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Implementing ONR's strategy for licensing a future Geological Disposal Facility

**Applicability of licensing guidance and current Licence Conditions to a future
Geological Disposal Facility**

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EXECUTIVE SUMMARY

Applicability of licensing guidance and current Licence Conditions to a future Geological Disposal Facility

When considering the high hazard inventory of a Geological Disposal Facility (GDF) and in line with Government policy, ONR believes that a GDF should be licensed subject to the requirements of the Nuclear Installations Act 1965 during the assessment, construction and operational phases.

Guidance on ONR's expectations with respect to granting a new nuclear site licence is provided to prospective licensees in *Licensing Nuclear Installations*. Once a nuclear site licence is in force for a GDF, it will be regulated for safety by ONR under the conditions attached to the site licence. As such, ONR has conducted an assessment of licensing guidance and the current Licence Conditions with respect to their application to a future GDF.

This report presents the assessment findings on the following:

- the applicability of the current guidance contained within *Licensing Nuclear Installations* to a future GDF;
- the applicability of the current Licence Conditions for regulating a future GDF; and
- the potential implications from ONR's Licence Condition review Phase 1 recommendations.

Numerous countries are pursuing geological disposal as a means of safely and securely disposing of higher activity radioactive waste and spent fuel. Significant progress with geological disposal has been made in many countries, including Sweden, Finland and France. ONR has sought to utilise its existing Information Exchange Agreements with international regulators to capture relevant regulatory intelligence while developing its approach to licensing and regulating a future GDF in the UK.

I conclude that additional guidance is required to supplement that already provided to prospective licensees in *Licensing Nuclear Installations* for the purposes of licensing a future GDF. I consider that an Annex should be included in *Licensing Nuclear Installations*, consolidating the guidance specific for a GDF.

I conclude that following the backfilling and closure of a GDF and cessation of all licensable activities, if the facility has been designed and constructed appropriately and operated without any problems, the licensee should be able to demonstrate 'no danger' from any radioactivity in the waste disposed of to a GDF and thus end the period of responsibility under the licence.

I conclude that the current standard set of Licence Conditions is applicable to regulating a GDF with some minor amendment. Only one condition (LC1) should require a variation to all other licences, with the other recommended changes being specific to the licence granted to the licensee for a GDF. The timescales before licensing of a GDF is required would allow the identified variation to be implemented at a later date.

I conclude that the approaches proposed to implement ONR's policy for licensing a GDF in the UK are broadly consistent with those taken internationally to geological disposal facilities in Europe and the United States. A system similar to that undertaken internationally for staged permissioning of a GDF, and any required pilot stages, could be achieved in the UK through the current regulatory framework. ONR routinely pursues a regulatory strategy of staged permissioning under the licence through use of primary and derived powers. These powers would be suitable and sufficient for implementing such an approach to a GDF as is consistent with international practice.

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I recommend that:

- ONR should provide additional guidance in the form of a new annex to Licensing Nuclear Installations with specific guidance for licensing and regulation of a GDF, covering:
 - an outline of the basis for including a GDF as a prescribed installation and reasons for regulating under NIA65 in line with Government policy expectations ;
 - clarification of ONR's role in siting and application of demographic criteria;
 - ONR's role in scrutinising the development of the generic Disposal System Safety Case;
 - how to define the licensed site;
 - guidance on the latest point of licensing;
 - application of the licensing process and the licence conditions to a GDF; and
 - interpretation of 'no danger' in the context of a GDF and ending the period of responsibility.

On the basis of the current Licence Conditions, I recommend that:

- ONR should amend LC1 to include a definition of the term 'plant', which should explicitly encompass the underground workings and waste emplacement activities of a GDF, such as access drifts/shafts, and excavated vaults, galleries and tunnels. This could be undertaken at a suitable future date as part of any wider updating of the licence conditions.
- ONR should consider partial disapplication of LC2(4) attached to the licence granted for a future GDF, to remove the requirement for marking the boundary of the site in relation to the underground workings of a GDF only.

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LIST OF ABBREVIATIONS

ASN	French Nuclear Safety Authority
GDF	Geological Disposal Facility
HAW	Higher Activity Radioactive Waste
HLW	High Level Waste
IAEA	International Atomic Energy Agency
ILW	Intermediate Level Waste
LC	Licence Condition
LLW	Low Level Waste
LLWR	Low Level Waste Repository
LNI	Licensing Nuclear Installations
NRC	United States Nuclear Regulatory Commission
ONR	Office for Nuclear Regulation
SAP	Safety Assessment Principle(s)
SRL	Safety Reference Level (WENRA)
SSM	Swedish Radiation Safety Authority
STUK	Finnish Radiation and Nuclear Safety Authority
TAG	Technical Assessment Guide (ONR)
TIG	Technical Inspection Guide (ONR)
WENRA	Western European Nuclear Regulators Association

LIST OF ACTS AND REGULATIONS

HSWA74	Health and Safety at Work etc. Act 1974
NIA65	Nuclear Installations Act 1965
NIR71	Nuclear Installations Regulations 1971

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1 BACKGROUND

1. A Geological Disposal Facility (GDF) will contain the highest radioactive inventory in the UK, including: vitrified high level waste (HLW), intermediate level waste (ILW), a significant proportion of the spent fuel currently stored at Sellafield, and all spent fuel from currently planned new nuclear power stations; collectively termed higher activity radioactive waste (HAW).
2. The radioactive inventory will be in a passively safe form, and packaged in highly engineered robust containers that will minimise the risk to the workforce and the public. However, there will be activities, both above and underground, in the operational phase of the GDF; including: surface interim storage, unloading waste from transport overpacks, package handling and disposal; which will need to be performed safely.
3. Therefore, when considering the high hazard inventory of a GDF, the requirements of relevant EC Directives and international standards and relevant good practice, ONR considers that a future GDF should be subject to the requirements of the Nuclear Installations Act 1965 (NIA65) during its design, construction and operation, and regulated for nuclear safety purposes by ONR [1]. This is in line with Government expectations as outlined in the 2014 White Paper, Implementing Geological Disposal [2].
4. Licensing of a GDF will also allow ONR to meet a commitment to reflect the draft WENRA Safety Reference Levels (SRLs) for disposal [3] in the UK regulatory framework. A GDF will also be required to meet international safeguards requirements and all relevant security, conventional health and safety and transport legislation.
5. A facility designed and operated for geological waste disposal is not currently prescribed under the Nuclear Installations Regulations 1971 (NIR71) and ONR has not previously licensed a facility for the purposes of disposal.¹ The Low Level Waste Repository (LLWR) was licensed on the basis of requirement to ensure safety the safe management of legacy nuclear materials stored on the site.
6. ONR has recognised that in order to implement its approach to licensing and regulating a GDF, the guidance provided to prospective licensees should be reviewed for its applicability to a GDF. Similarly, the standard set of 36 Licence Conditions (LCs) [4] attached to each nuclear site licence should also be reviewed for their applicability and completeness for regulating a GDF once a licence has been granted.

2 SCOPE OF ASSESSMENT

7. ONR's guidance to prospective licensees, provided in Licensing Nuclear Installations (LNI) [5], has been assessed for its applicability and completeness for licensing a GDF to identify areas that potentially require additional guidance. Where it is identified that the current guidance requires additional context for a GDF, possible alternative approaches that could be utilised during the licensing process have been determined, taking full account of legal advice.
8. The LCs have also been reviewed for their applicability and completeness for regulating a GDF and the specific safety characteristics of such a facility, and to identify any shortfalls and areas where additional guidance is required on interpretation of LCs specifically for a GDF.

¹ Government is taking forward work to amend the 1971 regulations to include a geological disposal facility on the list of prescribed installations which require a nuclear site licence under the Nuclear Installations Act 1965.

9. In addition to review against the existing set of LCs, a review has also been undertaken against the recommendations from Phase 1 of ONR's wider Licence Condition Review.
10. ONR has sought to take account of international practice on matters relating to licensing and regulation of GDF through engagement with regulators in France (ASN), Finland (STUK), Sweden (SSM) and the United States (NRC). The approaches taken in these countries are specific to the prevailing legislative and regulatory regimes, which are not the same as those in the UK, nonetheless, important intelligence has been gained to provide confidence that all relevant aspects and challenges have been considered.
11. ONR's Safety Assessment Principles (SAPs) [6], Technical Assessment Guides (TAGs) [7] and Technical Inspection Guides (TIGs) [8] have not been included at this stage. However, the review of the licensing guidance and LCs has identified areas that will require additional regulatory and technical guidance to be provided through inclusion in the SAPs and a new TAG specific to GDF. This work will be taken forward in conjunction with a review of the technical guidance against the requirements set out in the WENRA Disposal SRLs [3] and various relevant IAEA requirements and standards [9].

3 ASSESSMENT OF LICENSING GUIDANCE AND LICENCE CONDITIONS

3.1 LICENSING NUCLEAR INSTALLATIONS GAP ANALYSIS

12. Generally, the guidance provided in LNI will be applicable to a GDF as for any nuclear installation. The process of ensuring the prospective licensee is capable to hold a nuclear site licence is unaffected by the type of installation to be licensed. Similarly, the principles of the licence application dossier and the assessment steps to be undertaken by ONR are largely independent of facility type. ONR however will apply its guidance in a proportionate manner commensurate with the risks and hazards posed by the activities undertaken by the licence holder.
13. From a review of LNI [10], I consider the key aspects that require additional guidance regarding licensing a future GDF to be:
 - What ONR would consider as the latest point at which a GDF would be licensed
 - The definition of the extent of the licensed site and how to mark the boundary of a facility that could have a sub-surface footprint on the order of several square kilometres
 - Application of the test of "no danger" to determine the end of the period of responsibility under NIA65
14. ONR sought legal advice on the proposed approaches to dealing with the above issues [11]. The advice received recognises that these are complex and may require an iterative cycle of advice to completely understand the implications of the proposed approaches [12]. However, no immediate impediment has been identified to progressing with high-level advice for licensing a GDF.

3.1.1 THE LATEST POINT OF LICENSING FOR A GDF

15. The current guidance on what ONR considers to be the latest point of licensing states:

A nuclear site licence should be granted to a developer before they may undertake construction work that could, if inadequately conceived or executed, affect nuclear safety when the plant is operational. Based on this the latest point at which a licence is

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required is commencement of construction which ONR defines as the placement of the first structural concrete for buildings with nuclear safety significance.

16. This guidance was clearly not written with underground excavation of access tunnels, shafts or disposal galleries in mind, since it refers to “buildings with nuclear safety significance”. Furthermore, depending upon the geological environment of a GDF, “structural concrete” may not be required to stabilise underground excavations.
17. The point at which a nuclear site licence will be required for a GDF is generally understood to be prior to the start of ground excavations for construction of the GDF access shafts/drifts, but not including the phase of surface based investigations to characterise the site (i.e. deep borehole installation).
18. There are clear safety implications for the operational phase if the excavations are inadequately conceived or executed. Therefore, for the case of a future GDF, ONR should grant a nuclear site licence prior to commencement of ground excavations for the construction of the disposal facility, including access tunnels and/or shafts. I consider ONR should clearly state this position in LNI.

3.1.2 THE EXTENT OF THE LICENSED SITE

19. The following text is taken from the draft Technical Inspection Guide for Licence Condition 2 (LC2) Marking of the site boundary:

The purpose of this Condition is to ensure that the extent of the licensed site boundary is marked and the public is protected from danger by preventing inadvertent or unauthorised entry.

20. As far as the surface facilities at the GDF are concerned, compliance with LC2 is straightforward as for all other nuclear licensed sites. The sub-surface tunnels and galleries should only be accessible from within the boundary of the surface facilities, which thus ensures control of entry and prevents inadvertent public access to the underground workings, satisfying the main purpose of LC2.
21. Paragraph 107 to LNI states that:

The boundary should, so far as is practicable:

 - *be obvious and permanent;*
 - *avoid passing through a building and, in particular, avoid being three dimensional, i.e. the boundary should be a simple vertical limit;*
 - *encompass all underground workings.*
22. Implementing bullets 2 and 3 to paragraph 107 would require a significant licensed footprint at the surface, which is unlikely to be feasible for a number of reasons. However, the qualifying statement “so far as is practicable” enables a different approach to be taken for a GDF given its unique nature.
23. The possibility exists to use depth bounds to delineate the licensed site in three dimensions. Such depth bounds would be determined during the site characterisation stage delineating an acceptable host geological environment for the disposal galleries. Therefore, the lateral extent of the underground workings could be delineated on a map with the licensed area applying between a depth of x and y.
24. Such an approach would require application of a legal test as it contravenes current interpretation of the licensed site boundary under the principle of *ad coelum*.²

² *Cuius est solum, eius est usque ad coelum et ad inferos – whoever's is the soil, it is theirs all the way to Heaven and all the way to hell.*

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However, precedent has been set for a non-simple boundary at the interface between the Windscale and Sellafield nuclear sites (Site Licenses 81 and 31G, respectively), as detailed in Schedule 1 Part 1 to the Windscale site licence [13] and shown in the map attached to that licence [14].

25. Additionally, land ownership rights would need to be clarified in respect of a GDF operating beneath land that is not licensed and therefore potentially not owned by the licensee. Legal advice has been sought on this issue [11] but it is not seen as an impediment to licensing at this stage given there is precedent from the coal mining industry, although a change to legislation may be required in the future to enable application to a GDF [12].
26. Advice from the Department for Communities and Local Government [15], who lead on matters relating to Nationally Significant Infrastructure Projects, suggests that protections for the subsurface areas of a GDF could be provided through the use of restrictive covenants under the necessary Development Consent Order. For example, restrictive covenants have been used in the circumstances where the proposed railways have been located on a viaduct or in a tunnel and there was no compelling need to acquire outright the surface of the land above or below the structure but there exists an ongoing need for measures to protect the structure and to obtain access to it. This has direct parallels to a GDF.
27. Given the scale of the sub-surface facility, surface access points may be located several kilometres apart. Therefore, it may be necessary to have more than a single licensed area at the surface, under the same licence. Precedent for such an approach has been set at Rosyth Dockyard (Site Licence No. Sc 8) where two separate areas constitute the licensed site [16].

3.1.3 ENDING THE PERIOD OF RESPONSIBILITY

28. ONR expects that, once the GDF has been successfully closed, there will no longer be a need for the protection provided by the nuclear licensing regime. That is to say, there will cease to be a nuclear safety hazard from handling HAW and all construction activity that could impact upon nuclear safety will have ceased. It would be disproportionate to maintain a nuclear site licence after this point. Post-closure safety will be regulated by the relevant environment agency under the disposal permit.
29. To end the licensee's period of responsibility under the site licence, assuming no transfer of the site to any other licensee or the Crown, ONR must be satisfied that there has ceased to be any danger from ionising radiations from anything on the site.
30. This in the first instance appears to be challenging, given the intent is to dispose of a significant inventory of HAW into the GDF. However, given that the purpose of the GDF is to dispose of radioactive waste and isolate it to ensure that no harmful quantities of radioactivity ever reach the surface environment, this should be achievable. The post-closure performance target of a GDF is to achieve a risk of death of no more than 10^{-6} [19], which is consistent with ONR's current 'no danger' criteria. [2] The safety case will substantiate the design of the facility to achieve that target and will be subject to assessment by the relevant environment agency. It follows that successful design, construction, operation and sealing of the GDF to adequately implement the design intent and purpose of the GDF will enable demonstration that no danger exists to the public from the waste disposed of in the GDF.
31. Once the GDF has been sealed the licensee will have ceased to undertake licensable activities and the act of disposing of the waste will have removed the danger of exposure to the radioactivity contained within the waste, I consider that period of responsibility under the site licence could be ended at this point. This would not affect

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the licensee's duties under the permit for any monitoring to demonstrate post-closure safety to enable revocation of the permit.

32. If and when to delicense the site is a decision for the licensee but it has been suggested that individual vaults within the GDF could be delicensed once they have been sealed, through a variation to the licence, whilst operations are ongoing elsewhere in the GDF. However, this could be difficult to implement in practice and may result in certain potential future operations, such as further construction, retrieval³ or monitoring of waste packages, requiring relicensing of these areas again. Guidance on when is practical to delicense a GDF should be included in ONR technical guidance.
33. Institutional control in the post-closure period has not been defined by Government, however, continuing to have a nuclear site licence in force would be disproportionate. Should it be desired that the facility be re-opened at a later time for some purpose, ONR should seek to re-licence the facility at that point.

3.1.4 ADDITIONAL GUIDANCE RELATING TO A GDF FOR INCLUSION IN LICENSING NUCLEAR INSTALLATIONS

34. Further to the topics explored in Sections 3.1.1 to 3.1.3, I consider that ONR should include additional guidance specific to licensing a GDF in LNI, to provide clear guidance to applicants on the specific issues regarding the licensing of a GDF and how it would be implemented in practice. This further guidance should include:
- an outline of the basis for including GDF as a prescribed installation and reasons for regulating under NIA65 in line with Government policy expectations;
 - clarification of ONR's role in siting and application of demographic criteria;
 - ONR's role in scrutinising the development of the generic Disposal System Safety Case; and
 - application of the licensing process and the licence conditions to a GDF.

3.2 CURRENT LICENCE CONDITION GAP ANALYSIS

35. The applicability of the current standard set of Licence Conditions (LCs) [4] was the subject of an assessment paper [17] which considered each LC in turn, identifying any areas which may require revision to enable regulation of a future GDF.
36. Although a GDF is significantly different to any type of facility to have been licensed previously, the operations that will be conducted on the site are analogous to those that are routine on all licensed sites. From the assessment, I conclude that the standard set of LCs will be applicable to regulation of a GDF as they are currently used for any other types of installation. The peculiarity for ONR with respect to regulating a GDF, aside from the excavation to depths in excess of 200m below ground to construct the facility, is that the majority of operations involving the handling nuclear matter will be undertaken underground.
37. The assessment concluded that the current standard LCs are applicable to regulation of a GDF without major revision and no significant gaps exist in relation to regulating a GDF under the licence [17]. The assessment recommended that some potential minor amendments to specific LCs may be required, as discussed in sections 3.2.1 to 3.2.7.

³ The issue of retrievability of the wastes is a policy decision for Government and not a regulatory decision for ONR. Retrievability does not alter the intent of disposal - ie the facility is designed to facilitate retrieval of waste packages should the need arise, but the purpose remains final disposal.

3.2.1 LC1 – INTERPRETATION

38. The term 'plant' is used in several LCs but is not defined in the LCs or the SAPs [6], and is instead defined in s.53 of HSWA74 as including "any machinery, equipment or appliance". ONR usually takes 'plant' to include 'building' and considers that the term 'facility' encompasses 'plant' and 'nuclear installations', as defined in NIA65 [6].
39. The potential exists for the term 'plant' to not extend to cover the underground workings of a GDF; the drifts/shafts, vaults, galleries and tunnels; meaning a number of LCs could be construed as not being applicable.
40. I consider that ONR should include a definition of 'plant' in LC1 to include a GDF and all its underground workings to ensure the applicability of all LCs to a future GDF.

3.2.2 LC2 – MARKING OF THE SITE BOUNDARY

41. LC2(4) requires the licensee to mark the boundary of the licensed site by fences or other appropriate means. Should the site boundary not be a simple vertical limit, but have a three dimensional limit underground, compliance with LC2(4) becomes a challenge.
42. The purpose of LC2 is to prevent inadvertent or unauthorised access to the licensed site [8]. As long as the surface facilities have fences or other appropriate means to mark the boundary of the licensed site, as required by L2(4); providing all entry points to the underground workings are located within the confines of the surface licensed site, the purpose of LC2(4) is achieved. Persons in the underground workings will be aware that they are within a nuclear licensed site and should act accordingly, as per training and instructions.
43. A precedent has been set for Hinkley Point C to allow disapplication of LC2(4) where access controls to the wider construction site, which fully encompasses the licensed site, provide sufficient protection to those upon the site without having the extent of the licensed site physically marked [18]. I consider that in the case of a GDF, ONR should consider disapplication of LC2(4) for the underground workings, given that the extent of the licensed area at depth will encompass the full extent of the planned subsurface footprint, plus an appropriate margin.

3.2.3 LC6 – DOCUMENTS, RECORDS, AUTHORITIES AND CERTIFICATES

44. LC6(2) currently states that "the licensee shall make and implement adequate arrangements to ensure that every document required in pursuance of the conditions attached to this licence is preserved for 30 years or such other periods as ONR may approve."
45. The extended operational lifetime of a GDF compared to any other nuclear installation may necessitate preservation of appropriate documents and records required under the licence for periods longer than 30 years. However, given that this would be unique to a GDF, and that ONR has the primary power to approve other periods, I do not consider that a change to LC6 is required or appropriate for application to a GDF.
46. Further guidance on records retention in relation to a GDF should be provided by ONR in technical guidance.

3.2.4 LC8 – WARNING NOTICES

47. The requirement for appropriate warning notices of the kind specified in LC8 is especially applicable to a GDF considering the additional hazard of working underground.
48. LC8 makes explicit reference to notices of the locations of emergency exits. Relevant good practice for underground working is the provision of safe havens for use in the event of an underground emergency where exit is not possible. Further guidance on the provision of safe havens and the requirement for suitable and sufficient notices relating to them should be provided by ONR in its technical guidance. ONR expects that such locations should be considered during the GDF's design.

3.2.5 LC25 – OPERATING RECORDS

49. LC25(2) states that the records required by LC25(1) “shall include records of the amount and location of all radioactive material, including nuclear fuel and radioactive waste, used, processed stored or accumulated upon the site at any time.”
50. It is conceivable that waste will be disposed of (ie emplaced with no intent to retrieve) without installation of the backfill for a significant period of time, for example in a disposal concept utilising vaults of stacked packages. Such waste, although disposed of under an environmental permit, will continue to present a nuclear safety hazard until the backfill is installed and the waste isolated from the workforce.
51. The operator of a GDF will have to make appropriate records of waste disposals made under the permit and it is expected that arrangements would be made for such records to be kept for the duration that the permit is in force and for these records to be included in public archive thereafter [19]. It may also be beneficial for ONR to stipulate that the records referred to in LC25(2) also include records of waste disposed upon the site because of the implications for operational safety. However, the same ends could be achieved through an LC25(3) specification and therefore I recommend no amendment to LC25. Retention of such records should be discussed in ONR guidance as mentioned under Section 3.2.3.

3.2.6 LC32 – ACCUMULATION OF RADIOACTIVE WASTE

52. The purpose of a GDF is to dispose of a significant inventory of radioactive waste by isolation deep underground in an engineered facility. ONR should make clear that it does not consider disposal of waste to be an accumulation, else the purpose of the GDF would be diametrically opposed to the requirements of LC32. I recommend that this is made clear in ONR guidance and that LC32 is not amended.
53. With respect to radioactive waste generated on site at a GDF, LC32 will apply as for any other nuclear licensed site and generation of such waste should be minimised as far as reasonably practicable.

3.2.7 LC34 – LEAKAGE AND ESCAPE OF RADIOACTIVE MATERIAL AND RADIOACTIVE WASTE

54. LC34 requires the licensee to ensure that radioactive material and radioactive waste “cannot leak or otherwise escape from such control or containment” and “that no such leak...can occur without being detected”. ONR should make clear in its guidance that LC34 will apply to a GDF during its operation, as the disposed wastes will still present a potential nuclear safety hazard until the facility is backfilled and closed.

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55. During the operation of a GDF, any discharges or releases of radioactive waste in accordance with an approved operating rule or environmental permit shall not be covered by this licence condition as described by LC34(3).
56. The act of disposal will be regulated by the relevant environment agency under permit. LC34 does not extend to cover issues relating to post-closure environmental safety which are regulated under the environmental permit.

3.3 IMPLICATIONS OF THE RECOMMENDATIONS FROM ONR'S WIDER REVIEW OF THE LICENCE CONDITIONS

57. The gap analysis presented in section 3.2 was conducted against the current Licence Conditions, which are subject to an ongoing review. A consideration of the initial recommendations from this review shows that they do not conflict with the findings of the gap analysis with regard to their implications for regulation of a GDF: in fact, they would potentially facilitate the licensing of a GDF. As the LC review work progresses, the potential implications for a GDF will be kept under consideration and will be input to the review process.

4 INTERNATIONAL REGULATORY EXPERIENCE

58. ONR has engaged with international regulatory counterparts in France (ASN), Finland (STUK), Sweden (SSM) and the United States (NRC), involved with licensing of geological disposal facilities in their respective countries. The purpose of the engagement at this stage was to understand the licensing process in each country [20, 21, 22, 23] and to identify the key aspects considered in each case to ensure that ONR takes due account of international experience.
59. Further engagement is planned to support development of what ONR considers to be relevant good practice regarding operations at a GDF. This future work will contribute to production of ONR's technical assessment guidance for a future GDF.

4.1 FRANCE – ASN

60. Authorisation for the construction of a GDF in France is through a Government decree, which is based upon advice from assessment of the safety case by ASN. Once constructed, ASN will be responsible for granting permission for the commissioning and operation of the facility.
61. Under French law, the facility is required to undergo a pilot stage consisting of three stages, prior to full scale operation of the facility. The three stages include inactive trials, limited active trials with real waste packages, and finally disposal of a series of representative packages. The pilot stage will build upon experience gained from experiments in an underground laboratory in the vicinity of the disposal facility.
62. Andra, the developer in France, is able to obtain rights to the land used for the facility in a gradual phased manner as the facility is constructed, as opposed to having to own the full extent from the first point of construction. Andra is only required to own the land at the depths of the GDF, and not the overlying land at the surface, although this approach is subject to legislative review.
63. Site characterisation is not subject to regulation by ASN for nuclear safety.
64. French law requires the disposed waste to be retrievable at a later time and as such the design must not foreclose such options. In the UK, retrievability is a Government policy decision, not a regulatory decision for ONR³. If a future GDF is required to have the ability for waste retrieval, the safety case will need to demonstrate that safety will

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not be compromised as a result. Depending upon when a decision is made regarding Government policy, such considerations may need to be included in the safety case as part of the licence application dossier.

65. The details of the approach to terminate the licence for a GDF have yet to be determined.

4.2 FINLAND – STUK

66. In Finland, the licensed area for the GDF encompasses the entire surface footprint of the disposal galleries, and also includes the encapsulation facility. However, this is not required under Finnish Law, which does not apply the *ad coelom* doctrine⁴. It is because the land area is under a long-term lease to Posiva, the developer of the GDF, from the land owner, the energy utility TVO, who also owns Posiva.
67. A stepwise licensing process is utilised for all nuclear facilities in Finland. Permission and the licence at each stage is granted by the Government, with advice from the nuclear safety regulator, STUK. The operating licence for a waste facility is required to be renewed at 15 year intervals.
68. The termination of the licence will be supported by regulatory approval that all spent fuel has been safely and permanently disposed of, at which point responsibility passes to the state. Any period of on-going institutional control is yet to be determined.

4.3 SWEDEN – SSM

69. New nuclear facilities in Sweden are licensed by the Government, based on recommendations and reviews by the competent authority, which for nuclear safety is the Swedish Radiation Safety Authority (SSM). Once the Government has granted the licence to construct, possess and operate, SSM grants staged authorisations for the major lifecycle stages through licences for construction, trial operations, routine operations and closure.
70. No information was provided at this time regarding geographical extent of the licensed footprint or security of tenure. The process for terminating the licence once operations have ceased will require the operator to demonstrate that the facility has been constructed, operated and closed in accordance with the design, ensuring the long-term post-closure safety of the facility.

4.4 UNITED STATES OF AMERICA – NRC

71. The operator of a GDF, the US Department of Energy (DOE), is not required to hold a licence from the NRC for the characterisation of the Yucca Mountain site in Nevada.
72. The operational area and post-closure controlled area (extending 10km at the surface from the extent of the underground facility) for the GDF is required to be in and on land acquired by DOE, or land permanently reserved for its use. The land must be free of all other encumbrances, such as mining rights. Additional controls will also be established on land adjacent to but outside the post-closure controlled area to preserve the ability of the repository to achieve isolation of the waste.
73. A large number of siting criteria are established in law, including geological characteristics of the repository host formation and requirement for a low population density.

⁴ *Cuius est solum, eius est usque ad coelum et ad inferos* – whoever's is the soil, it is theirs all the way to Heaven and all the way to hell.

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74. DOE may apply for an amendment to terminate the licence, which may only be terminated if the NRC finds that the waste has been disposed of in accordance with the operational plan and that the final state of the repository conforms to the plan for permanent closure. That is to say, providing the facility has been constructed, operated and closed in accordance with the safety case, there would cease to be a requirement for the licence.
75. In the case of the Waste Isolation Pilot Plant (WIPP) in New Mexico owned by DOE, there is a complex regulatory oversight structure involving at least 7 organisations. The operational licence is granted by the US Environmental Protection Agency (EPA) to the operator, DOE. This is because from a nuclear safety perspective, DOE sites are self-regulated. The details of licensing and regulation of this facility therefore will not be considered by ONR any further.

5 CONCLUSIONS

76. I conclude that additional guidance is required to supplement that already provided to prospective licensees in Licensing Nuclear Installations for the purposes of licensing a future GDF. I consider that an Annex should be included in Licensing Nuclear Installations, consolidating the guidance specific for a Geological Disposal Facility that ONR has developed.
77. I conclude that following the completion of backfilling and closure of a GDF, and the cessation of all licensable activities, if the facility has been designed and constructed appropriately and operated without any problems, the licensee should be able to demonstrate that de-licensing criteria at the time are met and thus end the period of responsibility under the licence.
78. I conclude that the current standard set of Licence Conditions is applicable to regulating a GDF with some minor amendments. Only one condition (LC1) should require a variation to all other licences, with the other recommended changes being specific to the licence granted to the licensee for a GDF. However, the timescales before licensing of a GDF is required would allow the identified variation to be implemented at a later date as part of any future changes made from a wider review of ONR's Licence Conditions.
79. I conclude that the approaches proposed to implement ONR's policy for licensing a GDF in the UK are broadly consistent with those approaches taken internationally for geological disposal facilities in Europe and the United States. I consider that a system similar to that undertaken internationally for staged permissioning of a GDF, and any required pilot stages, could be achieved in the UK through the current regulatory framework. ONR routinely pursues a regulatory strategy of staged permissioning under the licence through use of primary and derived powers. These powers will be suitable for implementing such an approach to a GDF in line with international practice.

6 RECOMMENDATIONS

80. I recommend that:
- ONR should provide additional guidance in the form of a new annex to Licensing Nuclear Installations with specific guidance for licensing and regulation of a GDF, covering:
 - an outline of the basis for including a GDF as a prescribed installation and reasons for regulating under NIA65 in line with Government policy expectations ;
 - clarification of ONR's role in siting and application of demographic criteria;

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- ONR's role in scrutinising the development of the generic Disposal System Safety Case;
- how to define the licensed site;
- guidance on the latest point of licensing;
- application of the licensing process and the licence conditions to a GDF; and
- broad criteria for de-licensing and interpretation of 'no danger' in the context of a GDF to end the period of responsibility.

81. On the basis of the current Licence Conditions, I recommend that:

- ONR should amend LC1 to include a definition of the term 'plant', which should explicitly encompass the underground workings of a GDF, such as access drifts/shafts, and excavated vaults, galleries and tunnels. This could be undertaken in the future as part of any wider updating of the licence conditions.
- ONR should consider partial disapplication of LC2(4) attached to the licence granted for a future GDF, to remove the requirement for marking the boundary of the site in relation to the underground workings of a GDF only.
- ONR should consider the implications for regulation of a GDF as part of any further review of the Licence Conditions.

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