



Permissioning of Bradwell Licensed Nuclear Site into Care and Maintenance
Specification for Entry of Bradwell Licensed Nuclear Site into the Stage of Care and
Maintenance

Project Assessment Report ONR-SDFW-PAR-17-001
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EXECUTIVE SUMMARY

ENTRY OF BRADWELL LICENSED SITE INTO CARE AND MAINTENANCE

This report is in support of issuing a Specification under Licence Condition (LC) 35(5) to Magnox Ltd's Bradwell licenced nuclear site.

PERMISSION REQUESTED

Magnox Ltd (ML) has not submitted a permissioning request. The Office for Nuclear Regulation (ONR) is specifying that ML should not commence the decommissioning stage of Care and Maintenance (C&M) at the Bradwell licensed nuclear site without ONR's formal Consent under Licence Condition 35(5).

BACKGROUND

Bradwell is situated at Bradwell on Sea, Southminster, Essex, close to the Essex coastline. Electricity generation started in 1962 and the two reactors finally shutdown in 2002.

The Magnox Ltd decommissioning strategy is one that is based on an IAEA concept of deferred dismantling. This internationally recognised approach is one whereby progressive risk reduction is accrued from natural decay of radioactivity. The Bradwell site is undergoing an accelerated decommissioning programme, which is now nearing completion in preparation for entry into the C&M stage of its lifecycle. The safe quiescent period at Bradwell is expected to last approximately seventy years. During C&M the site will be managed from a remote location, initially from Sizewell A and eventually from a central location when sufficient sites have entered C&M to make this financially viable. As the name suggests, the licensee will be implementing a planned programme of monitoring and inspection and, where necessary, maintenance to ensure the integrity of the structures, systems and components important to safety are not significantly degraded during the period of C&M.

To prepare for C&M ML has undertaken an extensive programme of decommissioning and plant and equipment removal of some reactor systems and has demolished most of the ancillary buildings, including the turbine hall. The reactor buildings have been clad with special weatherproofing to create 'Safe-stores' designed to protect the remaining reactor core, reactor pressure vessel, and other primary circuit structures and which will contain radioactive material during the period of C&M. Upon entry to C&M Bradwell will have completed processing of its intermediate level waste on site and packaging the waste for interim storage in a newly constructed store. The redundant ponds have been cleaned, drained, sealed and over-clad with a protective structure to provide a weather-proof enclosure.

Bradwell will be the first British nuclear power generating site to enter a period of C&M and although the nuclear risks from the site are considered to be low, ONR has decided that this first-of-a-kind transition sets precedence for the UK and as such warrants the use of primary licensing powers to permission this major change to the lifecycle stage of the installation.

ONR has developed a regulatory strategy which targets specific aspects of the preparatory works where the risks to safe C&M are greatest and by issuing a Specification under LC35(5), ML will then subsequently need to apply to ONR for a Consent to proceed. ML submitted its safety justification/case documents in July 2017 with an intention to proceed into C&M between June and December 2018. Furthermore, the safety case will be considered to re-set the 10 yearly Periodic Safety Review (PSR) submission date as required under LC15 of the site licence. In addition, planned inspections by ONR and a formal senior-level meeting with the licensee, prior to C&M entry, will inform the decision to issue a formal Consent

In order for ONR to issue its Consent for Bradwell to enter C&M, ML will need to have demonstrated that it has:-

- Prepared the site adequately for entry into C&M
- Implemented and established adequate arrangements for the Site's remote management from the Sizewell A site.
- Submitted an adequate safety case to demonstrate the safety of the C&M stage, including transport and that adequate security arrangements are in place.

ML intends to submit a safety case final report that will summarise the case and take account of any issues and responses agreed during ONR's assessment (BWA/DPAF/4286 – Final Report), which will inform ONR in issuing its Consent.

ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR

The inspection and assessment work over the period of preparations for C&M has so far not revealed any issues significant enough to impede ONR's Consent being issued. The site has to date been adequately decommissioned and prepared to enter C&M. The conclusions of ONR's final assessment of the C&M entry stage safety submissions will further inform the final decision on whether to issue Consent.

CONCLUSIONS

This report concludes that:-

- As Bradwell is the first decommissioning nuclear power generation site to enter C&M in the UK it sets a precedent, and ONR should implement primary power permissioning via a Specification and subsequent Consent under Licence Condition 35(5).
- The ONR inspection activities for the Bradwell site have so far not revealed any issue that would prevent the sites progression to the stage of C&M, and that the site has been decommissioned and prepared to an adequate standard.
- Issuing Consent for the site to enter C&M should be considered after assessment of the C&M entry safety case / PSR stage submissions and the planned site readiness inspections.

RECOMMENDATION

ONR uses its primary powers under LC 35(5) by issuing a Specification to Magnox Ltd to ensure that the entry of the Bradwell site, into the stage of C&M, requires ONR's formal Consent.

LIST OF ABBREVIATIONS

ACM	Asbestos Containing Material
C&M	Care and Maintenance
CFP	Cavendish Fluor Partnership
CNS	Civil Nuclear Security (ONR)
DCIC	Ductile Cast Iron Container
FED	Fuel Element Debris
GDF	Geological Disposal Facility
HOW2	(ONR) Management System
ILW	Intermediate Level Waste
ISF	Interim Storage Facility
LC	Licence Condition
LLW	Low Level Waste
ML	Magnox Limited
MODP	Magnox Optimised Decommissioning Programme
NDA	Nuclear Decommissioning Authority
ONR	Office for Nuclear Regulation
PSR	Periodic Safety Review
REPPiR	Radiation (Emergency Preparedness and Public Information) Regulations 2001
RGP	Relevant Good Practice
RPV	Reactor Pressure Vessel
RWM	Radioactive Waste Management Ltd

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1 INTRODUCTION

1. This report is in support of a Specification being issued to require Magnox Ltd. (ML) to apply to the Office for Nuclear Regulation's (ONR) for Consent before it can commence an extended decommissioning stage of Care and Maintenance (C&M) at the Bradwell site.

1.1 BACKGROUND

1.1.1 DECOMMISSIONING STRATEGY

2. Bradwell site is situated at Bradwell on Sea, Southminster, Essex, close to the Essex coastline. Electricity generation started in 1962 and the reactor finally shutdown in 2002.
3. The Bradwell site is undergoing an accelerated decommissioning programme, which is now nearing completion in preparation for entry into the C&M stage of its lifecycle. One of the main objectives of ML's decommissioning programme is to bring the former Magnox generating sites into a quiescent state for a period, known as Care and Maintenance (C&M). This internationally recognised approach is one whereby progressive risk reduction is accrued from natural decay of radioactivity. After this period the sites will be restored to an agreed end state, through further dismantling and final site clearance.
4. An overall strategy for decommissioning the Magnox Ltd licensed sites has been agreed between ML and the Nuclear Decommissioning Authority (NDA) in the Magnox Optimised Decommissioning Programme (MODP), with 'early' entry of Bradwell site into C&M as a major objective.
5. Taking one site into C&M early in the programme was seen to have benefit in that operational experience and lessons from Bradwell would be captured and promulgated to sites scheduled for subsequent C&M entry. The approach for implementing the MODP strategy for Bradwell, is now well established with a high degree of maturity. The programme approach to delivery (formerly employed by ML in a number of specific areas e.g. decommissioning of cooling ponds, management of Intermediate Level Waste (ILW)) has been extended to cover all of the company's scope of work.

1.1.2 DECOMMISSIONING PROGRAMME

6. The Bradwell site is now reaching the final stages of preparation for entry into the C&M stage of its lifecycle. Decommissioning activity has been underway for several years and has included significant plant and equipment removal, and radioactive waste retrieval and treatment in preparation for entry into C&M. The period of C&M is currently expected to last around seventy years. During this period the site will be maintained from a remote location, initially from Sizewell A site and eventually from a central location that will eventually become responsible for all the ML sites.
7. A programme based approach has been adopted for the whole of the work scope involved in bringing the ML sites to the C&M configuration and establishing the arrangements needed to manage them during the C&M period. This arrangement was formerly in place for some of the work (e.g. ponds decommissioning, management of ILW). Under programme working, all of the work in a given area is managed as a coherent whole and common approaches are adopted across all of the sites. There are a number of advantages to this approach, including work force mobility. ML contends that the consistency promoted by this approach leads to improved safety and compliance through learning and reduction in human error. The routine inspections of the ponds remediation programme and the provision of Advanced Vacuum Drying

System (AVDS) plant for processing ILW at Dungeness A suggests that this approach is beneficial.

8. To prepare for the C&M stage ML has undertaken an extensive programme of decommissioning and plant and equipment removal including of the reactor systems and has demolished most of the ancillary buildings including the turbine hall. The reactor buildings have been clad with special weatherproofing to create 'Safe-stores' designed to protect the remaining reactor core and pressure vessel assemblies for the period of C&M. An outline of the work undertaken to prepare the site can be found in Reference 1.

2 ARRANGEMENTS FOR THE PERIOD OF CARE & MAINTENANCE

9. The approach is to decommission and remove redundant plant and equipment as far as practicable from the facilities to a stage where the reactor cores can be left defuelled for a period of up to 80 years. This is intended to allow the remaining radioactive substances (mainly the graphite core) to decay away naturally to very low levels of radioactivity thereby facilitating easier disposal of waste and final site clearance.
10. During this phase the intention is that the sites will not be permanently staffed but managed remotely from another location. Several ML sites are going to be in C&M early for a prolonged period of years before the others enter C&M. Therefore an interim state has been proposed whereby the early C&M sites are managed remotely from a 'buddy' site on a regional basis. It is considered that this is more cost effective than setting up a central 'hub' organisation immediately just to manage one site for a number of years.
11. The C&M security strategy has developed from an initial approach under which a permanent site security presence would be maintained for sites entering C&M, to the current proposal that there will be no personnel on site during C&M. The concept of a site completely without permanent staff has now been accepted in principle by ONR but the final decision on this matter is still to be made. ML is currently working with ONR-Civil Nuclear Security (CNS) inspectors to generate a site protection plan proportionate to the risks remaining on a site in C&M.
12. There will still be a need to allow for personnel access to the site for such things as routine inspections, structural surveys, and any damage repairs which may become necessary as a result of unanticipated occurrences. The Interim Storage Facility (ISF) will periodically require access to load packages of ILW and will remain as an operational store for the duration of C&M.
13. For the initial period of C&M Bradwell will be managed remotely from the Sizewell A site followed by transitioning to central hub management once a sufficient number of additional sites enter the C&M stage.

3 PERMISSIONING BY ONR

14. ONR has developed a clear strategy for regulation of licensed sites entering into a quiescent phase (Reference 2) and Bradwell will be the first British nuclear power generating site to enter such a phase. Although the nuclear risks from the site are now considered to be very low, the importance of this first-of-a-kind approach in GB is considered sufficient to warrant formal permissioning under the primary powers of the site licence. If a similar approach is adopted by ML for subsequent reactor sites ONR is minded not to use its primary powers but to rely on a more flexible permissioning approach under ML's own arrangements.

15. ONR has decided that the transition to C&M is permitted via a formal Specification and Consent under Licence Condition 35(5). The C&M Stage Submission documents were submitted to ONR in July 2017 with an intended implementation date of between June and December 2018. ONR will consider Consent through assessment of the safety case, which is also deemed to constitute a PSR and will re-set the submission dates under the requirements of LC15.
16. ML is to submit a combined C&M safety Case and PSR submission in the form of 'Stage Submission' and 'Stage Submission Addendum' documents, which will be assessed by ONR specialist inspectors. ONR will aim to complete its review and assessment by early 2018. This gives at least 6 months to complete the final preparations before the site will have completed the preparatory works to achieve the C&M site entry state.
17. It is intended that ONR will grant formal Consent to enter C&M based on a satisfactory outcome from its assessment of the C&M stage submissions, combined with readiness inspections of the site, and in conjunction with the Environment Agency (EA).
18. Following completion of ONR's assessment ML will issue a C&M submission final report that will close out the submission taking into account any issues raised by ONR or EA. Assuming successful completion of the assessment and readiness inspections and a final formal meeting between ONR and Bradwell staff, it is intended to issue ONR's formal Consent to enter C&M. More detail of ML's current strategy is provided in Reference 3.

4 NDA CONTRACT STATUS

19. The Nuclear Decommissioning Authority (NDA) contract with Cavendish Fluor Partnership (CFP) to operate the ML licensed sites was challenged by the previous contractor and the high court upheld that the award of the contract was flawed. This in turn has resulted in the NDA giving notice of cancellation of the current contract with CFP with a contractual clause of two years' notice (ending in August 2019). The cancellation of the contract should not materially impact on the arrangements for the Bradwell programme to enter into the stage of C&M, which is due in 2018.

5 ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR THROUGH SITE'S PREPARATIONS FOR ENTRY INTO C&M

20. ONR has been regulating the safety of defuelling and decommissioning activities on the site. During this period the preparations for entry into the stage of C&M have progressed without significant incident, through a series of regulatory interactions on a number of themes. During this process a clearer understanding of the requirements for C&M have been developed. The main areas of regulatory attention during this period have been:-
 - The integrity of the RPV and boilers for C&M.
 - Cladding of the reactor buildings (Safe-stores)
 - The use of Ductile Cast Iron Containers (DCIC's) for ILW storage and the provision of RWM letters of compliance (LoC's)
 - Use of an Interim Storage Facility (ISF) for the interim storage of ILW.
 - Ponds decommissioning end-state for C&M.
 - Remediation of the Fuel Element Debris (FED).
 - Emergency response arrangements and de-staffing
 - Post entry management systems and security for C&M
21. These areas were selected for attention because they represent what ONR consider as the main areas of risk to adequate implementation of a prolonged period of C&M.

5.1 BOILER WITHSTAND AND PONDS DECOMMISSIONING END-STATE

22. Following previous work on taking the boilers down at Berkeley power station, and pond bay surface decontamination removal at Trawsfynydd, Magnox Ltd contended that these were costly operations that generated a lot of waste and would take a long time to complete. This would delay the decommissioning programme and create a larger overall radioactive dose to workers. Magnox Ltd submitted proposals to leave the boilers in position with suitable seismic strengthening, and to adopt the more simple operation of cleaning and sealing the ponds as more cost effective solution with lower overall dose uptake. Following its assessment ONR was satisfied that the low levels of nuclear risk involved would make objections to these proposals disproportionate.
23. ONR issued a Licence Instrument (LI506) in May 2013 agreeing to the sealing of the ponds and released a regulatory hold point in September 2014 (Reference 4) to permission the installation of boiler supports that were needed during the period of C&M.

5.2 THE USE OF DUCTILE CAST IRON CONTAINERS (DCIC) FOR ILW STORAGE AND THE PROVISION OF RWM LETTERS OF COMPLIANCE (LOC'S)

24. ML proposed the use of DCICs instead of 500ltr drums for radioactive waste storage as a readily available solution to interim storage of ILW generated from the decommissioning work on site. ONR has been involved in determining the suitability of these containers, particularly with respect to the possibility of longer-term issues of container pressurisation and its effects. ML has submitted adequate justification that these containers will be fit for purpose and the containers have been given a letter of compliance by Radioactive Waste Management Ltd (RWM) thereby signifying that they should be suitable for emplacement in the UK geological disposal facility (GDF) when it is eventually constructed by RWM. ONR released the regulatory hold point on transfer of ILW to DCIC's in December 2012 (Reference 5).

5.3 USE OF AN INTERIM STORAGE FACILITY (ISF) FOR THE STORAGE OF ILW ON THE SITE.

25. The need to store Intermediate Level Waste (ILW) until the UK's Geological Disposal Facility (GDF) becomes available has led to the design and construction of an interim storage facility (ISF) on site. This new store will house the ILW packages produced as a result of decommissioning activities on the site. The ISF is a modern facility that will safely store waste packages for many decades until a GDF is commissioned. The Bradwell ISF was not subject to specific formal permissioning by ONR as it was considered to be of a very similar design and construction of new ISF on other Magnox Ltd sites that ONR had previously assessed and given permission to. The assessment of the use of DCICs by ONR considered the ISF as an integral part to the ONR permission to use DCICs, which in themselves provide substantial protection to the ILW they contain.

5.4 REMEDIATION OF FUEL ELEMENT DEBRIS (FED).

26. FED mainly refers to the magnesium oxide outer cladding of the fuel elements that is stripped off when the fuel is sent for re-processing. ONR was involved in the permissioning of a FED dissolution plant that dissolved the FED into solution, passed it through a treatment plant separating the radioactive species and discharged the bulk solution to the estuary. Initial teething problems with the plant hampered the ability to process the originally intended volumes of FED. However ML was able to achieve reliable operations and have processed more FED than was originally forecast following commissioning of the plant. Residual FED stocks, falling into the Low Level Waste (LLW) category have been exported from site to be processed by an

independent waste contractor for eventual disposal in the LLW repository in Cumbria. ONR permissioned FED retrievals via a series of hold points (Ref 6, 7, 8 & 9). Magnox Ltd completed the programme of FED retrieval and processing in June 2017.

5.5 EMERGENCY RESPONSE ARRANGEMENTS AND DE-STAFFING.

27. ONR has also been involved in assessing the emergency arrangements on the site which have progressively reduced in scope as the nuclear risks have decreased due to the defuelling and decommissioning work on the site. The risks from the site are now so low that the site is no longer considered to generate a reasonably foreseeable risk of a radiation emergency as defined in the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR) and therefore the emergency arrangements have been scaled back accordingly.
28. ONR has permissioned the removal of the need for an off-site and on-site emergency plan under REPPIR (Refs 10 & 11). ONR is considering Approval to amend the emergency arrangements to align with the proposed move from 24/7 shift working to office hours, once all waste processing ceases on the site. Eventually the extent of the emergency arrangements will reflect the C&M stage of a safe quiescent site with no personnel, and will accordingly have very simple contingency type plans.

5.6 CLADDING OF THE REACTOR BUILDINGS ('SAFE-STORES')

29. To protect the integrity of the reactor pressure vessel (RPV) and associated boilers and pipe-work for the intended period of C&M ML enveloped the existing reactor buildings within a new outer shell. The intention being that these new over-buildings will provide a protective, weathertight envelope encompassing the whole of each reactor building with the main objective of preventing corrosion of metal components and degradation of the concrete structure by preventing rainwater ingress and condensation.
30. This modification known as the reactor 'Safe-stores' required the existing cladding to be removed and replaced with new cladding. This was a significant undertaking involving scaffolding the entire sides of the reactor buildings, the removal and disposal of the existing cladding and the fitting of the new cladding system. This work is now nearing completion and early indications are that it is adequate to achieve the required duty. ONR issued LI 505 giving its agreement to use of this cladding in February 2013. The cladding is designed and installed to high standards, including for fire-resistance.

5.7 ASBESTOS MANAGEMENT

31. Bradwell has removed a significant amount of asbestos from the site, which started in 2004 when more than three thousand tonnes was removed from the boiler houses and associated areas. However, many items of asbestos containing materials (ACMs) remain on site. ONR will be seeking information regarding the condition of ACMs, including around the RPV, the main gas duct void cells and the reactor voids. Access to some of these areas, due to the radiological dose rates, is currently not reasonably practicable. Evidence of balance of risk between radiological and asbestos exposure hazards will be assessed to provide justification for the planned management arrangements.
32. ONR will assess the proposals for asbestos management as part of the considerations for issuing its Consent. ONR's regulatory approach will be based around Magnox Ltd providing evidence that asbestos management arrangements for Bradwell are suitable for the period of C&M.

6 MATTERS ARISING FROM ONR'S REGULATORY WORK

33. Bradwell site remains subject to a programme of planned inspections and technical assessment by ONR to support permissioning activities. To date, compliance inspections of the ONR site licence conditions and hazard and risk reduction projects have not revealed any significant safety issues that need to be addressed prior to the transition of the site into C&M. The site has been prepared to a high standard. The final considerations by ONR prior to making its decision on issuing a Consent, will be through assessment of the C&M entry final stage safety submissions, final readiness inspections and a formal meeting at site with a senior regulator where ML will present its evidence in support of entry into C&M.
34. A further important area of ONR's assessment is that of the arrangements for managing safety following entry into C&M over a period of 70 years. This will include matters such as what routine surveillance and more detailed inspections are required and on what frequency, and what, if any, routine maintenance will be needed. The site licence also requires periodic safety reviews and the scope of these will also be examined.
35. Several standard ONR Approvals are in force for controlling changes to ML site arrangements, such as the emergency arrangements. As the site enters C&M it would be proportionate to remove the requirements for such formal Approvals as the site will have no personnel on it and the residual risk will be very low and should be progressively reducing over the period of C&M.

7 CONCLUSIONS

36. This report concludes that:-
 - a. As the first decommissioning nuclear power generation site to enter C&M in the UK, it is reasonable that ONR should implement formal permissioning through the primary powers available under the site licence conditions.
 - b. ONR's routine inspection and assessment activities related to the Bradwell licensed site have not revealed any issues that would prevent the sites progression into the stage of C&M.
 - c. The regulatory decision for the site to enter C&M should be considered after assessment of the final C&M entry safety case / PSR stage submissions, site readiness inspections and formal C&M entry meeting.

8 RECOMMENDATIONS

37. ONR uses its primary powers under LC35(5) by issuing a Specification (LI No 516) to ML to ensure that the entry of the Bradwell site into the stage of C&M requires ONR's formal Consent.
38. ONR removes the need to seek formal Approval for changes to site arrangements, this should form part of ONR's work to issue its Consent.

9 REFERENCES

1. History of Bradwell's progress through decommissioning, Magnox press literature in support of the Specification PAR for entry to C&M. (TRIM 2017/128667)
2. ONR Strategy for the Regulation of Licensed Nuclear Sites entering a Quiescent Phase (TRIM 2016/6965)
3. NP/SC 5323 Rev.1 Updated strategy for taking Magnox sites into care and maintenance. September 2016. (TRIM 2017/164581)
4. Letter: Bradwell Regulatory Schedule, (BRAD/REG/SCHED/001, Issue 6, 2 April 2014) release of hold point 1.3. 9th September 2014. (TRIM 2014332660)
5. Letter: ONR-DFW-AR-13-002 Retrieval of ILW Resin and Sludge and transfer into Ductile Cast Iron Containers for temporary storage Revision 0 060213, 6th Feb 2013 (TRIM 2013/51784)
6. Letter: Bradwell letter BWA 80043N lifting hold point prior to the retrieval of FED from Vault 1B - 25 September 2102. 25th September 2012. (TRIM 2012/373307)
7. Letter: Confirming permission to proceed beyond Regulatory Milestone 1.14 at Bradwell (Use of Circulator Hall 2 for Buffer Storage of FED), 22nd August 2012. (TRIM 2012/333755)
8. Letter: ONR confirming no objection to commencement of active commissioning of in relation to Early FED Retrieval Project - BWA8036N 23 February 2012. (TRIM 2012/87973)
9. Letter: BWA 80053N Bradwell - no objection letter for retrieval of all remaining FED. 28th January 2013. (TRIM 2013/37497)
10. Letter: BWA80076N: LI 515 Granted Under Condition 11(3) – 24th November 2016. (TRIM 2016/441591)
11. Project Assessment Report - ONR-SDFW-PAR-16-027 - Revised Emergency Arrangements. 25th November 2016. (TRIM 2016/413381)