016/321134
- 9 NGL - HYB51053R Appendix 12 INA Concurrence Document, 25 Oct 2016, TRIM 2016/432569
- 10 NGL - HYB51053R Appendix 11 - EC 353443 Statutory Outage Approval of Inspection Results, 7 Nov 2016, TRIM 2016/432560
- 11 NGL - HYB51053R Appendix 11a - EC 353443 RTS - INSA APPROVAL Statement, 7 Nov 2016, TRIM 2016/432561
- 12 Heysham 2 R8 2016 - NGL - HYB51053R Appendix 2A Certificate of Maintenance Schedule Completion for Pressure Vessel, 26 Oct 2016, TRIM 2016/432532
- 13 NGL - HYB51053R Appendix 2B - Written Scheme of Examinations Heysham 2 Power Station Reactor 8 CPV Penetration PSSR Inspections, 31 Oct 2016, TRIM 2016/432533
- 14 NGL - HYB51053R Appendix 1 Written Scheme of Examination Statement from Bureau Veritas, 3 Nov 2016, TRIM 2016/432530
- 15 ONR Station Outage Plan - Heysham 2 R8 Outage 2016, Sept 2016, TRIM 2016/72548
- 16 ONR-OFP-AR-16-048 - Heysham 2 Reactor 8 2016 Periodic Shutdown – Assessment of the results of the Graphite Core Inspections, 7 Nov 2016, TRIM 2016/426948
- 17 NGL - Heysham 2 – Assessment Report – 16-041 - Assessment of Statutory Examination of the Pre-stressed Concrete Pressure Vessel - R8, Oct 2016, TRIM 2016/405354
- 18 NGL - Heysham 2 - Assessment Report - 16-38 - Assessment of Structural Integrity in Support of the Restart of Reactor 8 following the 2016 Periodic Shutdown, 8 Nov 2016, TRIM 2016/390852
- 19 Heysham 2 R8 2016 - Mechanical Desktop Review of Heysham 2 R8 Outage 2016, 31 Oct 2016, TRIM 2016/417116
- 20 NGL - OFP - Intervention Record - 16-140 - Heysham 2 Reactor 8 Statutory Outage 2016 - Inspection of Electrical Related Aspects, 5 Oct 2016, TRIM 2016/394419
- 21 NGL - OFP - Intervention Record - 16-153 - Heysham 2 Reactor 8 Statutory Outage 2016: Control and Instrumentation (C&I) Inspection, 24 & 25 Oct 2016, TRIM 2016/423033
- 22 NGL - OFP - Intervention Record - 16-152 - Heysham 2 Reactor 8 Statutory Outage 2016. Radiological Protection Inspection under LC 30, 11 Oct 2016, TRIM 2016/413910

- 23 ONR-COP-IR-16-034 - Fire IR Heysham 2, 6 Sept 2016, TRIM 2016/341013
- 24 NGL - OFP - Intervention Record - 16-121 - Heysham 2 - Inspection to support Outage Intervention Strategy focusing on LC 17, 13-14 Sept 2016, TRIM 2016/369566
- 25 Heysham 2 R8 2016 - Impact of event recovery on hours worked, 31 Oct 2016, TRIM 2016/430347
- 26 NGL - OFP - Intervention Report - 16-139 - Heysham 2 - Unannounced LC26 Inspection, 5 Oct 2016, TRIM 2016/398521
- 27 NGL – OFP – Contact Record - 16-381 - Reactor 8 2016 Statutory Shutdown updates, 18 Oct 2016, TRIM 2016/412423
- 28 NGL - OFP - Intervention Record - 16-154 - Heysham 2 Reactor 8 Periodic Shutdown 2016 – Failure of a structural steelwork beam supporting the main steam pipework, 25 Oct 2016, TRIM 2016/427165
- 29 NGL - HYB51053R Appendix 18a - EAN Civil Design Group R8 Outage Review of Main Steam Pipework Supports, Nov 2016, TRIM 2016/432577
- 30 Heysham 2 R8 2016 - Return to Service documentation - Appendix 18 - Grey beam justification - Review by Civils, 8 Nov 2016, TRIM 2016/433153
- 31 Heysham 2 R8 2016 - Review of recommendations from structural integrity assessment , 8 Nov 2016, TRIM 2016/433285
- 32 Heysham 2 - R8 2016 - Start-up report - HB/REPS/MO027, 27 Oct 2016, TRIM 2016/418946
- 33 NGL - OFP - Contact Record - 16-427 – Heysham 2 R815 Outage Start-Up Meeting, 2 Nov 2016, TRIM 2016/436401
- 34 Heysham 2 R8 2016 - Outage start-up - Environment Agency no objection , 25 Oct 2016, TRIM 2016/413475
- 35 Heysham 2 R8 2016 - Outage Start-up meeting - Security Statement - 4 Nov 2016, TRIM 2016/434270