Office for Nuclear Regulation

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Sizewell B – Periodic Shutdown 2017 (Refuelling Outage 15)

EDF Energy Nuclear Generation Limited (NGL) – Sizewell B - Consent under Licence Condition 30(3) to start-up the reactor following periodic shutdown.

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EXECUTIVE SUMMARY

Title

EDF Energy Nuclear Generation Limited (NGL) – Sizewell B - Consent under Licence Condition 30(3) to start-up the reactor following periodic shutdown.

Permission Requested

NGL, the licensee of Sizewell B power station, has requested that the Office for Nuclear Regulation (ONR), grants consent to start-up the reactor following its periodic shutdown as required under Licence Condition (LC) 30(3) of nuclear site licence number 63.

Background

Sizewell B is a single pressurised water reactor (PWR) incorporating a nuclear steam supply system (NSSS) based on a Westinghouse standard four loop design. The NSSS comprises of enriched uranium fuel assemblies contained within a steel reactor pressure vessel (RPV) with four associated coolant loops each connected in parallel to the RPV. Each cooling water loop has its own reactor coolant pump (RCP), steam generator (SG) and interconnecting pipe work. The primary cooling circuit is closed and pressurised by a single pressuriser vessel which is maintained part filled with water and part with steam in equilibrium. The secondary coolant side is isolated from the primary cooling circuit by the steam generator tubes that produce steam which is passed to two 600MW turbine generators producing a nominal 1200MW of electricity.

The reactor operating cycle lasts approximately 18 months, when it is required to shut down so that it can be refuelled. When refuelling is undertaken, some of the fuel assemblies (around one-third) are replaced with new ones. The existing fuel assemblies are returned to the core in a rearranged array to ensure optimum fuel utilisation.

To continue to operate safely and reliably the reactor plant requires regular examination, inspection, maintenance and testing. Continuous improvement also requires plant upgrades to be implemented where deemed to be reasonably practicable. Whilst some of these activities can safely take place when the reactor is operating at power, many of them require the reactor to be shut down. The refuelling outages at Sizewell B provide the opportunity for undertaking such activities. As required under an ONR legal Specification, the reactor may not be started-up following a refuelling outage without the Consent of ONR.

The current shutdown of the Sizewell B reactor commenced on 3rd November 2017 and represents commencement of refuelling outage 15.

In addition to the routine inspection and maintenance activities, the following significant planned work was completed during the outage:

- Inspection of control rod drive mechanism J-weld
- Polar crane load monitoring panel - refit and calibration
- Reactor building fan cooler motor assembly exchange

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 Sizewell B to evaluate samples of the licensee's EIM&T activities. .

Routine examination of the Sizewell B Steam Generator (SG) D channel head bowl, undertaken by NGL at the start of the outage, revealed minor deposits of boric acid crystals which were confirmed to have originated from the primary circuit in this operating cycle. On removing insulation from the channel head bowl, evidence of a pinhole defect in a weld adjacent to the drain line insert was identified. A review of repair options was initiated in response to the discovery, this being led from the station with support from the company's Design Authority and Structural Integrity support.

Non-destructive testing (NDT) performed by NGL identified hairline radial cracks in all four steam generator drain line weld pads, caused by primary water stress corrosion cracking. The extent of the cracks was found to be limited and the defective material was removed. With sufficient material of the weld pad remaining, it was possible to adopt a plug repair option on all four SGs.

ONR's structural integrity specialist inspectors closely monitored developments to examine:

- NGL's inspection and NDT of all four steam generator channel heads
- Development and execution of repair solutions.
- Justification for return to service of the repaired steam generators.

ONR's structural integrity specialist inspectors are satisfied that the repair method chosen by NGL was based on sound engineering judgement and was subject to the appropriate scrutiny through appropriate NGL company processes. They also satisfied with the testing and qualification work performed to ensure that the repair was performed to a high standard.

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 the reactor for a further operating cycle, 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.

No matters preventing the granting of consent to start-up arose from the work undertaken by ONR inspectors in relation to the Sizewell B reactor periodic shutdown 2017, refuelling outage 15.

Conclusions

Following assessment and inspection of matters arising in relation to the Sizewell B reactor periodic shutdown 2017, 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.63 for the reactor at Sizewell B nuclear power station to start-up following the 2017 periodic shutdown, and Licence Instrument 553 be issued and released to the licensee to permit this outcome.

LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
APEX	Appointed Examiner
ASME	American Society of Mechanical Engineers
C&I	Control and Instrumentation
CEGB	Central Electricity Generating Board
CR	Condition Report
CRDM	Control Rod Drive Mechanism
CRPG	Cycle Related Project Group
CTO	Central Technical Organisation
EA	Environment Agency
EBS	Emergency Boration System
EC	Engineering Change
EDG	Essential Diesel Generator
EIM&T	Examination, Inspection, Maintenance and Testing
FA	Fuel Assemblies
FME	Foreign Material Exclusion
HICS	High Integrity Control System
INA	Independent Nuclear Assurance
INSA	Independent Nuclear Safety Assessment
LC	Licence Condition
LI	Licence Instrument
LOLER	Lifting Operations and Lifting Equipment Regulations
NGL	EDF Energy Nuclear Generation Limited
NSSS	Nuclear Steam Supply System
OCC	Outage Control Centre
OID	Outage Intentions Document
ONR	Office for Nuclear Regulation
OPEX	Operational Experience
PAR	Project Assessment Report
PCC	Pre-stressed Concrete Containment
PCS	Plant Control System
PCG	Plant Computing Group
PMI	Plant Maintenance Instruction
PORV	Power Operated Relief Valve
PPS	Primary Protection System
PSSR	Pressure Systems Safety Regulations
PWR	Pressurised Water Reactor

PWSCC	Primary Water Stress Corrosion Cracking
RCCA	Rod Cluster Control Assembly
RCP	Reactor Coolant Pump
RHR	Residual Heat Removal
RO15	Refuelling Outage 15 (this outage)
RPV	Reactor Pressure Vessel
RTR	Rapid Trending Review
RTS	Return To Service
RUHS	Reserve Ultimate Heat Sink
SAP	Safety Assessment Principle(s)
SG	Steam Generator
SIP	Structural Integrity Panel
SME	Subject Matter Expert
SP	Surveillance Programme
SQEP	Suitably Qualified and Experienced Person
SZB	Sizewell B power station
TDAFW	Turbine Driven Auxiliary Feed Water (pump)
UT	Ultrasonic Testing

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1 PERMISSION REQUESTED

1. EDF Energy Nuclear Generation Limited (NGL), the operator and licensee of Sizewell B power station, has written (Reference 1) to the Office for Nuclear Regulation (ONR) requesting consent under Licence Condition (LC) 30(3) to start-up the reactor on completion of its periodic shutdown (also known as its refuelling outage (RO15)). This Project Assessment Report (PAR) presents my consideration of this request and recommends that ONR grants consent to start-up the reactor through issuing Licence Instrument (LI) 553.

2 BACKGROUND

2.1 GENERAL

2. Sizewell B is a single pressurised water reactor incorporating a nuclear steam supply system (NSSS) based on a Westinghouse standard four loop design. The NSSS comprises of enriched uranium fuel assemblies contained within a steel reactor pressure vessel (RPV) with four associated coolant loops each connected in parallel to the RPV. Each cooling water loop has its own reactor coolant pump (RCP), steam generator and interconnecting pipe work. The primary cooling circuit is closed and pressurised by a single pressuriser vessel which is maintained part filled with water and part with steam in equilibrium. The secondary coolant side is isolated from the primary system by the steam generator tubes that produce steam which is passed to two 630MW turbine generators producing a nominal 1260MW of electricity.

3. The reactor operating cycle lasts approximately 18 months when it is required to shut down so that it can be refuelled. When refuelling is undertaken, some of the fuel assemblies (around one-third) are replaced with new ones. The existing fuel assemblies are returned to the core in a rearranged array to ensure optimum fuel utilisation.

4. To continue to operate safely and reliably, the reactor plant requires periodic examination, inspection, maintenance and testing. Ongoing plant modifications and upgrades are implemented where deemed to be reasonably practicable. Whilst some of these activities can safely take place when the reactor is operating at power, many of them require the reactor to be shut down. The refuelling outages at Sizewell B provide the opportunity for undertaking such activities.

5. ONR has specified (Reference 2) that the licensee requires consent from ONR under LC 30(3), to start-up the reactor following a periodic shutdown. The previous consent to start-up the reactor, Sizewell B LI 550 (Reference 3) was dated 31 May 2016.

6. The current shutdown for the Sizewell B reactor commenced on 3 November 2017 and represents the end of cycle 15 and commencement of refuelling outage 15.

2.2 OUTAGE PLANNING AND MANAGEMENT

2.2.1 Reactor outage intentions

7. NGL's planned outage work programme was outlined in the Sizewell B 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 31 May 2017 (Reference 5).

8. Refuelling Outage 15 was noted to be short in duration and therefore limited major work packages had been scheduled. ONR inspectors did not raise any specific issues relating to the content of the OID but sought clarification on some topics which were subsequently satisfactorily addressed by NGL.

9. Prior to the start of the outage the station received Operating Experience from the manufacturer of the Turbine Driven Auxiliary Feed Water (TDAFW) pumps, indicating hairline cracks on the impeller at two international PWR stations. The station produced Engineering Change (EC) 361652 justifying operability until RO15 Mode 5. ONR was satisfied with this position.

2.2.2 Licensee's outage management

10. The arrangements for the management of the refuelling outage are described in the Station Management Control Procedure SZB/MCP/034V 'Outage Management' which implemented the requirements of NGL's integrated company practice BEG/ICP/OPS/009 'Outage Management Process'.

11. NGL's own internal regulator, Independent Nuclear Assurance (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.

12. 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 6). A statement to support the request for consent to start up (Reference 7) was provided in advance of the formal concurrence part B statement, in-line with NGL arrangements (SRD/PROC/009).

13. In line with NGL's arrangements, a team of INA inspectors, and outage staff from other stations, conducted a rapid trending review (RTR) during the first week of the outage, observed by the ONR outage project inspector. The RTR report (Reference 8) presented points of positive feedback as well as highlighting areas for improvement during the outage.

14. The licensee produced a Return to Service (RTS) Engineering Change (EC) (Reference 9) that approves the results of inspections completed in the RO15 inspection programme. INA has issued an Independent Nuclear Safety Assessment (INSA) approval statement (Reference 10) for the RTS EC.

15. Following ONR's issue of its consent to allow Sizewell B 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

16. 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.

17. The ONR activities in support of the NGL outages for 2017/18 are articulated in task sheet TS074 (Reference 11). The task sheet was endorsed by the Operating Reactors sub division board.

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
- OPEX and outstanding issues recorded in the regulatory issues database
- specialism specific areas of interest
- other areas of interest which could only be assessed during an outage period

19. The following ONR specialisms were identified as required for the RO15 project:

- Structural integrity
- Fuel Performance
- Mechanical engineering
- Electrical engineering
- Control and Instrumentation systems
- Civil Engineering
- Radiological Protection
- Site inspection oversight

20. 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.

21. The RO15 project inspector has maintained a spreadsheet Sizewell B RO15 Outage ONR Action Tracker (Reference 12) to monitor progress and status of all restart and non-restart related actions.

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

22. 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
  - Fuel performance
  - Mechanical engineering
  - Electrical engineering
  - Control and instrumentation
  - Civil Engineering
- Assessment of the safety management of the outage including radiological protection and outage management.
- Response to emergent issues
- Attendance at start-up meeting

3.1 ENGINEERING ASSESSMENTS

3.1.1 Structural integrity

23. Reference 13 presents ONR's assessment of the adequacy of the inspections of components required by ASME Boiler and Pressure Vessels Code, Section XI, any additional components of note and compliance with Pressure Systems Safety Regulations (PSSR) undertaken during Sizewell B periodic shutdown.

24. The assessment was conducted in three stages:

- Routine level 4 meetings on Surveillance Programme (SP) 6 and SP9 work streams and a review of the outage intentions proposals (including attendance at the outage intents meeting),
- Inspection at Sizewell B to evaluate the adequacy of the EIM&T in progress during the outage,
- Monitoring of the Structural Integrity Panel (SIP) through attendance over the phone and reading the minutes throughout the outage to identify how the inspections are progressing and how any issues identified are managed and resolved.

25. During a scheduled walkdown within containment to look specifically for boric acid leak sites, the licensee identified a pinhole leak in the connection weld of the steam generator 'D' (SG D) drain line. The investigation and repair of the leak is discussed further in section 3.3.1.

26. Completing this periodic shutdown is the start of Sizewell B's 3rd ASME XI 10 year inspection cycle. The Reactor Pressure Vessel top dome (head) inspections were an element of this outage. The specialist inspector enquired as to the sentencing of indications detected on several CRDM (Control Rod Drive Mechanism) penetrations, and has received justification that these are not in-service defects. The inspector was satisfied that this justification adequately demonstrated the safety of continued operations.

27. The inspections of the reactor pressure vessel flux thimble tubes had been deferred from RO14 due to inspection equipment incompatibility. Appropriate modifications were made during RO15 and the thimble tube inspections were conducted. The inspector noted that the inspection of five of the 58 tubes had not been completed but had no objection to these being deferred until a future outage.

28. He was satisfied that the inspections have been undertaken in line with the 2017 outage intentions documents and that Sizewell B have followed corporate procedures in the assessment and sentencing of inspection results.

29. Through sampling of the inspection activities during his site visit and through activities subsequent to this he was satisfied that Sizewell B are following the ASME code and have complied with Licence Condition 28.

30. Based upon the sampling he undertook, and the evidence presented, he judged that the licensee has undertaken sufficient inspection and assessment to support the safe return to service of Sizewell B from a structural integrity perspective, and no issues, other than the Steam Generator D drain line leak, have been found that would prevent Sizewell B from returning to service from a structural integrity perspective for the next operational period.

31. Following concerns raised on products manufactured by Kobe Steel Group, ONR has sought further information from NGL, this is discussed further in section 3.3.4.

32. On completion of repairs to the drain lines on all four steam generators, the inspector completed an assessment of the return to service engineering change justification for the steam generator drain line repairs. He judged the justification was adequate and supported the return to service of the Sizewell B reactor.

33. From a structural integrity perspective, he has no objection to ONR issuing the Licence Instrument to grant a Consent for start-up of Sizewell B Nuclear Power Station, following the 2017 periodic shutdown.

3.1.2 Fuel performance

34. The Sizewell B Cycle 16 reload safety case has been subject to a limited assessment, Reference 14, by an ONR specialist fuels inspector given that the safety case is similar to that made for Cycle 15, for which a full assessment was previously conducted.

35. Whilst the reload safety case for cycle 16 is similar to that for cycle 15, the specialist fuels inspector noted that the cycle length has been increased by 10%. This is a minor change for a single cycle and has not challenged the margins available in the generic reload safety case. However, the licensee plans to continue to increase cycle lengths and add reactivity in cycle 17 through increased fuel enrichment. He therefore recommends that the cycle 17 safety case should be considered for a full ONR assessment.

36. RO15 has no RCCA (Rod Cluster Control Assembly) inspections within its scope. The safety case for core component operability and in particular RCCA wear does not rely on inspections at every outage but rather sets limits on the cumulative duration of RCCA in-reactor operations between inspections. It is therefore reasonable that on this occasion no inspections are necessary.

37. The specialist fuels inspector undertook an inspection during the outage, Reference 15, targeting the following areas in response to the fuel operability issues that occurred in RO14 leading to a late core redesign:

- Fuel inspection methodology and adequacy of training for personnel undertaking this task.
- Fuel operability assessment including decision making processes, meetings and oversight. Specifically the Cycle Related Project Group (CRPG).
- Adequacy of current and future programme for capability to recover foreign material from fuel assemblies.
- Adequacy of close out and monitoring of fuel related activities through the reload Quality Plan and Operational Commitments.

38. During this inspection he made the following observations and judgements:

- He sampled the reload Quality Plan, which governs the core reload readiness and compliance with the safety case requirements. Within this he focussed on the evidence that RCCA are suitably operable for reload. Overall, he found that arrangements were adequate. The inspection identified some areas where improvements could be made for future outages. NGL have committed to address these findings for RO16 and a level 4 regulatory issue has been raised to track this commitment to completion.
- He examined and sampled the evidence associated with Core off-load as controlled by SOI (Station Operating Instruction) 9.2.2 and the procedure associated with the arrangements for inspection of fuel assemblies (FA) for foreign material, confirmation of training for fuel inspection and verification of the core map. The evidence was found to be compliant with the arrangements with good controls in place against the expectations of LC 24.
- One of the key activities in confirming fuel operability for reload is the inspection of fuel during off-load. He therefore targeted this due to its significance to safety. He sampled the arrangements for training of the inspections team and discussed with them their role in supporting the safety case for reload. During the off-load of the reactor he observed inspections taking place and sampled the quality of the visual inspections and how findings were recorded and sentenced. In his judgement the team where adequately

trained and briefed with a good working knowledge of the inspection process and operational experience of fuel damage and degradation mechanisms. There was evidence that inspection findings were sentenced conservatively.

- In support of the reload safety case, NGL produce a fuel operability report, which is used to demonstrate acceptability of the FAs for reload in the coming cycle. The inputs to the report include results of fuel visual inspections made during reactor off-load. He examined the documentation and challenge process concerning these safety cases including attending the CRGP, which decides the forward strategy for managing such issues. The process he witnessed had a strong focus on safety with oversight from the internal regulator via the NGL LC22 arrangements. He judged that the outcomes to declare the fuel operable to reload for cycle 16 as planned was appropriate and gave adequate consideration of the options to reduce risk in so far as is reasonably practicable.
- The justification for reload of two fuel rods produced by AREVA subject to a manufacturing concession is discussed in section 3.3.3. The inspector judged the safety case and approach adopted by NGL to be adequate.
- SZB does not have the equipment to remove objects discovered during fuel inspections but NGL fuel specialists had, prior to RO15, produced advice regarding the options for managing foreign material. The inspector has sought to influence improvements in this area in line with relevant good practice and has therefore raised a regulatory issue.

39. Based on the assessment of the cycle 15 reload safety case submission and the compliance inspection, the inspector identified no safety concerns with the proposed core design or to the Sizewell B reactor returning to power following its refuelling outage.

3.1.3 Mechanical engineering

40. Reference 16 presents the findings of the ONR inspection of the adequacy of the Mechanical Engineering related activities conducted by the licensee to comply with the requirements of LC 28 – Examination, Inspection, Maintenance and Testing (EIM&T) against a sample of nuclear safety significant reactor components. During this inspection the following aspects were examined:

- Examination, inspection, maintenance and testing of:
  - Replacement of reactor cooling water pump (RCP) ‘A’ seal replacement
  - Replacement of Emergency Boration System (EBS) valve actuator
- Turbine driven auxiliary feed water pump ‘A’ second stage impellor exchange.
- Lifting tasks and equipment associated with mechanical maintenance.
- Main cooling water pumps maintenance lifting operations.
- Walk downs of their associated maintenance facilities/areas.

41. During the inspection, the following observations and judgements were made:

- The work carried out on maintaining, monitoring and testing associated with the RCPs is considered adequate.
- The EBS isolation valves had operated adequately within the technical specification time limits and the work carried out on maintaining, monitoring and testing associated with the EBS actuators was adequately controlled.

- The second stage impellor on TDAFW pump 'A' was being replaced with a spare which would provide sufficient operating life until a modified impellor design could be produced. During the dismantling of the TDAFW pump it was observed that first stage impellor, the 'inducer', had noticeable cavitation wear and it was replaced in line with the manufacturer's recommendation.
- The station adequately explained the documentation controls used for controlling nuclear significant lifting activities.
- The lifting equipment was judged to be appropriately inspected in accordance with the requirements of the Lifting Operations and Lifting Equipment Regulations (LOLER). The inspector was also content that all the equipment was appropriately labelled and satisfied that the LOLER and liftings aspects of the LC28 maintenance sampled are adequate.

42. Based on the samples taken and observations during the inspection, the mechanical engineering specialist inspector was satisfied with the LC28 arrangements in place for EIM&T and their associated lifting actives for reactor coolant pumps, EBS valve actuators, main cooling water pumps are adequate and was satisfied that they are adequately implemented.

43. He therefore supports a request under License Condition 30 to return Sizewell B to operation following its 2017 periodic shutdown.

3.1.4 Electrical engineering

44. Reference 17 presents the findings of the ONR inspection of the adequacy of the electrical engineering related activities conducted by the licensee. The sample inspections were undertaken during the refuelling outage and periodic shutdown. The scope of inspection consisted of a brief overview, explanation and demonstration of the electrical engineering aspects of the refuelling outage and periodic shutdown. This included discussions, explanations and demonstrations, where appropriate, on: progress of the outage work activities, findings of significance, resolution of findings, where appropriate, deferred activities, a sample of documentation related to the outage work activities and a plant walk-down to observe the work.

45. During this inspection, he made the following principal observations and judgements:

- For Generator Transformer 1, he was advised that no issues had been encountered during the maintenance, with the exception of a number of marks which had been observed by the maintenance contractor on the neutral earth bar dropper associated with it. Station has implemented the established arrangements and commenced investigating the marks to establish what has caused them. NGL's Central Technical Organisation (CTO) and the external earthing and lightning protection subject matter expert (SME) are assisting with the investigation. The ONR inspector was satisfied that the appropriate action was taken by station and with the advice given as to the impact on nuclear safety, the instigation of an investigation and the assistance obtained from CTO and the external suppliers.
- He sampled a number of shutdown-related electrical activities referred to within the OID. Through explanations, discussions and a live demonstration using the station's asset management system he was satisfied that clear and auditable links were apparent between the shutdown-related electrical activities, referred to within the OID, and the station's maintenance schedule through to the maintenance instructions. It was also evident that the electrical activities were undertaken in the appropriate periodicity.
- Of the maintenance documentation sampled, it was identified that a maintenance check sheet did not detail any acceptance criterion for a specific

maintenance test activity against which the recorded test results could be compared. In response, NGL has applied its corrective action programme, to identify learning from this finding and implement corrective actions. The inspector was satisfied with NGL's immediate response and its plans to prevent recurrence. A Level 4 regulatory issue has been raised in order to monitor this issue to closure.

- During the plant walk-down, he observed acceptable standards of general housekeeping throughout all of the areas sampled, with no visible sign of water ingress within the areas inspected. Plant and equipment inspected was in an acceptable condition and there were no visible signs of external corrosion or flaking paintwork on any plant, equipment or supporting structures within the electrical areas inspected.

- He observed instances in which foreign material exclusion practices were being adequately applied and acceptable use of seismic restraints on equipment stored within the laydown areas in electrical switch rooms.

46. The overall outcome from the inspection was that there were no electrical issues identified at the time of the inspection that should affect the return to service of Sizewell B, subject to the completion of the planned and any emergent work.

3.1.5 Control and instrumentation

47. Reference 18 presents the findings of the ONR inspection of the control and instrumentation (C&I) systems maintenance and modification activities being 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 remain fit for their intended purpose at Sizewell B.

48. During this inspection, the C&I inspector made the following observations and judgements in relation to LC 12 and LC 28:

- He examined the Suitably Qualified and Experienced Person (SQEP) management arrangements of the teams that support the Primary Protection System (PPS), High Integrity Control System (HICS) and the Plant Control System (PCS). Overall, he was satisfied that the Plant Computing Group (PCG) is maintaining adequate SQEP personnel. Notwithstanding this, he identified that the PCS has two levels of SQEP and for routine outage work the level required is not specifically stated. ONR has raised a Level 4 regulatory issue seeking NGL to consider expanding or developing further documentation to identify the relevant level of SQEP to undertake maintenance and test activities on the PPS, HICS and PCS systems during outages.

- He noted that preventative maintenance and inspection of the PPS had been undertaken during RO14 without reported defects and the work planned for RO15 was still ongoing.

- He identified that that four temporary engineering changes associated with the Process Computing System/Distributed Computing System (PCS/DCS) had been implemented since RO14. He was content that this work had been carried out to the appropriate standard. The maintenance activities were discussed with the system engineers and they were able to demonstrate to his satisfaction that to date no shortfalls had been identified.

- His inspection of the PPS; HICS; PCS; Neutron Flux and Nitrogen and In-core Flux Monitoring indicates that adequate arrangements are in place at Sizewell

B to ensure reactor safety circuit equipment is adequately installed, operated and maintained so as to be fit for its intended purpose.

49. During this inspection, the C&I inspector reviewed progress on a sample of the C&I modifications being implemented:

- Cameron Transmitter replacements
- Polar Crane load monitoring system
- Power operated relief valve (PORV) controller replacement.

50. His inspection of work associated with the implementation of the C&I related modifications during the RO15 outage found adequate arrangements are in place at SZB to ensure that these are adequately conceived and installed so as to be fit for their intended purpose

51. This inspection has established that, in general, the commitments made in the OID for C&I equipment and systems important to safety at SZB have been satisfied.

52. In his opinion, the assessment and inspection did not identify any significant issues in relation to the C&I equipment and systems that should prevent ONR from issuing a Consent to allow restart.

3.1.6 Civil engineering

53. Reference 19 presents the findings of the ONR assessment of the report submitted by the NGL Appointed Examiner (APEX) and the surveillances undertaken on the Sizewell B pre-stressed concrete containment (PCC). The assessment included communications with the station to resolve queries. The inspector had visited the site three times in the last year; to look at secondary containment structures, tendon stressing activities on the primary containment and corrosion management, and therefore judged that a site visit was not required for the purpose of the assessment.

54. The APEX for the PCC provided an initial overview report of the inspections and tests that had been carried out so far and indicated what work was required to be completed (dome liner inspections and some local leak rate tests). The report covered the surveillances undertaken during the fifteenth fuel cycle of operation and the current refuelling outage (RO15), including; visual examination of the steel liner, sumps, access airlocks, penetrations, moisture barriers, concrete surfaces, crane corbels, and penetration leak rate tests.

55. The overall conclusion reached by the APEX was that the pre-stressed concrete containment and the other nuclear safety-related civil structures examined are in a satisfactory condition for continued service.

56. During a review of logged data from thermocouples embedded in the PCC, NGL identified higher than expected concrete temperatures adjacent to the steam and feed penetrations. This was investigated and is reported further in section 3.3.2.

57. In his assessment the inspector considered that:

- the codes and standards used during the surveillance work,
- the examination and test procedures,
- the inspection intervals,
- the schedule of leak rate tests, and
- the beach and sea defence surveys

were appropriate and met the requirements of the relevant Safety Assessment Principles (SAPs) (Reference 20).

58. The inspector compared the work reported in the APEX summary report with the surveillance requirements in the relevant sections of ASME XI and found adequate agreement.

59. The PCC tendon load values were last checked in late 2016 to early 2017. The inspector visited site during the load checking to witness the use of new jacking equipment that was used to determine the tendon loads. As part of the outage assessment, the APEX provided a preliminary set of tendon load test results. From these, discussions with the APEX, and observations on the site visit, the inspector agreed with the APEX conclusion that the tendon loads are acceptable for the next period of operation.

60. The inspector reviewed the APEX overview report from the previous outage, RO14, and noted that the APEX had some recommendations, largely concerning the Reserve Ultimate Heat Sink (RUHS) building whose steelwork was showing signs of corrosion. The inspector visited Sizewell B in February 2017 during which he inspected NGL's remedial works to address this corrosion issue, noting adequate progress had been made. A significant programme of work has been conducted in the last two years to refurbish the RUHS and general site corrosion management is now being addressed through ongoing planned work. The inspector confirmed that there were no outstanding recommendations made in the RO14 APEX report that should prevent ONR granting permission to return the reactor to service.

61. The inspector received the results from the containment local leak rate tests at the end of the outage and he confirmed that they were within specification.

62. From the results of the surveillances, inspections and tests reported in the documentation provided, observations during three site visits, and acceptance of the judgements made by the Appointed Examiner, the inspector was content to support the return to service of the containment vessel and the associated nuclear-safety related civil structures for the next operating period.

3.2 SAFETY MANAGEMENT

3.2.1 Workforce Radiological Protection

63. Reference 21 presents the findings of the ONR pre-outage inspection of NGL's refuelling outage work programme against the requirements of the Ionising Radiations Regulations 1999 and focussing on worker radiological protection. During this inspection, the following aspects were examined

- Summary of outage work programme and its radiological implication
- Review of Pre-Outage ALARP report
- Radiation protection input to outage work planning
- Operational dose management: plans for day-to-day dose management and profiling during the outage.
- Radiation protection personnel and monitoring equipment provision: roles, numbers, staffing continuity and contingency planning
- Contractor control, training and RPS supervision arrangements
- Radiography work

64. Inspectors identified the following good practices:

- The Station has prepared a 'Radiation Protection Coaching Guide' to support those people who coach to improve radiological protection performance;

primarily Radiological Protection staff, Radiation Protection Supervisors and other line supervisors.

- The scope and content of the post-outage (RO14) report indicates a healthy culture of progressive learning within the RP function on the site.
- The tracking of the lessons learnt and their future implementation

65. No improvements were considered necessary for RO15 and nothing was identified which should affect start-up consent from ONR. The inspection identified two opportunities where improvements could be made for future outages. Specially, these issue relate to:

- Improving the effectiveness of the ALARP Committee and its role as an instrument for management, challenge and oversight of workforce radiological protection issues.
- Procurement of additional general areas cleaning resource during outages.

66. NGL have committed to consider these improvements for the next outage, RO16, and will be followed-up through routine interactions by RP Specialist Inspectors with the Station. In the opinion of the inspectors, there are no specific objections relating to ONR's granting a Consent, under licence condition 30 of the Licensee's nuclear site licence, allowing the Licensee to return the reactor to power.

3.2.2 Outage management

67. The project inspector observed the operation of the outage control centre (OCC) periodically throughout the intervention, Reference 22. The OCC oversees all of the outage activities and monitors timely completion of the work packages. The operation of the OCC appeared well organised, making good use of status boards / screens for each of the islands and general outage management. The use of work windows and protected systems ensured that the availability of required safety systems was being maintained. A range of video cameras had been installed in the containment and provided views of the general work areas.

68. He attended the mode change meeting for the mode[3] 5 to 6 transition, when the reactor pressure vessel head closure bolts start to be detensioned and the reactor pressure vessel head will be removed to allow for defuelling, which confirmed the readiness for the next planned mode change. The initial stages of mode 6 are considered the highest risk state as the reactor is depressurised, coolant levels lowered and the pressure vessel head unbolted. The aim is to transition to mode 6 with the head removed and refuelling cavity flooded as promptly as possible. The remaining preparations for the mode change were confirmed and timescales agreed. The meeting appeared a robust control for the confirmation of readiness for a mode change.

69. He attended the daily screening meeting where the condition reports (CR) from the previous two shifts were reviewed. He considered that this initial review process was adequate to allow the CRs to be appropriately progressed.

70. He conducted a walkdown of containment to observe ongoing operations and the general housekeeping at the early stage of the outage. Most of the activity was focussed on mobilisation where equipment is being transferred into containment and preparations were being made to start maintenance activities.

[3] As defined in the SZB Technical Specifications – the MODE corresponds to a combination of core reactivity condition, power level, average reactor coolant temperature and reactor vessel head closure bolt tensioning while fuel is present in the reactor vessel.

71. He noted that the securing mounts for the multi-stud tensioner lifting adapter had been replaced following the deck lifting event in the last outage. The new mounts were open-ended to ensure the restraining clevis pins cannot get jammed in place before they are removed. This modification should remove the possibility of inadvertent lifting of the deck to which the mounts are attached. Throughout containment he noted a high standard of housekeeping and a robust safety culture, including where incorrectly adjusted PPE was identified, challenged and corrected.

72. This was the first outage where a new 'Mode 6' pump had been deployed. The purpose of the pump is to provide a prompt means of injecting coolant into the primary circuit should there be a loss of cooling / coolant whilst the pressure vessel is unpressurised with reduced coolant levels before the refuelling cavity is flooded up. The provision of this pump was identified as an ALARP improvement during a safety case review. During a walk-down of the site the inspector noted the pump installed to the side of the reactor building.

73. It was also noted during a site walkdown that the backup high pressure pump had been readied for use; suction and supply hoses run out to the connection points. NGL stated that this was taken as a precautionary measure to support cooling if the TDAFW pump impellor due for replacement should fail as the plant was shutting down.

74. During this outage he observed the Rapid Trending Review (RTR) carried out during Refuelling Outage 15 (RO15) by NGL. The RTR took place during the first week of the outage and its aim is to identify performance shortfalls in the early stages of an outage to enable station management to reduce or eliminate undesirable behaviours and conditions which could have an adverse impact on outage process. NGL considers the RTR review successful when the effective corrective actions prevent the recurrence of the identified shortfalls during the remainder of the outage period and in future outages. The response of station management to correct adverse condition and deliver sustained performance improvement is therefore a key factor in the overall success of the RTR process. He observed two walk downs, one looking at the weekly contractor management walkdown and a second one for the safety of diving operations. He found the review conclusions comprehensive and relevant to the outage and noted the acceptance of the findings by the station management, reflecting a high maturity of this process at Sizewell B.

75. Overall the project inspector concluded that the licensee's outage management and focus on nuclear safety were robust.

3.2.3 Licence Condition compliance inspections

76. The project inspector reviewed activities undertaken in support of the Sizewell B statutory shutdown, Reference 23, and measured compliance against the following Licence Conditions:

- LC 22 – Modification or experiment on existing plant
- LC 26 – Control and supervision of operations

77. He examined the modification to replace a main steam isolation valve bypass isolation valve and some of the supporting pipework and made the following observations:

- He reviewed the modification documentation and supporting implementation records. He found that the modification presented an effective solution to prevent problems during the installation of this valve.
- The records for the off-line manufacture of the valve and pipe assembly demonstrated that the requisite standards had been achieved in a controlled

environment. When the modification is completed it should ensure that valve and its supporting pipework meet the required integrity standards.

- He examined the quality plan; inspection and test plan for the spool piece fabrication. This was awaiting final sign off as the results from the last radiographic inspection were still outstanding. He identified that a small number of the sign off points had been completed without accompanying dates; this was pointed out to the project lead and Doosan QA to rectify.
- During the inspection he identified that there was no FME (Foreign Material Exclusion) cover on the instrument air-line which had been disconnected from the valve actuator by a different contractor. The air-line was checked and an FME cover applied. On leaving the steam and feed cells he checked the FME covers on another instrument air-line where an actuator had been removed, this had a piece of tape rather than a designated FME cover. The project engineer stated that use of appropriate FME covers would be raised with the relevant contractor and reinforced during the start on shift brief the next day.
- He observed the preparation and cutting out of the old valve and pipework. This work was conducted by Doosan and overseen by the NGL project engineer. The setting to work and pre-job briefs were thorough and enabled the work to be effectively controlled and conducted.

78. Overall he was satisfied that the activities were adequately controlled through the work order process and the use of appropriate permits to manage specific risks. He considered that the supervision and oversight conducted by the NGL and Doosan staff was effective and was ensuring that the work was conducted to a suitable standard.

3.3 EMERGENT ISSUES

3.3.1 Steam Generator D drain line leak

79. During a scheduled walkdown within containment to look specifically for boric acid leak sites, a leak was detected on Steam Generator D (SG-D) drain line. An Event Recovery team[4] was set up and a process started to investigate the root cause and repair the drain line in accordance with NGL processes.

80. Sizewell B is a four loop Westinghouse Pressurised Water Reactor design, with four steam generators. The function of the steam generators is to generate steam from heat transfer of the reactor primary water to turn the turbine, generating electricity. Another of its functions is to reduce the temperature of the returning primary water to the reactor. The drain line is at the very bottom (centre) of the steam generators and is used to drain out the small amounts of primary water left over during normal drain down through the large inlet and outlet nozzles in the same region known as the “channel head”.

81. The drain is comprised of a small penetration (approximately 18mm diameter) through the channel head shell and cladding into which a small bore tube ‘insert’ is inserted. The tube insert is adjacent and above a short nozzle ‘boss’ that partially extends beyond the external surface of the channel head forging. The configuration of the drain penetration is shown in Figure 1.

82. The failure of the drain line is considered within the safety case as a design basis fault resulting in a small loss of coolant accident. Whilst it is within the station’s mitigation

[4] Event Recovery is an NGL process which enables the timely resolution of a significant adverse condition through investigation and recovery actions with the allocation of specific personnel and resources.

capability, so there is no threat to core cooling and fuel integrity, the location cannot be isolated and so any leak is clearly undesirable. The loss of coolant through this route could not of itself have compromised the safety of the core, although it could result in the spraying of primary coolant fluid onto plant and the potential spread of contamination.

83. NGL developed suitable non-destructive examination techniques and intrusive inspection activities to confirm the damage to SG-D, support forensic metallurgical investigation into the failure mode and establish the extent of condition on the drain lines of the remaining three SGs (SG-A, B and C).

84. Weld W1.9 was confirmed as the site of the leak site detected on steam generator D. However, further inspections identified radial defects in all four steam generator drain line weld pads (W1.8) caused by primary water stress corrosion cracking (PWSCC). Further inspections found that no other welds associated with the drain line connection (or the channel head) were defective.

85. Dye penetrant examinations at stages during the machining processes determined that cracking of weld W1.8 was limited and the defective material was removed. With at least 5mm of weld W1.8 remaining, NGL decided to implement a non-complex plug repair on all four SGs (see Figure 2).

86. ONR's structural integrity specialist inspectors closely monitored developments to examine:

- Steam generator channel head inspection and forensic analysis of the affected area (covering Steam Generator D and the other three steam generators)
- Development and execution of repair solutions.
- Justification for return to service of the repaired steam generators.

87. Reference 24 presents ONR's additional assessment in relation to the steam generator repair and associated return to service safety case, EC 362240.

88. The inspector was satisfied that the repair method chosen by NGL was suitable and had been subject to the appropriate scrutiny through established company processes. He was also satisfied by the testing and qualification work performed to ensure that the repair was performed to a high standard. The inspector has reviewed the evidence supporting removal of the drain line and was satisfied that it was unlikely to adversely affect the operation or safety of the reactor.

89. The repair is presently limited to two cycles of operation and NGL have committed to a number of work packages to provide further evidence to support the continued operation of the drain line. The inspector judged that the current safety case was sufficient for two cycles of operation and that for long term operation (post two cycles) the commitments were sufficient to address long term uncertainties.

90. As NGL will continue to collect evidence before the end of this cycle (until RO16), the inspector recommended that NGL provides an assessment of the status of the drain line prior to return to service following the RO16 outage. This has been recorded as part of an ONR regulatory issue.

91. Overall, from a structural integrity perspective, the inspector supported the granting of consent for the start-up of Sizewell B Nuclear Power Station, following the 2017 periodic shutdown.

3.3.2 Steam and Feed Containment Penetration Elevated Concrete Temperatures

92. Within the PCC, embedded thermocouples were originally installed to enable measurements for the commissioning tests and are welded to the steam and feed penetrations. The logging and analysis of the embedded instrumentation is undertaken as a prudent measure but is not claimed in the Safety Case. During production of the most recent embedded instrument report, higher than expected readings were identified at these thermocouples. The validity of these temperature readings was confirmed by using a thermal camera.

93. Inspections of the penetrations were performed in RO15 and identified varying amounts of insulation within the penetrations, with some penetrations containing little or no insulation. If present, insulation would tend to thermally isolate the containment concrete from the hot process pipes. The original Sizewell B design documentation suggested that these penetrations would normally be expected to have insulation installed within them.

94. Reference 25 presents ONRs review of the NGL assessment of the steam and feed containment penetration temperature, EC 362342.

95. In addition to the lack of insulation, it was found that the thermal modelling used to establish the original design limit temperatures had some erroneous assumptions. A corrected model, with the insulation installed as intended, predicted a peak steam line penetration temperature of around 90℃ which is within the original design limit.

96. Radial cracks in the outer face of the concrete were reported in the APEX report after the first cycle of operation, and these have been closely monitored ever since. The cracks are narrow (less than 0.1mm wide) and were attributed to drying shrinkage. There has been no significant growth of these cracks during the operational life of the plant and this crack behaviour is consistent with the findings of a full scale test undertaken by the CEGB in 1972 on a penetration at Oldbury power station.

97. NGL has now installed insulation in the steam and feed penetrations as originally designed and will monitor the penetration temperatures after returning the plant to power. NGL has made a commitment to prepare a strategy to insulate other potentially affected penetrations by the end of 2018.

98. The EC made a recommendation to load test a tendon close to these penetrations during the next tendon surveillance campaign. The inspector has asked site staff to demonstrate how this recommendation will be logged and carried forward as the next campaign is not for several years, and he will pursue this during future planned interventions with NGL and the Sizewell B APEX.

99. Overall the inspector agreed with the conclusions and the recommendations, and did not consider that this issue should prevent the reactor being returned to service for a further operating cycle.

3.3.3 Operability of Fuel Assemblies 4A04 and 4F06

100. NGL were notified on 30 October 2017 by AREVA (fuel vendor) that two fuel rods located within fuel assemblies 4A04 and 4F06 have no associated ultrasonic (UT) examination records present. This was highlighted following discovery of a sporadic computer bug within the UT control stations at the AREVA fuel cladding tube manufacturing plant. There are approximately 50,000 fuel rods, combined into fuel assemblies, in the SZB reactor core and the affected fuel assemblies were previously loaded at Sizewell B in Cycles 14 and 15 and were scheduled to be reloaded for the upcoming Cycle 16 in Refuelling Outage 15.

101. NGL produced EC362219 to justify the operability of the affected fuel assemblies so that they could be loaded for Cycle 16. The ONR fuels inspector examined this issue and sampled the operability EC, INA oversight and attended the CRPG.

102. The inspector particularly focused on the demonstration of confidence in the number of fuel rods at risk, where AREVA and NGL claimed that only two rods were at risk and that the likelihood that they were defective was low. This was key to the adequacy of the safety case because it provided an envelope for the potential radiological consequences of the safety case being inadequately conceived or executed. The inspector was satisfied with the responses provided by NGL and judged the safety case for operability of these FAs was adequate.

103. Oversight of the issue was discussed with the INA team at Sizewell B for RO15. Whilst the EC was at category 3 and not normally subject to INSA, the INA assessor examining fuel reload had undertaken a detailed review. To monitor the INA oversight the assessor inserted a milestone into the process such that the EC could not be progressed to approval without his agreement. The inspector considered this to be a good use of the process and demonstrated adequate internal oversight.

104. The inspector observed the CPRG where the operability issues were discussed and he considered that the challenge provided was adequate and included discussion of the options available and risks for this cycle and further cycles both in terms of fuel, risks to the public and risks to workers. The meeting confirmed the forward strategy to work towards demonstrating operability of the FAs in question.

105. Based on the observations above and the category 3 EC provided by NGL, the inspector judged that the safety case and approach adopted by NGL is adequate to demonstrate that the two FAs in question remain operable. There is no reason to believe that the rods are deficient and they have not failed during two operating cycles so far. In the very unlikely event that they were to fail, it is well within the capability of the plant to deal with this. NGL utilised the company modification arrangements (LC22) in implementing the modification and through these arrangements positive influence from the internal regulator was demonstrated.

3.3.4 Kobe Steel Group components

106. Following recent statements from the Kobe Steel Group a letter was sent from ONR to all duty holders asking for information on whether they had Kobe Steel Group products installed in their facilities, and if they had, whether the risks had been considered and what mitigating action had been taken.

107. In the case of Sizewell B, previous interventions by ONR on heavy section ferritic forgings had identified that the tube sheets on the steam generators had been supplied by Kobe Steel.

108. The EdF response to the new request from ONR identified that as well as the tube sheets (4 off), a further 5 components had been supplied by Kobe steel – these were austenitic stainless steel forgings, so out-with the scope of previous enquires, and were for the flange and four outlet nozzles for the core barrel, which is a support structure inside the reactor pressure vessel.

109. Work to review the manufacturing records and documentation associated with these components is ongoing, but it is recognised that the Kobe Steel Group components which have been identified to be of concern are not related to the components supplied for SZB, and the manufacturing period of concern post-dates the production of the SZB components by many years. ONR is therefore satisfied that there are no immediate concerns, but will continue to monitor the position both in terms of the Licensee response and if there are any further developments from Kobe Steel Group.

3.4 START-UP MEETING

110. The Sizewell B start-up meeting was held on 5 December 2017 chaired by the station Technical and Safety Support Manager with presentations from the outage programme leads (Reference 26). ONR's attendance at the start-up meeting consisted of the operating reactors sub-division superintending inspector, nominated site inspector and the RO15 project inspector.

111. The agenda covered:

- Minutes previous meeting and status of actions
- Outage manager's report
- Feedback from ONR site tour
- Safety management review
- Maintenance review and projects
- Safety case review by exception
- Independent nuclear assurance report
- Review of consent and start-up issues

112. For the safety management, maintenance and project reviews, NGL outlined the current status, work outstanding and any findings or lessons learnt.

113. At the time of the start-up meeting, most of the non-nuclear work had been completed but the progress on the refuelling operations was halted awaiting the resolution of the SG drain line issues.

114. Whilst no new outage actions were raised during the meeting it was noted that there was still significant work to address the SG drain line issues and the steam and feed penetrations elevated temperatures. These would both require an adequate demonstration of safe operation; see sections 3.3.1 and 3.3.2 above, prior to the Consent to restart being provided.

115. Following the meeting a formal start-up meeting report, Reference 27, was provided by NGL which provided greater detail on the progress and conduct of the outage.

4 MATTERS ARISING FROM ONR'S WORK

116. I have considered the licensee's request to ONR to grant a Consent under LC 30(3) to start-up the Sizewell B reactor 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 opinions of ONR specialist inspectors and the outage project inspector.

117. In Reference 1, the Sizewell B 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.

118. INA has provided a concurrence statement, Reference 7, 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.

119. The PSSR competent persons (for the nuclear island and the conventional island) have confirmed, Reference 28, that their examinations have been satisfactorily completed and the plant was considered to be acceptable to return to service.

120. ONR specialist assessors from the following disciplines undertook inspections to support my permissioning work:

- Fuel
- Structural integrity
- Civil engineering systems
- Control and instrumentation systems
- Electrical systems
- Mechanical engineering
- Radiological protection
- Site inspection

121. Each discipline has produced a report that presents the inspection findings, inspector's opinions, judgments 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. 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.

122. I consulted with the other relevant regulator, the Environment Agency (EA), to establish if they had any specific objections that would prevent ONR from issuing LI 553, Consent to start-up the Sizewell B reactor. The EA confirmed, Reference 29, they do not object to ONR granting consent.

5 CONCLUSIONS

123. The Sizewell B reactor periodic shutdown, refuelling outage 15, has been undertaken in accordance with the requirements of the work scope outlined within the OID.

124. The licensee has followed its arrangements in undertaking the periodic shutdown, culminating in the Sizewell B Station Director writing to ONR requesting consent to start-up the reactor. His letter stated that subject to the completion of the remaining outage activities, he was satisfied that the reactor was fit for return to service and sufficient procedures were in place to assure safe operation through to the next periodic shutdown.

125. 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 the reactor post its periodic shutdown.

126. The PSSR competent persons have each confirmed that they are content for the reactor to start up.

127. 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.

128. I consider that the licensee delivered a shutdown that was safely managed and completed the required safety related work activities.

129. Following assessment and inspection of matters arising in relation to the Sizewell B reactor periodic shutdown, RO15, 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.

130. I have prepared Sizewell B Licence Instrument 553, 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

131. I recommend that the Superintending Inspector:

- Signs this Project Assessment Report to confirm support for the ONR technical and regulatory arguments that justify issuing Sizewell B Licence Instrument 553.

132. I recommend that the Deputy Chief Inspector signs Sizewell B Licence Instrument 553, which grants Consent under Licence Condition 30(3) attached to Nuclear Site Licence No.63 to start-up the Sizewell B reactor.

7 REFERENCES

1 EDF - Sizewell B – NSL SZB 50851R - LC 30(3) - Request for Consent to Start-up the Reactor under Licence Condition 30(3), 19 January 2018, [redacted]

2 Sizewell B - SZB 75704N - Specification LC 30(3) - Requirement for a consent to start up a reactor, 27 March 1996, [redacted]

3 EDF NGL - Sizewell B - LI 550 Consent to Start Up Reactor, 31 May 2016, [redacted]

4 EDF NGL Sizewell B RO15 2017 – SZB/OZR/247 Outage Intentions Document - Rev 000, March 2017, [redacted]

5 NGL - OFD - Intervention Record - 17-039 - Sizewell 'B' - Inspection week - 30 May to 2 June 2017, [redacted]

6 Sizewell B RO15 - INA Concurrence Part A - RO15 Return To Service - SRD/REP/CON/SZB/013A - Rev 000, August 2017, [redacted]

7 SZB 50851R - Attachment 6 - Memorandum Stating INA's Position on SZB Return to Service from RO15, 18 January 2018, [redacted]

8 SZB RO15 - Sizewell B 2017 Rapid Trending Review (RTR) final report, [redacted]

9 SZB 50851R - Attachment 5 - Return to service justification following ISI during RO15 - EC 361154, 17 January 2018, [redacted]

10 SZB 50851R - Attachment 5 - INSA - Return to service justification following ISI during RO15 - EC 361154, 19 January 2018, [redacted]

11 Operating Reactors - Intervention Task Sheet - TS074 - Outage Planning for April 2017 – March 2018, [redacted]

12 SZB RO15 ONR Action Tracker, [redacted]

13 NGL - Sizewell B - Assessment Report - 17-044 - Assessment of Structural Integrity in Support of the Restart following the 2017 periodic shutdown, Nov 2017, [redacted]

14 NGL Sizewell B Assessment Note - SZB Fuel Performance Assessment of Cycle 16 RO15 Core Reload Safety Case EC 358825, November 2017, [redacted]

15 Sizewell B - ONR-OFD-IR-17-173 - RO15 Core Reload Safety Case EC358825 and Fuel Operability Inspection, November 2017, [redacted]

16 Sizewell B - ONR-OFD-IR-17-158 - Outage – Mechanical Engineering Inspection, 7 & 8 November 2017, [redacted]

17 Sizewell B - ONR-OFD-IR-17-157 - Refuelling Outage 15, 2017 Statutory Outage – LC 28 Inspection of Electrical Related Aspects, [redacted]

18 Sizewell B - ONR-OFD-IR-17-169 - SZB RO15 Control & Instrumentation outage inspection, 12 - 14 November 2017, [redacted]

19 NGL - Sizewell B - Assessment Report - 17-056 - Assessment of the Appointed Examiner's Initial Overview Report on the Statutory Examination at RO15, December 2017, [redacted]

20 Safety Assessment Principles for Nuclear Facilities. 2014 Edition Revision 0. January 2014. http://www.onr.org.uk/saps/saps2014.pdf.

21 Sizewell B - ONR-OFD-IR-17-152 - RO15 - Radiological Protection pre-outage inspection, 23 October 2017, [redacted]

22 Sizewell B - ONR-OFD-IR-17-160 - Outage Management and Rapid Trending Review - 8-10 November 2017, [redacted]

23 Sizewell B - ONR-OFD-IR-17-167 - LC22 LC26 and outage management, 14-17 November 2017, [redacted]

24 NGL - Sizewell B - Assessment Report - 17-053 - Assessment of the structural integrity aspects of the return to service engineering change for the steam generator D drain line repair during the RO15 periodic shutdown, January 2018, [redacted]

25 NGL Sizewell B RO15 - High PCC concrete temperatures - EC 362342 – File-note, 22 December 2017, [redacted]

26 SZB RO15 Start Up Meeting Presentation - FINAL , 5 December 2017, [redacted]

27 Sizewell B RO15 - SZB/OZR/254 - Start Up Meeting Report, December 2017, [redacted]

28 SZB 50851R - Attachment 4
b - Lloyds Inspection Certificate - PSSR Nuclear Island, 16 January 2018, [redacted]
c - Lloyds Inspection Certificate - PSSR Conventional Island, 16 January 2018, [redacted]

29 Email - Sizewell B RO15 - EA statement for return to service post outage, 25 January 2018, [redacted]

Figure 1 - Steam Generator Drain Region Layout and Welds

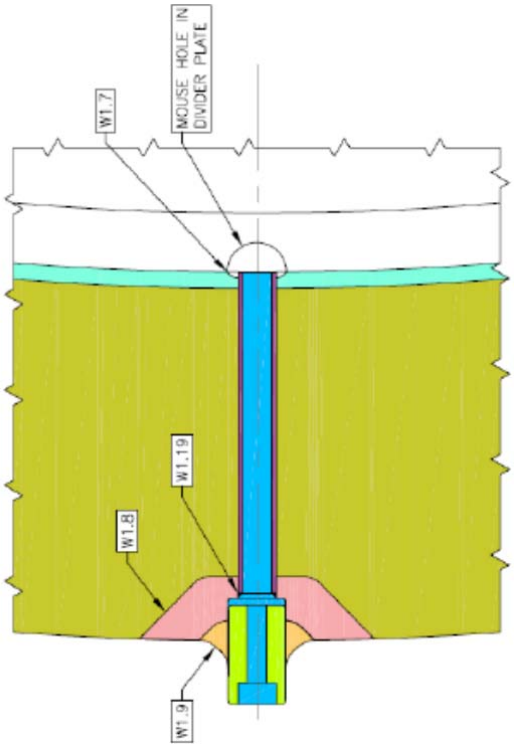
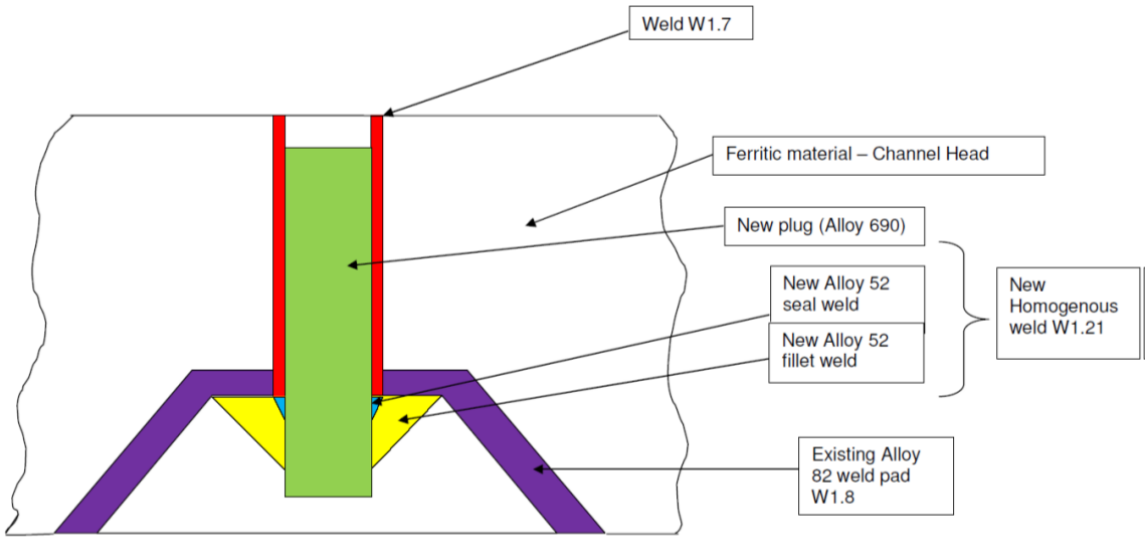


Figure 2 - Steam Generator Drain Line Repair



Not to Scale (Cladding not shown for clarity)