



| PROJECT ASSESSMENT REPORT                        |   |                  |             |
|--|---|------------------|-------------|
| <b>Unique Document ID and Revision No:</b>       | ONR-DNB-PAR-15-001<br>Revision 0  | <b>TRIM Ref:</b> | 2015/285629 |
| <b>Project:</b>                                  | Dungeness B Reactor 22 Periodic Shutdown 2015   |                  |             |
| <b>Site:</b>                                     | Dungeness B   |                  |             |
| <b>Title:</b>                                    | EDF Energy Nuclear Generation Limited (NGL) – Dungeness B – consent under Licence Condition 30(3) to start-up Dungeness B Reactor 22 following the 2015 Periodic Shutdown |                  |             |
| <b>Licence Instrument No:</b><br>(if applicable) | 547 (Consent)   |                  |             |
| <b>Nuclear Site Licence No:</b>                  | 61  |                  |             |
| <b>Licence Condition:</b>                        | 30(3)   |                  |             |

#### Document Acceptance and Approval for Issue / Publication

| Role                                  | Name       | Position                 | Signature | Date        |
|---------------------------------------|------------|--------------------------|-----------|-------------|
| Author                                | [REDACTED] | Inspector                |           | 06 Aug 2015 |
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| Approval for publication <sup>2</sup> | [REDACTED] | Superintending Inspector |           | 06 Aug 2015 |

#### Revision History

| Revision | Date         | Author(s)  | Reviewed By | Accepted By | Description of Change                               |
|----------|--------------|------------|-------------|-------------|---|
| A        | 30 July 2015 | [REDACTED] | [REDACTED]  | n/a         | 1 <sup>st</sup> draft for review                    |
| B        | 05 Aug 2015  | [REDACTED] | [REDACTED]  | n/a         | 2 <sup>nd</sup> draft incorporating review comments |
| 0        | 06 Aug 2015  | [REDACTED] | n/a         | [REDACTED]  | First accepted issue                                |
|          |              |            |             |             |   |

<sup>1</sup> Acceptance of the PAR to allow release of LI

<sup>2</sup> Approval is for publication on ONR web-site, after redaction where relevant

**Circulation (latest issue)**

| Organisation                  | Name  | Date |
|-------------------------------|---|------|
| Office for Nuclear Regulation | [REDACTED] – Head of CNRP (DCI)<br>[REDACTED] – Operating Reactors Unit SI<br>[REDACTED] – Operating Reactors Engineering SI<br>[REDACTED] – Dungeness B Site Inspector<br>[REDACTED] – General Fire Precautions Inspector<br>[REDACTED] – Mechanical Engineering Inspector<br>[REDACTED] – Civil Engineering Inspector<br>[REDACTED] – Mechanical Engineering Inspector<br>[REDACTED] – Quality Management Inspector<br>[REDACTED] – Electrical Engineering Inspector<br>[REDACTED] – Graphite<br>[REDACTED] – Control & Instrumentation Inspector<br>[REDACTED] – Radiological Protection Inspector<br>[REDACTED] – Structural Integrity Inspector<br>[REDACTED] – Quality Management Inspector<br>[REDACTED] – CNS Site Inspector<br>[REDACTED] – Dungeness B Reactor 22 2015 Outage Project Inspector |      |
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## **Dungeness B Reactor 22 Periodic Shutdown 2015**

**EDF Energy Nuclear Generation Limited (NGL) – Dungeness B – Consent under Licence Condition 30(3) to start-up Dungeness B Reactor 22 following the 2015 periodic shutdown**

Project Assessment Report ONR-DNB-PAR-15-001  
Revision 0  
6 August 2015

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Published 09/15

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## EXECUTIVE SUMMARY

### Title

EDF Energy Nuclear Generation Limited (NGL) – Dungeness B – consent under Licence Condition 30(3) to start-up Dungeness B Reactor 22 following the 2015 periodic shutdown.

### Permission Requested

NGL, the licensee of Dungeness B power station (DNB), has requested that the Office for Nuclear Regulation (ONR), grants consent to start-up Reactor 22 following completion of the 2015 periodic shutdown

### Background

DNB is a nuclear licensed site operating two Advanced Gas-cooled Reactors (AGRs), known as Reactor 21 and Reactor 22. To continue to operate safely and reliably the reactor plant requires examination, inspection, maintenance and testing. Continuous improvement also requires plant safety improvements to be implemented where these are deemed to be reasonably practicable. Whilst some of these activities can take place when the reactor is at power, many of them require it to be shut down. The Licensee's arrangements require that periodic shutdowns, as required by LC 30(1), are carried out every three years at each reactor at DNB. The previous start-up consent for Reactor 22 was granted on 29 May 2012. On completion of a periodic shutdown the reactor concerned cannot be started up without consent from ONR under LC 30(3).

During the Reactor 22 periodic shutdown 2015, which commenced on 01 May 2015, the Licensee has conducted:

- Examinations, inspections, maintenance and testing activities in accordance with the Maintenance Schedule (MS).
- Inspections to support the station safety case.
- Work to comply with statutory requirements.
- Remedial work to rectify plant adverse conditions.
- 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 ONR granting consent to reactor start-up.

Towards the end of the periodic shutdown, the DNB Station Director wrote to ONR requesting consent to start-up Reactor 22. In that letter, the Station Director confirmed that all maintenance required for start-up would be completed and that actions requiring closure before start-up would be completed and evidence provided. This evidence has subsequently been provided by the licensee.

### 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 requirements of the MS, 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 inspect samples of the licensee's implementation of arrangements. ONR specialist inspectors have undertaken compliance inspections and assessments and produced reports for each specialism. I have made use of these reports in the production of this Project Assessment Report (PAR).

The main issues during the periodic shutdown activities which required unplanned additional safety justification, related to:

- broken wires on vertical tendon E27
- extension of major overhaul interval to 12 years for gas circulator 28

These have been assessed and were considered adequately addressed but with a number of ongoing commitments from the Licensee.

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 22, and its operation for a further period of three years, ONR gives consent to start-up Reactor 22 under LC 30(3).

### **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 to ensure risks continue to be reduced as low as reasonably practicable.

No matters preventing the granting of consent to start-up arose from the work undertaken by ONR inspectors in relation to the DNB Reactor 22 periodic shutdown 2015.

### **Conclusions**

Following assessment and inspection of matters arising in relation to the Dungeness B Reactor 22 periodic shutdown 2015, I am satisfied that the licensee's justification to start-up the reactor and operate for a further period of three years is adequate; consequently, consent to start-up the reactor can be granted.

### **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:61 for Reactor 22 at Dungeness B nuclear power station to start-up following the 2015 periodic shutdown. Licence Instrument 547 should be issued and released to the licensee to permit this outcome.

## LIST OF ABBREVIATIONS

|       |  |
|-------|--|
| ALARP | As low as reasonably practicable                 |
| AMS   | Asset Management System                          |
| APEX  | Appointed Examiner                               |
| C&I   | Control and Instrumentation                      |
| CNRP  | Civil Nuclear Reactor Programme                  |
| CNS   | Civil Nuclear Security (ONR)                     |
| DNB   | Dungeness B Power Station                        |
| EA    | Environment Agency                               |
| EIM&T | Examination, Inspection, Maintenance and Testing |
| EC    | Engineering Change                               |
| FSC   | Fire Safety Coordinator                          |
| GC    | Gas Circulator                                   |
| GFP   | General Fire Precautions                         |
| INA   | Independent Nuclear Assurance                    |
| INSA  | Independent Nuclear Safety Assessment            |
| IR    | Intervention Record                              |
| IRR99 | Ionising Radiations Regulations 1999             |
| LI    | Licence Instrument                               |
| LC    | Licence Condition                                |
| MOM   | Mid-Outage Meeting                               |
| MS    | Maintenance Schedule                             |
| NGL   | EDF Energy Nuclear Generation Limited            |
| OID   | Outage Intentions Document                       |
| OIM   | Outage Intentions Meeting                        |
| ONR   | Office for Nuclear Regulation                    |
| PAR   | Project Assessment Report                        |
| PCPV  | Pre-stressed Concrete Pressure Vessel            |
| PSSR  | Pressure Systems Safety Regulations 2000         |
| RCA   | Radiation Controlled Area                        |
| RTS   | Return To Service                                |
| SUM   | Start-Up Meeting                                 |

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## **1 PERMISSION REQUESTED**

1. EDF Energy Nuclear Generation Limited (NGL), the operator and Licensee of Dungeness B power station (DNB), has written (Reference 1) to the Office for Nuclear Regulation (ONR) requesting consent under Licence Condition (LC) 30(3) to start-up Reactor 22 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 22 through issuing Licence Instrument (LI) 547.

## **2 BACKGROUND**

### **2.1 GENERAL**

2. The nuclear site licence issued to NGL for DNB 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 DNB's Plant Maintenance Schedule (MS) under LC28. At DNB, 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 22 on completion of its periodic shutdown. The previous consent to start-up Reactor 22, DNB LI 537 (Reference 3), was dated 29 May 2012 and the Reactor 22 periodic shutdown 2015 commenced on 01 May 2015.
4. During the Reactor 22 periodic shutdown 2015 the Licensee conducted:
  - 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.
  - Plant safety improvements where these are deemed to be reasonably practicable.

### **2.2 OUTAGE PLANNING AND MANAGEMENT**

#### **2.2.1 Licensee's management**

5. NGL began planning the Reactor 22 periodic shutdown approximately two years prior to its start. Progress was monitored by NGL with the aid of its Pre-Outage Milestone Plan. Appropriate milestones were completed prior to the start of the periodic shutdown.
6. The periodic shutdown activities were managed using a Station Control Centre, which provided overall control and monitoring of shutdown work based on use of an area and plant island approach:
  - Electrical Island;
  - Fuel Route Island;
  - Gas Circulators Island;
  - Reactor Island;

- Turbine and Feed Island.
7. Each island was led by an engineering group head and had allocated staff to control shutdown work planning, execution and completion, including any response required to emergent issues:
  8. The Licensee's periodic shutdown process had planned into it a series of meetings with ONR, these being the Outage Intentions Meeting (OIM), the Mid-Outage Meeting (MOM) and the Start-Up Meeting (SUM).
  9. NGL produced the Outage Intentions Document (OID) (Reference 4) for Reactor 22 periodic shutdown 2015, which was updated to reflect significant changes in the work programmes. This outlined the periodic shutdown organisation, infrastructure and management arrangements to deliver the planned safety related activities. The OID, together with the referenced scope related supporting documents comprised the periodic shutdown intentions for Reactor 22.
  10. NGL provided ONR with a copy of the OID prior to holding the OIM on 13 November 2014 which was distributed to ONR specialist inspectors assigned to DNB Reactor 22 periodic shutdown 2015. The organisational arrangements and programme of work for the shutdown were discussed at the meeting.
  11. NGL held the MOM and SUM on 17 June and 22 July respectively. ONR inspectors attended both meetings. The purpose of the MOM was to allow the Licensee and ONR to review the progress and developments with the periodic shutdown. The purpose of the SUM was for the Licensee to demonstrate it had adequately met the requirements of the Maintenance Schedule, dealt with emergent issues, identified any additional actions to be completed and demonstrated the safety of Reactor 22 for the next operational period.
  12. On 28 July 2015, the DNB Station Director wrote to ONR requesting consent to start-up Reactor 22 on completion of the periodic shutdown (Reference 1). The request letter was sent prior to completion of the shutdown. In his request letter, the Station Director stated that an Operational Review Safety Committee would confirm that all maintenance required for start-up had been completed and that the actions raised during the Start-Up Meeting requiring closure before start-up had been addressed.
  13. The Licensee's internal process requires that NGL's internal regulator, Independent Nuclear Assurance (INA), independently supports the application for reactor start-up. INA seeks assurance by undertaking a series of activities both before and during the periodic shutdown. The scope of these activities for the current DNB periodic shutdown is defined in the INA Concurrence Part A (Reference 5).
  14. On completion of these activities, INA issued a report, Concurrence Part B (Reference 6), which presented the findings of their work and included a statement supporting the start-up.
  15. The Licensee produced a Return To Service (RTS) Engineering Change (EC) (Reference 7) that approves the results of inspections completed in the Reactor 22 periodic shutdown inspection programme. INA has issued an Independent Nuclear Safety Assessment (INSA) approval statement (Reference 8) for the RTS EC with no caveats.
  16. 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 22 to start up (Reference 9 , Reference 10 and Reference 11 ).

17. During the reactor start-up and raising to full power there are 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'.

### **2.2.2 ONR's intervention management process**

18. The DNB Site Inspector produced a task sheet (Reference 12) which justified the resource for ONR activities during the Reactor 22 2015 periodic shutdown and was endorsed by the CNRP management team.
19. The anticipated outcomes of the project included:
  - The Licensee delivering a shutdown that is safely managed.
  - Closeout of significant issues raised by ONR interventions to the satisfaction of the inspector raising the issue, prior to the conclusion of the shutdown (or an acceptable plan to address the issue beyond the shutdown).
  - The Licensee delivering the required safety related work activities, enabling ONR to produce a PAR that considers NGL's request to start up Reactor 22 on completion of the shutdown.

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

20. The work undertaken by ONR can summarised as follows:
  - Assessment of the safety management of the outage including:
    - Quality management systems
    - Radiological protection
    - Fire safety
    - Control and supervision of operations
    - Management of modifications
  - Engineering assessments of maintenance, modifications and other work during the outage covering the following specialisms:
    - Civil Engineering
    - Control and instrumentation systems
    - Electrical engineering
    - Graphite core integrity
    - Mechanical engineering
    - Structural integrity
  - Formal meetings (the OIM, the MOM and the SUM) looking at the preparations, progress and readiness to restart.
  - Emergent issues
  - Consultation with ONR Civil Nuclear Security and the Environment Agency

### 3.1 SAFETY MANAGEMENT

#### 3.1.1 Quality management systems

21. The Management Systems inspector conducted an intervention on 4-5 and 9 June 2015 to assess the Licensee's compliance against its periodic shutdown management systems which support Licence Condition 17 (LC 17) management systems and quality assurance arrangements. The findings of the intervention are presented in the Intervention Record (IR) at Reference 13.
22. The inspection focussed on the following areas:
- DNB Outage R22 018 outage management systems and quality arrangements
  - DNB Site QA and INA oversight of management systems implementation
  - Quality Forum (QF)
  - DNB Supply Chain
  - Procedural Use and Adherence
23. The inspector was satisfied that from the activities examined, the management systems for the R22 periodic shutdown, the quality management oversight arrangements and their implementation during the shutdown were adequate and consistent with the relevant integrated company practices and specifications procedures. No formal actions were raised; however, a number of minor actions and 'opportunities for improvement' were identified.
24. Based on the areas and activities sampled during the intervention, the inspector considered that the management systems and their implementation for the periodic shutdown were adequate to support the granting of consent to the start-up of Dungeness B Reactor 22.

#### 3.1.2 Radiological protection

25. The radiological protection inspector conducted an intervention on 4 June 2015 to establish that the Licensee's periodic shutdown work programme was being conducted in compliance with the Ionising Radiations Regulations 1999 (IRR99). The findings of the intervention are presented in the IR at Reference 14.
26. The following matters were inspected:
- The licensee's periodic shutdown work programme and its radiological implications.
  - Radiation protection personnel cadres and monitoring equipment provision.
  - Contractor control and supervision.
  - Radiation protection input to shutdown work planning.
  - Integration of as low as reasonably practicable (ALARP) management principles with personal radiation exposure restriction and contamination control.
  - Training.
  - Radiation survey instrument maintenance and provision.
  - Radiological event investigation and follow-up.
  - Record-keeping.
  - Planning for radiologically significant shutdown tasks.
  - Operational dose management.

27. The periodic shutdown activities had not planned to encompass any work where projected collective doses would exceed the NGL corporate threshold for its formal ALARP management processes to apply; these become effective at projected personal doses in excess of 3 mSv and collective doses in excess of 10 mSv. Accordingly, the shutdown activities were being conducted in accordance with local ALARP arrangements, for example by using Radiation Work Permits to specify dose restriction detail. The inspector was content with the arrangements in place to manage this.
28. A visual inspection was conducted of the following areas to assess house-keeping and IRR99 compliance:
- Pile cap/charge hall
  - Gas circulator quadrant
  - Gas by-pass desiccator plant
  - Other Areas

Particular attention was paid to radiological area designations, tidiness and their segregation and demarcation, particularly at C0/C2/C3 boundaries, and to radiation monitoring point functionality and calibration. No issues were identified in any of the areas assessed.

29. The radiological protection inspector considered the Licensee's arrangements and their compliance with the IRR99 to be good. From a radiological protection standpoint, he was content with the way in which the Licensee was conducting its periodic shutdown work programme and, accordingly, was of the opinion that there was sufficient evidence of the Licensee's readiness to bring reactor 22 back to power in due course.

### **3.1.3 Fire safety**

30. A general fire safety inspection was conducted on 08 July 2015 during the shutdown to confirm that the Licensee was compliant with the requirements of the Regulatory Reform (Fire Safety) Order 2005. Reference 15 provides the ONR fire safety inspector's findings of the inspection.
31. The inspection focused on the practical fire safety provision during the periodic shutdown of Reactor 22 and all associated equipment. Particular emphasis was given to:
- cooling water pump house
  - reactor building gas circulator level
  - reactor building basement level
  - turbine hall.
32. Issues identified at the previous fire safety inspection were reviewed and the inspector noted that there was one action still outstanding relating to the need to extend the fire alarm and detection system to some rooms on the stores mezzanine. The rooms affected had been put out of use until the work was completed.
33. During the walk-down, the inspector noted the attention to detail that had been applied to ensure that the erection of scaffold structures did not compromise any of the existing general fire precautions (GFP). The inspector encouraged the scaffolding contractor to engage the services of the DNB fire safety coordinator (FSC) during the scaffolding planning stage and to further reiterate to the scaffolding crews the GFP issues that can

be compromised as a result of a scaffold structure in order to ensure the knowledge and understanding does not become diluted.

34. Outage training was mandatory for persons to work on the site during the periodic shutdown and the inspector noted that fire safety formed one of the three major subject areas covered and that a considerable element of the package was made up from operational experience.
35. Overall in the areas inspected, the inspector found that an adequate level of fire safety provision and management was demonstrated. The site management, and especially the FSC, understood that in order for the fire safety systems in place at Dungeness B to do their job adequately, it was imperative that all members of staff were fully conversant with the important role that they play in the fire safety strategy. The inspector identified a number of areas of potential improvement which were communicated to the FSC.

#### **3.1.4 Control and supervision of operations**

36. The site inspector and I conducted this intervention on 12 May 2015 to review the adequacy and implementation of the arrangements for Licence Condition 26, control and supervision of operations, during the periodic shutdown. The findings of the intervention are presented in the IR at Reference 16
37. We inspected a series of tasks being undertaken at the time of the inspection, both within and outside the RCA, for shutdown and non-shutdown related work which was being conducted by both NGL and supporting contractor staff.
38. All working groups had the principal document to control operations, a work order card, and most also had other supporting instructions. We found some minor issues in some cases and recommended where the station could improve. We also found that the level of supervision was adequate. We concluded that control of both outage and non-outage related work was adequate.

#### **3.1.5 Modifications**

39. The site inspector and I inspected compliance against Licence Condition 22 for modifications being implemented during the Reactor 22 periodic shutdown. The findings of the intervention are presented in the IR at Reference 17.
40. We selected a sample of engineering changes to confirm that they had gone through the correct due process for approval to implement them and that the appropriate records were available within the Asset Management System (AMS). For all of these we found a comprehensive suite of records in AMS and were able to review Verifier, Categoriser and Approver comments and confirm that changes had been incorporated.
41. We selected a number of ECs to review for their implementation, looking at the records within AMS and the documentation used to manage and record the modification activities:
42. All the sampled modifications were found to have been created and approved in accordance with NGL corporate process and their implementation was appropriately managed and recorded within the AMS. We found some minor issues in some modifications, the majority of which were addressed during the inspection.
43. We judged that the control of modifications to plant during the periodic shutdown was adequate.

## 3.2 ENGINEERING ASSESSMENTS

### 3.2.1 Civil engineering

44. Reference 18 presents the findings of the ONR assessment of the pre-stressed concrete pressure vessel (PCPV) Appointed Examiner's (APEX) Start-up Statement (the statement). The statement reports NGL's progress with the statutory surveillances, inspections and tests on the PCPV as described in the Maintenance Schedule.
45. The scope of the ONR assessment focussed primarily on those aspects that affect the structural integrity of the PCPV:
- concrete surface examinations
  - tendon load checks
  - tendon anchorage examination
  - tendon corrosion examination
  - PCPV settlement and tilt
  - vibrating wire strain gauges
  - vessel temperature
  - main reactor coolant loss
  - pressure vessel cooling system
  - top cap deflection.
46. The inspector was satisfied with the data presented and the judgements of the APEX in the statement. Some of the inspection data was 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.
47. The inspector agreed that the recommendation made by the APEX, to re-survey the local reference datum for the settlement and tilt surveys back to the Ordinance Datum, was prudent and should be pursued by the Licensee.
48. During the load checks on the tendons, a vertical hoop tendon (E27) was found to have 4 broken wires and 5 of 8 further wires removed for examination were corroded. A safety case was produced justifying the next period of reactor operation with this tendon in a relaxed/unloaded state. This was reviewed by the inspector and is discussed in the emergent issues section below.
49. From the assessment of the results of the surveillance inspections and the safety case EC, acceptance of the judgements made by the Appointed Examiner, and noting the Licensee's commitments regarding the unloaded tendon, the inspector was content to support the return to service of the Reactor 22 pre-stressed concrete pressure vessel for the next operating period of three years.

### 3.2.2 Control and instrumentation systems

50. Reference 19 presents the findings of the ONR assessment of a sample of control and instrumentation (C&I) systems and equipment important to nuclear safety as presented in the OID and its supporting documentation provided by NGL. These documents provided a description of the routine maintenance activities and engineering changes that were implemented during the periodic shutdown of Dungeness B Reactor 22.
51. The scope of the assessment included the following plant, systems, equipment and activities:

- Maintenance of data processing and control system;
  - Maintenance of safety circuits and safety related circuits;
  - Maintenance of post trip interlock system;
  - Maintenance of neutron flux detectors;
  - Maintenance of laddic circuits;
  - Maintenance of and modification to gas circulators;
  - Maintenance of enhanced shutdown system;
  - Modification regarding continuous emergency monitoring system; and
  - Modification to main boiler feed pump and main turbine governor.
52. The inspector found that, in the areas sampled, the commitments made in the OID for C&I systems and equipment important to nuclear safety at R22 had been satisfied or, where the commitments related to testing could only be undertaken during return to service, arrangements were in place to ensure suitable and sufficient testing would be carried out. The inspector also found that the standard applied was adequate and consistent with the standards expected from C&I suitably qualified and experienced persons.
53. Some of the C&I tests can only be carried out during R22 return to service; therefore the results of these tests were not available at the time of the inspection. ONR will assess the test results, which will be part of the 28 day report, and respond accordingly through normal regulatory business.
54. The inspector found that, on the basis of the areas sampled, DNB was maintaining C&I equipment in accordance with its arrangements. However, a number of minor shortfalls were identified during the course of the inspection, the majority of which had been satisfactorily addressed and the proposed resolution of the remainder had been agreed and was not considered a return to service issue.
55. A review of the emergent work relating to Gas Circulator (GC) 28 was also conducted and this is further discussed in the relevant emergent issues section below.
56. Overall, the inspector found that, for the areas sampled, C&I activities undertaken had been conducted in accordance with the station work management system by suitably qualified and experienced persons. The inspector also found that, on completion of the planned and emergent work, no issues had been identified for DNB C&I work that should affect the return to service of R22.

### **3.2.3 Electrical engineering**

57. Reference 20 presents the findings of the ONR assessment of the electrical engineering work conducted during the periodic shutdown of Dungeness B Reactor 22. The assessment considered the electrical aspects outlined in the OID and sampled the shutdown related maintenance activities, including relevant documentation, that had been applied to electrical switchboard maintenance and other electrical systems that were important to the safety of R22.
58. From the intended scope of electrical system work during the Reactor 22 2015 periodic shutdown the following areas were considered for assessment:
- Gas Circulator Motors
  - Grid (Transmission System connection)
  - Transformers
  - Electrical Switchboards

59. The inspector focussed the assessment against those systems which performed a Category A function, as defined in BS EN 61226, classification of instrumentation and control functions. Noting that the majority of electrical maintenance schedule activities are undertaken whilst at power, the inspector also considered those systems important to safety maintained outside the periodic shutdown window to ensure they were being completed and there were no associated issues which could affect nuclear safety.
60. Some maintenance activities remained to be completed at the time of the assessment but the inspector was content with the assurances received from NGL, and their processes, that these would be completed before the return to service of Reactor 22 and would be reported in the 28 day report.
61. Following a review of the maintenance for all 415V switchboards on site by the Licensee, a shortfall was identified which was not in accordance with the Licensee's own guidance for maintaining LV switchboards. Recognising the function that these boards performed, the inspector sought a commitment from the Licensee to complete the maintenance on these boards in a prioritised order, based on the systems that they support, and in an overall timely manner. An initial external inspection of the switchboards by the Licensee did not give them cause to remove them from service immediately and an appropriate prioritised recovery plan for the maintenance was agreed with the inspector.
62. In relation to the electrical aspects of the Reactor 22 outage in 2015, the inspector did not identify any issues of significance that should prevent ONR from granting consent to allow Reactor 22 to restart. Therefore, the inspector recommended that consent was granted for Reactor 22 at Dungeness B to start-up following its 2015 periodic shutdown.

#### **3.2.4 Graphite core integrity**

63. Reference 21 presents the findings of the assessment of the graphite core inspections of DNB Reactor 22 during the 2015 periodic shutdown and supporting documentation provided by NGL. It also includes an assessment of a revised graphite weight loss safety case based on analysis of the results from the Reactor 21 planned shutdown in 2014.
64. During the periodic shutdown of DNB Reactor 22 the following graphite inspections were conducted:
  - Inspection of 5 fuel channels and 3 control rod channels both visually and dimensionally, a total of 88 bricks.
  - Removal of 48 trepanned samples, 6 for each of the 8 channels.
65. The results from the graphite core channel bore measurements and inspections were consistent with the extant graphite core safety case.
66. The safety case limit for core average graphite weight loss is 8%. The graphite samples trepanned during a periodic shutdown are analysed to determine their weight loss and this information is used in the safety case. The analysis takes some time and hence the results will not be available until after the reactor has returned to service. Samples were taken during the 2014 Reactor 21 periodic shutdown, which finished in July 2014 and the results were incorporated into a revised safety case in Engineering Change EC353784 in June 2015. The revised safety case was used by the Licensee to support the operation of Reactor 22 through to its next periodic shutdown and hence was assessed by ONR as part of its outage assessment, by justifying that the average graphite weight loss will remain below 8% until the following outage in August 2018.

67. The ONR assessment concluded that, whilst the inspector judged that there was likely to be an adequate margin available to support the return to service, there was significant remaining uncertainty in the predictions of weight loss, due in part to the reliance on data from Reactor 21. He therefore recommended that trepanned sample data from Reactor 22 should be analysed within a year and a new safety case document prepared.
68. To ensure that the revised safety case is prepared promptly, the station director has committed the Licensee to produce it by end August 2016, Reference 22. This commitment includes additional earlier milestones to ensure that should any problems arise with the safety case, they are identified as soon as possible. ONR will monitor progress against the achievement and content of these milestones through the extant regulatory issue 1737, relating to DNB graphite weight loss.
69. In conclusion, the inspector found the graphite inspection activities to be adequate and noted the Licensee's commitment to update the graphite weight loss safety case. The inspector considered that none of the inspection findings arising had led to objections to the granting of consent for return to service.

### **3.2.5 Mechanical engineering**

70. Reference 23 presents the findings of the ONR assessment of the adequacy of the Mechanical Engineering related activities conducted by the Licensee to comply with the requirements of Licence Condition 28 – Examination, Inspection, Maintenance and Testing (EIM&T) against a sample of nuclear safety significant reactor components.
71. The activities examined were selected due to their nuclear safety significance and included:
- EIM&T of gas circulators
  - EIM&T of safety significant valves
  - EIM&T of control rod assemblies
  - Standard of nuclear significant maintenance facilities
72. Based on the sampling conducted, the inspector found no significant issues in these areas.
73. The gas circulator maintenance had encountered a number of issues which the inspector considered had been appropriately managed:
- Gas circulator 25 (GC25) stationary seal leakage, requiring an unplanned full overhaul of the gas circulator.
  - GC26 problems with maintenance related components, which did not affect the safe operation of the gas circulator.
  - GC28 deferral of major overhaul interval to 12 years, see emergent issues section below.
74. From a mechanical engineering perspective, the inspector has no objection to the granting of consent for Dungeness B Reactor 22 to return to power for the next operating cycle.

### **3.2.6 Structural integrity**

75. Reference 24 presents the findings of the ONR assessment of the adequacy of the inspections of welds, pipework, boilers and reactor internals conducted during the

2015 Dungeness B Reactor 22 Periodic Shutdown in support of compliance with LC 30.

76. The assessment covered the structural integrity aspects of the Licensee's scope and results of the examination, maintenance, inspection and testing steel components that were required to fulfil a nuclear safety function.
77. The inspector identified from the scoping documentation, the following areas for sampling during the site inspection:
- Steam and feed system in-service inspections
  - Reactor internal inspections
  - Flow assisted corrosion (FAC) inspections
  - Reactor seawater cooling system inspections
  - Pipe hanger and restraint inspections
  - Gas bypass rooms (North Wall plant rooms)
  - Steam turbines
78. The inspector identified no significant safety issues and the sampled inspection results were found to be appropriately processed and managed.
79. Earlier evidence of water ingress into R21 north wall plant rooms had led to the planning of remediation work in the R22 north wall plant rooms this shutdown. This work included the application of protective coatings to pipework, renewal of lagging and improving drainage. The bypass filter vessels were also delagged in areas at risk of waterlogging and inspected for corrosion. Limited corrosion was found and the vessels were considered suitable for service with routine shutdown inspections now scheduled.
80. Following discussions within ONR and with an NGL INA engineer, additional sampling was identified relating to the decision taken by station not to remove the dome ends from a number of superheater outlet headers and to sample the renewal strategy of the hot reheat SRV flexible hoses.
81. The decision had been taken by station not to renew the flexible hoses based upon re-prioritising of resources following a risk assessment. As such, instead of renewing the hoses as originally planned, a detailed inspection was conducted on the flexible hoses. The Licensee's metallurgist did not have any significant concerns relating to the integrity of those hoses inspected. The original intent for renewing the flexible hoses was to reduce the risk posed from asbestos contained within the hose structure and not in relation to any nuclear safety issues. Therefore, from the information provided and discussions on site, the inspector judged that the integrity of the SRV flexible hoses was adequately managed during this periodic shutdown.
82. In summary, adequate examination, inspection, maintenance and testing had been undertaken on a number of systems essential to safety including the seawater cooling and pipework hanger systems. All defects identified of any significance had been adequately dealt with by NGL according to their procedures and processes. The reactor internal inspections had been completed in line with the outage proposals document for in-service inspections. Alterations, deletions and additional inspections were dealt with following NGL's company guidance. In terms of Structural Integrity, the inspector judged that no issues had been identified that would prevent Dungeness B Reactor 22 from returning to service.

### **3.3 MEETINGS**

#### **3.3.1 Outage intentions meeting**

83. On 13 November 2014 the site inspector attended the OIM for statutory outage of Reactor 22 at DNB. The purpose of the meeting was for DNB to present the scope of work intended to be carried out in the Reactor 22 2015 statutory outage to ONR. In addition NGL presented an overview of the outage organisation, infrastructure and management arrangements to deliver the safety related activities being undertaken in order to meet the requirements of the relevant sections of Site Licence Conditions 28 and 30.
84. There were no issues raised during this meeting and no emergent nuclear safety issues that required a change to the proposed intervention task sheet for the upcoming outage. A brief report on the OIM is given in Reference 25.

#### **3.3.2 Mid-outage meeting**

85. The Mid-Outage Meeting was held on 17 June 2015, day 47 of the outage programme. The aim of the meeting was for NGL to provide ONR with an update of the outage progress up to 16 June and highlight any issues which might impact on the outage programme. The presentation used for the meeting contained the detail of general outage progress and issues, Reference 26. Each section of the presentation was given by the appropriate technical lead.
86. Steady progress was being made against the outage schedule but there were issues relating to the gas circulator 25 stationary seal and the knock on effect of addressing this to the GC 28 maintenance programme. The proposal to move the major maintenance of GC28 to a 12 yearly cycle is discussed further under the emergent issues section below.
87. We discussed the outage actions already raised by the ONR inspectors and reviewed the other actions that had been raised during and following the recent inspections which had not yet been finalised. Six, including two draft, were identified as 'Consent Issues' requiring closure before ONR grants consent for the reactor start up. These actions primarily related to the supply of documentation and further information and have subsequently been addressed.

#### **3.3.3 Start-up meeting**

88. The Start-Up Meeting was preceded by a comprehensive plant walk-down on 21 July 2015. ONR was represented by the Superintending Inspector, the Site Inspector and myself. The walk down encompassed many of the work packages conducted during the periodic shutdown. The first of the plant life extension (PLEX) work packages was completed during this shutdown, the replacement of unit transformers 22A and 22B.
89. Most of the intrusive work had been completed and there was still a considerable amount of final cleaning and scaffolding to be removed. Improvements to the general access and cleanliness in the turbine hall basement were scheduled to be conducted post shutdown as an ongoing programme of workplace improvements.
90. The Start-Up Meeting was held on 22 July 2015, chaired by the station Technical and Safety Support Manager, and was attended by the ONR Superintending Inspector, Site Inspector and myself. The purpose of the SUM was for the Licensee to demonstrate that it had adequately met the requirements of the Maintenance Schedule, dealt with emergent issues and demonstrated the safety of Reactor 22 for the next operational period. The Dungeness B Reactor 22 2015 Outage Start-Up Report, Reference 27,

was provided prior to the meeting and was used as the basis for the presentations and discussions held during the meeting.

91. ONR had raised 11 actions during their inspections and assessments which required closure prior to granting consent to start-up Dungeness B Reactor 22. These were confirmed as closed with responses and acceptance recorded in the ONR action tracking log, Reference 28.
92. Five new actions were identified during the meeting. Only one, related to agreeing the commitments in support of the graphite condition monitoring work, required to be completed before the issue of the consent to start-up Reactor 22.
93. During the periodic shutdown a number of modifications relating to the on-going Japanese Earthquake Response (JER) programme were completed and subsequent to the meeting it was confirmed that all physical plant modifications as part of the JER programme were complete; with final commissioning, documentation, training and handover due to finish in 2016, Reference 29.

### **3.4 EMERGENT ISSUES**

94. During the periodic shutdown inspection and maintenance activities, defects in the plant condition were identified which required unplanned additional work and safety justification. ONR considered that two of these were of sufficient safety significance that the safety justifications would be reviewed.

#### **3.4.1 Tendon E27 broken wires**

95. One tendon (E27) was found to have four broken wires (out of the total of 163) and five of eight further wires that were withdrawn for examination showed signs of pitting and corrosion. The corroded areas coincided at about the mid-height of this vertical tendon. The tendon and duct were dry however, with no signs of running or standing water, and the lower anchorage components showed no signs of corrosion or of being wetted.
96. Tendon E27 was a vertical tendon that was within the 'barrel' or cylindrical portion of the pressure vessel. A particular conceptual design feature of these PCPVs was their ability to tolerate the loss of several tendons without significantly affecting their overall structural capability, and this was the principle safety argument given in the Licensee's safety case for returning Reactor 22 to service with tendon E27 unloaded, EC356234, Reference 30. This EC was included in the assessment conducted by the ONR civil engineering inspector, Reference 18.
97. Replacing this tendon requires access from the pile cap and involves procedures that are only permitted whilst the reactor is off load, and changing a full tendon of 163 wires takes around 2 to 3 weeks to complete. The Licensee considered it ALARP not to replace this tendon during this shutdown and justified this in Reference 30.
98. ONR civil engineering assessed Reference 30 and considered that the three main elements of the safety case were:
  - The margin on the total vessel pre-stress load and the redundancy in the number of tendons.
  - That the extent of the condition is sufficiently well known for it to be unlikely that significant numbers of other tendons have been similarly affected.
  - In-service monitoring will detect any tendon failures and could detect any further individual wire breaks.

99. The Licensee had committed to investigate the cause of the corrosion and was awaiting results from metallurgical examinations and tests. This information would then inform the ALARP decisions for the future strategy. Whilst this could involve removing the entire tendon from the vessel at the next periodic shutdown, at this stage no commitment had been made to install a new tendon. The inspector explained to the Licensee that a prime directive should be to restore the vessel to its original design intent and the inspector will pursue this principle during future interventions on this matter.
100. The inspector noted the Licensee's commitments detailed in Reference 30 and the inspector considered that the safety case for returning the vessel back into operation with tendon E27 in an unloaded state was adequate.

#### **3.4.2 Gas circulator 28 - extension of major overhaul interval to 12 years**

101. The maintenance schedule required the licensee to undertake a major overhaul of each gas circulator every 9 years. During the 2015 outage the original intent was to perform a major overhaul on GC 26 and GC 28. During the deployment of the stationary seal on GC25 for maintenance, a fault was identified which required the unscheduled major overhaul of GC25. The licensee decided that the best way forward was to complete major overhauls on GC 25 and GC 26, and to not perform the scheduled major overhaul on GC 28. The impact of this meant that DNB proposed that the major overhaul of the GC28 cartridge be extended to a 12 year interval through engineering change EC355902.
102. The result of this was that GC28 would only have a minor overhaul at this time. The scope of the activities affected were all that required the removal of the concrete shielding at the outer end of the GC penetration:
- Running seal replacement
  - Cartridge unit inspection, cartridge unit shaft , bearings, anti-back turning clutch, stationary seal operation
  - Sleeve valve actuators overhaul
  - Main drive shafts and alignment
  - Spherical white metal bearing inspection.
  - Instrumentation
103. Due to the nature of the deferral proposal and the equipment affected, EC355902 was reviewed by ONR inspectors from the following disciplines, who each concluded that the proposal was acceptable::
- Control and instrumentation (Reference 19)
  - Mechanical engineering (Reference 23)
  - Electrical engineering (Reference 31)
  - Structural integrity (Reference 32)

I therefore conclude that the proposal to extend the maintenance interval for GC 28 is acceptable.

#### **4 MATTERS ARISING FROM ONR'S WORK**

104. I have considered the Licensee's request to ONR to grant a consent under LC30(3) to start-up DNB Reactor 22 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 ONR site inspector.

105. In Reference 1, the DNB the Station Director stated that an Operational Safety Review Committee would be convened prior to start-up to confirm all maintenance, operational, training and re-commissioning activities are adequately complete to allow Reactor 22 to be returned to service safely and in compliance with the Licence Conditions. The letter also stated that subject to the completion of the activities identified in the Start-up Quality Plan, the Station Director was satisfied that Reactor 22 was fit for return to service and sufficient procedures were in place to assure safe operation through to the next periodic shutdown.
106. INA has provided its Concurrence Part B (Reference 6), which confirmed that they have completed their periodic shutdown assurance activities and that they support the start-up and subsequent operation of Reactor 22 within the constraints of the current safety case.
107. The PSSR competent persons (for the PCPV, the reactor penetrations and the balance of plant) have each confirmed that they are content for Reactor 22 to start up.
108. ONR specialist assessors from the following disciplines undertook inspections to support my permissioning work:
  - Civil engineering systems
  - Control and instrumentation systems, including reactor protection systems
  - Electrical systems
  - Fire safety
  - Graphite core integrity
  - Mechanical engineering
  - Quality assurance
  - Radiological protection
  - Site inspection
  - Structural integrity
109. 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, see Reference 28. None of the outstanding actions have been deemed sufficiently significant for ONR to withhold consent to start-up Reactor 22. All the reports contain either a statement supporting issuing consent to start-up Reactor 22, or note that there is no reason to withhold consent.
110. I consulted with other relevant regulators, EA and CNS, to establish if either had any specific objections that would prevent ONR from issuing LI 547, consent to start-up Dungeness B Reactor 22. Both the EA (Reference 33) and CNS (Reference 34) confirmed they do not object to ONR granting consent.

## **5 CONCLUSIONS**

111. The Dungeness B Reactor 22 periodic shutdown 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 DNB Station Director writing to ONR requesting consent to start-up Reactor 22. His letter stated that subject to the completion of the activities identified in the Start-up Quality Plan, he was satisfied that Reactor 22 was fit for return to service

and sufficient procedures were in place to assure safe operation through to the next periodic shutdown.

113. The Licensee's internal regulator, INA, has provided the concurrence part B report that supported the return to service of Dungeness B Reactor 22 post its periodic shutdown.
114. The PSSR competent persons have each confirmed that they are content for Reactor 22 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 Reactor 22. All actions raised during their inspections and assessments have been satisfactorily addressed or have acceptable plans for resolution.
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 Dungeness B Reactor 22 periodic shutdown 2015, I am satisfied that the Licensee's justification to start-up the reactor and operate for a further period of three years is adequate; consequently, consent to start-up the reactor can be granted.
118. I have prepared DNB Licence Instrument 547, 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 the Solicitors Office.

## **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 Dungeness B Licence Instrument 547.
120. I recommend that the Deputy Chief Inspector signs Dungeness B Licence Instrument 547, which grants consent under Licence Condition 30(3) attached to Nuclear Site Licence No.61 to start-up Dungeness B Reactor 22.

## 7 REFERENCES

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- 2 Dungeness B, LI 6 - DNB70597N - LC30(3) Specification to require consent to start up a reactor after LC30(1) shutdown, 28 March 1996. TRIM 2015/288185
- 3 Dungeness B – Licence Instrument 537 - Consent under Licence Condition 30(3) to start up Dungeness B Power Station reactor 22 following the 2012 periodic shutdown, 29 May 2012. TRIM 2012/223431
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- 14 NGL - CNRP - Intervention Record - 15-032 – Dungeness B R22 Outage 18 - Radiological Protection Inspection, 04 June 2015. TRIM 2015/215478
- 15 ONR - COP - Intervention Record - 15-15 - Dungeness B Outage FS Inspection Final, 8 July 2015. TRIM 2015/258983
- 16 ONR – CNRP – Intervention Record – 15-018 – Dungeness B Planned Intervention - 11-14 May 2015, TRIM 2015/174172
- 17 ONR – CNRP – Intervention Record - 15-035 - Dungeness B Planned Intervention - 15-18 June 2015, TRIM 2015/214710
- 18 EDF NGL – Dungeness B - Assessment Report - 15-038 – DNB R22 2015 Periodic Shutdown -Civil Engineering - Assessment of the Pre-stress Concrete Pressure Vessel Appointed Examiner Start-Up Statement, 30 July 2015. TRIM 2015/278411

- 19 ONR - CNRP – Assessment Report - 15-030 - EDF Energy Nuclear Generation Limited (NGL) Dungeness B Power Station (DNB) Reactor 22 (R22) 2015 Periodic Shutdown: Control and Instrumentation (C&I), 08 July 2015. TRIM 2015/245312
- 20 EDF NGL – Dungeness B - Assessment Report - 15-025 - DNB R22 2015 Periodic Shutdown – Electrical Engineering Assessment, 31 July 2015. TRIM 2015/279581
- 21 EDF NGL - Dungeness B - Assessment Report - 15-017 - DNB R22 2015 Periodic Shutdown - Assessment of the results of the Graphite Core Inspections, 28 July 2015. TRIM 2015/276649
- 22 EDF - CNRP - NSLDNB50809Y - Graphite Weight Loss Safety Case Compliance Strategy, 27 July 2015. TRIM 2015/282769
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- 25 NGL - CNRP - Intervention Record - 14-181 - Planned Inspection of Dungeness B including OIM - 10-13 November 2014. TRIM 2014/423161
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- 31 Email - Dungeness B R22 Outage 018, 2015 - EC355902 - Gas Circulator 28 Maintenance Deferral - Electrical Engineering, 16 July 2015. TRIM 2015/264833
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