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| ONR Technical Assessment Guide  Land quality management |



ONR Technical Assessment Guide (TAG)

Land quality management

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| 2.3 | Minor update. Format of document updated into new TAG template. Removal of Appendix 2 and integration of relevant information to the main body of the TAG. Consolidation of sources of RGP into an Appendix. Updated figures. |

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# Introduction

1. The Office for Nuclear Regulation (ONR) has established its Safety Assessment Principles (SAPs) [1] which apply to the assessment by ONR specialist inspectors of safety cases for nuclear facilities that may be operated by potential licensees, existing licensees, or other dutyholders.   
   The principles presented in the SAPs are supported by a suite of guides to further assist ONR’s inspectors in their technical assessment work in support of making regulatory judgements and decisions. This technical assessment guide (TAG) is one of these guides.

# Purpose and scope

1. The purpose of this guidance is:

* to draw together those aspects of legislation, Government policy and international standards that are relevant to the work of ONR in regulating the management of land quality, including radioactively contaminated land[[1]](#footnote-2) and groundwater;
* to provide a framework for the assessment on a consistent basis of licensees’ arrangements for land quality management (LQM); and
* to outline the mechanisms of working with the environmental regulators[[2]](#footnote-3) or the local authority, with whom joint working on matters of land quality is essential.

1. LQM is defined by ONR to include the prevention of new contamination and management of existing contamination of both land and groundwater and extends to remediation (including control and monitoring) of radioactive and non-radioactive contamination on the surface of the ground, in the ground, and in groundwater. As LQM includes preventative measures, it is required irrespective of whether or not any contamination currently exists.
2. On Great Britain (GB) nuclear sites, both ONR and the environmental regulators have roles for regulating land and groundwater contamination. When investigating and remediating such land, licensees must take account of all relevant UK legislation and policy when developing and executing plans for clean-up or on-site disposals. ONR will take the lead regulatory role for instances of radioactive contamination and this TAG deals solely with radioactively contaminated land and groundwater.
3. ONR has a Memorandum of Understanding (MoU) with each of the environmental regulators on matters of mutual interest on nuclear licensed sites [2, 3, 4], and supporting joint regulatory guidance to their inspectors concerning the working-level implementation of the MoUs [5, 6, 7].
4. ONR does not prescribe targets or methodologies for licensees to follow to achieve compliance with the Licence Conditions (LCs) or the SAPs. It is the licensee’s responsibility to set out how it will achieve compliance and for ONR to assess whether the arrangements are adequate.

# Relationship to licence and other relevant legislation

1. As stated in Licence Condition (LC) 1 in the ‘Licence Condition Handbook’ [8], ONR has chosen to adopt similar definitions of ‘radioactive material’ and ‘radioactive waste’ to those contained within the Radioactive Substances Regulation (RSR), enforced by the environmental regulators, encompassing The Environmental Permitting (England and Wales) Regulations 2016 (EPR16) and The Environmental Authorisations (Scotland) Regulations 2018 (EASR18). These regulations differ in some aspects of detail but are sufficiently similar in aims and implementation that they can be regarded as providing a common framework.
2. It should be noted that LC 1 is yet to be amended to reflect EASR18 which came into force on 1 September 2018, replacing the Radioactive Substances Act 1993 (RSA93), associated Exemption Order and The High-Activity Sealed Sources and Orphan Sources Regulations 2005. LC 1 will be updated in due course but references to RSA93 should be construed as meaning EASR18.
3. Government guidance on radioactive substances legislation shows that material that is unintentionally contaminated with radioactivity and which remains on the premises cannot be considered radioactive material and is out of scope of the legislation [9]. The LC 1 definition of ‘radioactive material’ disregards the EPR16 exception for contaminated articles and substances to ensure ONR retains regulatory control over the nuclear matter causing such contamination. There is no such exemption under EASR18. The effect of this is radioactively contaminated land and groundwater can be regulated by ONR under relevant LCs as radioactive material. LQM activities may lead to the generation of radioactive waste which would be regulated under the permit as normal.
4. ONR considers radioactively contaminated land and groundwater to be accumulations of nuclear matter, since any radioactivity in the ground or groundwater would not normally be considered to meet the general expectations for storage (refer to [Appendix 1](#_Appendix_1_-)).

## ONR’s nuclear safety purposes

1. Section 68 of the Energy Act 2013 (EA13) sets out ONR’s nuclear safety purposes to mean the purposes of protecting persons against risks of harm from ionising radiations from GB nuclear sites, and these include through arrangements to minimise those risks in the event of an escape or release of such ionising radiations. An escape or release of ionising radiations from a GB nuclear site includes ionising radiations from nuclear matter that has escaped or been released on or from a GB nuclear site.

## Nuclear site licensing

1. Under section 4 of NIA65, ONR has attached 36 standard conditions to each nuclear site licence, as described in the ‘LC Handbook’ [8].
2. All LCs apply to the extent that they are relevant. However, several LCs have general applicability for the regulation of LQM matters; these, along with their relationship to the LQM principles set out in the joint expectations, are illustrated in Figure 1.

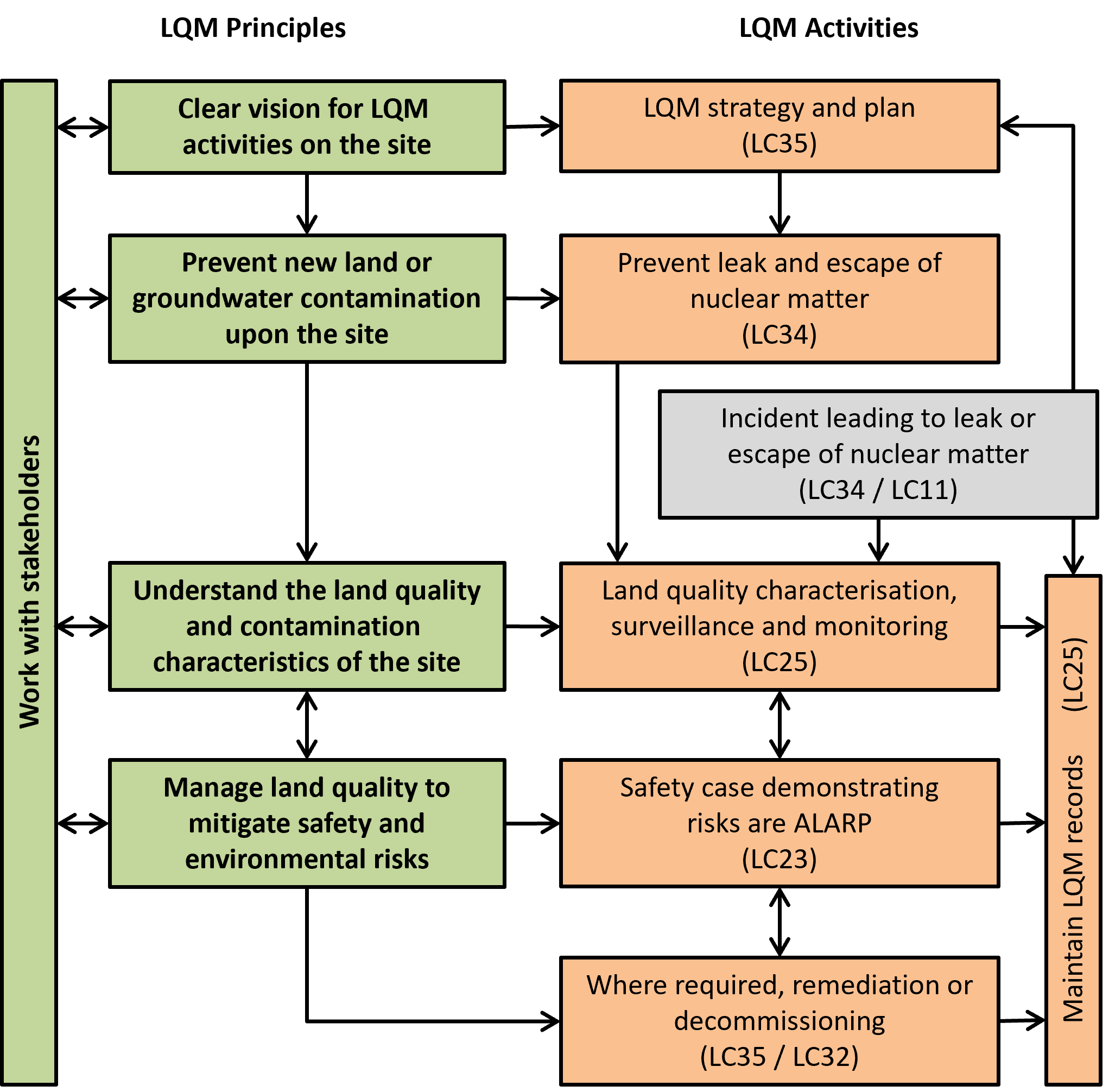


Figure 1 - LQM principles and their relationship to key LCs.

* **LC 34: Leakage and escape of radioactive material and radioactive waste -** This condition requires the licensee, so far as is reasonably practicable, to ensure adequate control and containment of radioactive material and radioactive waste so as to prevent the creation of radioactively contaminated land and groundwater, and to ensure appropriate management of existing radioactively contaminated land and groundwater. However, this condition will also be used if a leak or escape of radioactive material or radioactive waste to land or groundwater on a nuclear licensed site (a) occurs; (b) has not been detected by the licensee; or (c) is not notified, recorded, investigated or reported by the licensee under its LC 7 arrangements.
* **LC 35: Decommissioning -** The licensee’s decommissioning arrangements and programmes should consider (a) the risks to decommissioning workers from any existing radioactively contaminated land and groundwater; (b) measures to avoid or minimise the creation of new radioactively contaminated land or groundwater from decommissioning activities; and (c) the remediation of radioactively contaminated land and groundwater as an integral part of the decommissioning programme. It should be noted that although LQM is integral to decommissioning, it is not the intention that LQM activities should be confined to being delivered only during the decommissioning phase.
* **LC 23: Safety documentation -** The safety case should identify the relevant structures, systems and components (SSCs) that are important to the prevention of leak and escape of radioactive material and radioactive waste, and to the control of land quality, including the potential impact to the quality of land and groundwater from operations. The SSCs should be complemented by the licensee’s plans for characterisation, monitoring, and remediation of any contamination arising. In general, licensees’ safety cases should demonstrate how the risks to and from land and groundwater contamination are minimised. Where appropriate, for any areas of contaminated land and groundwater that exist, licensees should produce a safety case demonstrating how the safety of employees and other persons has been achieved. This may be demonstrated through the Site Wides Environment Safety Case (SWESC) required under the environmental permit.
* **LC 25: Operational records -** The licensee must undertake appropriate characterisation of any known or suspected contaminated land or groundwater to determine the extent of such contamination in respect of the quantity of radioactive material and its location upon the site[[3]](#footnote-4), which should be kept up to date through adequate on-going monitoring. Additionally, the licensee should make and implement adequate arrangements for recording and preserving information needed for safe and effective control and remediation of radioactively contaminated land, now and in the future.

1. Other LCs relevant to LQM are considered in [Appendix 1](#_Appendix_1_-).
2. ONR expects that licensees will implement LQM arrangements that are proportionate to the hazard and risk on the site and reflect the scope of operations being undertaken, during construction and operation of any new nuclear facility.

## Health and safety legislation

1. Activities for safe and effective LQM must be undertaken by licensees to ensure that, so far as is reasonably practicable, the health, safety and welfare of their employees and the health and safety of other persons are protected, as required by sections 2(1) and 3(1) of HSWA74. Licensees and operators must reduce the risks associated with radioactively contaminated land or groundwater, so far as is reasonably practicable, through the production of a justification for the work to be done that demonstrates that the risk to employees or other persons is ‘as low as reasonably practicable’ (‘ALARP’). More guidance on the demonstration of ALARP is available in the relevant TAG (NS‑TAST-GD-005) [10].
2. In addition to HSWA74, the following regulations also have relevance to LQM:

* The Ionising Radiations Regulations 2017 (IRR17) control the use of ionising radiation in the workplace with the intent of restricting exposure and limiting dose to the workforce and the public. Regulations 8 (radiation risk assessments), 9 (restriction of exposure), 12 (dose limitation) and 29 (accounting for radioactive substances) are particularly relevant to LQM activities.
* The Management of Health and Safety at Work Regulations 1999 (MHSWR99) require employers to carry out an assessment of the risks resulting from work activity to the health and safety of employees, and others, such as the public, volunteers and external contractors visiting the premises, and then implement measures to control the risks identified. The more specific requirement for a prior risk assessment under regulation 8 of IRR17 is complementary to the more general risk assessments required by regulation 3 of MHSWR99.

## Environmental legislation

1. ONR and the environmental regulators have published a joint document titled, ‘Regulatory expectations for successful LQM at nuclear licensed sites’ [11]; outlining the overall objective for LQM on nuclear licensed sites in GB. The joint expectations laid out in that document apply to radioactive and   
   non-radioactive contamination of land and groundwater. It is expected that a joint regulatory approach will be adopted, especially in instances where radiological and non-radiological contamination is co-located.
2. A permit from the relevant environmental regulator is required to dispose of radioactive waste on or from a nuclear licensed site. Any radioactivity in the ground or groundwater attributable to a lawful disposal is not considered to be radioactive material or radioactive, unless a process which was not foreseen at the time of disposal results in a substantial increase in radiation exposure to the public or contamination of the environment [12].
3. A leak or escape of either radioactive material or radioactive waste is liable to be a breach of LC 34 if the licensee is unable to demonstrate adequate control or containment, so far as is reasonably practicable (SFAIRP). Such a leak or escape may also be a breach of the environmental permit.
4. If a leak or escape of radioactive material or radioactive waste to land or groundwater occurs on a nuclear licensed site ONR shall work closely with the relevant environmental regulator to ensure a coordinated regulatory response. Inspectors are referred to the relevant technical inspection guide (TIG) for further guidance [5, 6, 7].
5. The Environmental Protection Act 1990 (EPA90) Part IIA contaminated land regime was extended in 2006 to cover radioactive contaminated land but it does not apply to such land within a nuclear licensed site or an MoD nuclear site [13, 14, 15]. Public Health England (PHE; previously Health Protection Agency) considers that an annual effective dose of 3 mSv or above is appropriate for designation of land as radioactively contaminated under the Part IIA RCL regime [16], which is more conservative than guidance from the International Commission on Radiological Protection (ICRP) [16].   
   However, since the Part IIA RCL regime does not apply to nuclear licensed sites, neither do the criteria and licensees should use a risk-based approach to managing radioactively contaminated land on nuclear licensed sites.
6. Radioactive substances are considered to be hazardous substances for the purposes of the groundwater legislation [17] and so their discharge to groundwater must be prevented. For planned disposals of radioactive waste this is achieved through conditions in environmental permits and enforced by the environmental regulators.

## Interface with end states and removal of regulatory control

1. ONR regulates radioactively contaminated land and groundwater under NIA65 and conditions attached to nuclear site licences for the nuclear safety purposes of protecting persons against risks of harm from ionising radiations, as described in paragraph ‎11. Inspectors and assessors need to be aware that licensees may also be working to define or achieve site end states for other related but different purposes:

* A licensee wishing to end its ‘period of responsibility’ under NIA65 for all or part of its nuclear licensed site is required to demonstrate to ONR that the site (or part of the site) meets the relevant criteria.   
  Further information on delicensing is provided in ONR’s policy, ‘Criterion for Delicensing Nuclear Sites’ [18], and associated guidance [19]. Note that government is making amendments to the regulatory framework for the final stages of decommissioning and clean-up which will potentially allow sites to be delicensed earlier and when they may still have some areas of contaminated land that will be managed under the environmental permit following release from the nuclear site licence.
* A licensee may be working with the relevant environmental regulator to meet the requirements for release of the site from radioactive substances regulation [20]. The environmental permit requires dutyholders to produce and maintain a site wide environmental safety case (SWESC) and Waste Management Plan (WMP).
* A licensee that is also one of the Nuclear Decommissioning Authority (NDA) operating companies may be working towards achieving an end state for the purposes of revocation of a designating direction given by the Secretary of State to the NDA under the Energy Act 2004, and if the site is in Scotland, the Scottish Ministers also.

### On-site disposal of radioactive waste on nuclear sites by deposit or burial

1. ONR and the environmental regulators have jointly published a statement of common understanding (updated in 2021) which sets out the harmonised regulatory approach taken for the regulation of the on-site disposal of solid radioactive waste on nuclear sites [12], to ensure the safety of the public, workers and the environment.
2. The approach ensures that any proposals for such disposals will need to demonstrate that human health and the environment will be protected.   
   The statement explains the interface between the permitting of radioactive waste disposals by the environment agencies, and the regulation of the safety of disposal activities by ONR. The document also clarifies the terminology used in this context for ‘radioactive waste’, ‘disposal’ and ‘storage’ and sets out regulatory expectations for the timing of applications to the agencies for disposal activities.

# Relationship to Safety Assessment Principles, WENRA Reference Levels, and IAEA Safety Standards and Guides

## Safety Assessment Principles

1. The Safety Assessment Principles (SAPs) [1] provide nuclear inspectors with a framework for making consistent regulatory judgements on the safety of activities and include the legal duty to reduce risk so far as is reasonably practicable (SFAIRP). The SAPs are split into sections relating to different aspects of nuclear safety. One section of the SAPs is dedicated to LQM and those principles are summarised here:

* **RL.1** – this principle relates to the production of a strategy for the control and remediation of any known or suspected radioactively contaminated land on the site, which should be integrated with other related strategies (for example, radioactive waste or decommissioning).
* **RL.2** – this principle relates to licensees understanding the extent and nature of radioactively contaminated land on and adjacent to the site.
* **RL.3** – this principle relates to licensees having suitable arrangements for detection of leaks and escapes giving rise to radioactive land contamination, such that they can be controlled.
* **RL.4** – this principle relates to characterisation of radioactively contaminated land to facilitate its safe and effective control and remediation.
* **RL.5** – this principle relates to characterisation of any radioactively contaminated land such that it is kept up to date.
* **RL.6** – this principle relates to preparation and implementation of a plan for safe control and remediation of radioactively contaminated land, and which is subject to appropriate stakeholder engagement.
* **RL.7** – this principle relates to the records for safe and effective control and remediation of radioactively contaminated land, now and in the future.
* **RL.8** – this principle relates to appropriate remediation and control of any radioactively contaminated land prior to construction of new facilities upon that land.
* **RL.9** – this principle relates to the production of a safety case to demonstrate safety of LQM activities, which is kept up to date as work progresses.

1. In addition to the LQM SAPs, the following SAPs may also be of relevance to LQM:

* **SC.1, SC.3 to SC.8** – these principles relate to the process for producing safety cases, including their characteristics, content, maintenance and ownership.
* **RP.1 to RP.7** – these principles relate to radiation protection and control of areas to limit spread of radioactive contamination.
* **ENM.1 to ENM.6** – these principles relate to the control of nuclear matter on the nuclear licensed site.
* **RW.1 to RW.7** – these principles relate to the management of radioactive waste at all stages of the lifecycle of a facility.
* **DC.1 to DC.6, DC.9** – these principles relate to arrangements for decommissioning of a facility, which apply at all stages of the lifecycle of a facility.
* **ECS.1 to ECS.5** – these principles relate to classification and standards of SSCs employed to deliver safety functions, which may include, for instance, leak detection systems and groundwater monitoring networks.
* **EMT.2** – this principle relates to the regular and systematic examination, inspection, maintenance and testing of SSCs employed in, for instance, preventing land contamination and delivering LQM plans, as defined in the safety case.
* **ESR.8** – this principle relates to the provision of leak detection systems, which includes instrumentation to enable monitoring of the location and quantity of escaped radioactive material.
* **FP.1 to FP.5, FP.8** – these are the fundamental principles which underpin the SAPs and outline ONR’s expectations regarding responsibility, leadership and management for safety, optimisation of protection measures, safety assessment, limitation of risks to individuals and protection of present and future generations.

## 

## Technical Assessment Guides

1. There are many other TAGs which may be of relevance to LQM, due to the large number of SAPs which are of potential relevance. The full list of TAGs can be accessed through the [ONR website](https://www.onr.org.uk/publications/regulatory-guidance/), and the most relevant are listed in the Table 1.

Table 1 – Relevant TAGs

|  |  |
| --- | --- |
| Document reference | Title |
| NS-TAST-GD-005 | Regulating duties to reduce risks to ALARP [10] |
| NS-TAST-GD-009 | Examination, inspection, maintenance and testing of items important to safety [21] |
| NS-TAST-GD-023 | Control of processes involving nuclear matter [22] |
| NS-TAST-GD-024 | Management of radioactive material and radioactive waste on nuclear licensed sites [23] |
| NS-TAST-GD-026 | Decommissioning [24] |
| NS-TAST-GD-033 | Management of records [25] |
| NS-TAST-GD-038 | Radiological protection [26] |

## WENRA Safety Reference Levels and IAEA Safety Standards

1. LQM is outside of the scope of the WENRA Safety Reference Levels (SRLs) for decommissioning and those relevant to delicensing. There are no specific SRLs directly applicable to LQM.
2. LQM activities covered by this TAG will contribute to satisfying aspects of the IAEA General Safety Requirements (GSR) Part 3 (‘Radiation Protection and Safety of Radiation Sources’) [27], Part 4 (‘Safety Assessment for Facilities and Activities’) [28], Part 5 (‘Predisposal Management of Radioactive Waste’) [29], and Part 6 (‘Decommissioning of Facilities’) [30].   
   Further information on how this TAG covers specific requirements is provided in [Appendix 2](#_Appendix_2_–_1).

# Advice to inspectors

1. Where the inspector is not a specialist on the topic of land quality management, guidance should be sought from specialist inspectors from within the Nuclear Liabilities Regulation specialism.

## Overall objective of LQM

1. Our overarching objective and five key principles for successful LQM are set out in the joint expectations. They are intended to promote relevant good practice (RGP); they do not specify regulatory requirements and in their own right are not legally binding on licensees. However, the key principles are underpinned by the LCs described in section ‎3, which are legally binding requirements. It should also be noted that licensees will need to take account of other relevant legislation and guidance, in particular regarding possible on-site disposals of radioactive waste. This guidance builds on the joint expectations, providing more detail regarding how those expectations fit into our system of regulation.
2. The overall objective of LQM is to take all reasonably practicable measures to prevent contamination and to ensure that if it occurs, or if it has already occurred, it is managed safely and unacceptable risks to people or the environment are mitigated. This includes acting in a proportionate way, putting sustainability at the heart of how land quality management is planned and carried out. ONR and the environment regulators expect that licensees and operators manage land quality in ways that:

* prevent unacceptable activities from taking place that might fail to protect land and groundwater; and
* ensure that any risks to people and the environment associated with land quality are promptly and properly managed.

1. This includes ensuring that where contamination exists, proportionate remediation is undertaken to avoid, so far as is reasonably practicable, risks to human health, safety and the environment for present and future generations. Licensees should have a robust strategy for managing land quality which is implemented through integrated implementation plans.   
   The development of the strategy and plans should be systematic, integrated and iterative, addressing the following expectations:

* prevent new land contamination, so far as is reasonably practicable;
* understand the land quality and contamination characteristics of the site, so as to inform decisions on LQM;
* assess the options for LQM taking due account of sustainable development;
* identify and prioritise LQM activities;
* apply the waste management hierarchy;
* avoid the creation of radioactive wastes in forms which may foreclose options for safe and effective long-term management;
* ensure sufficient and competent resources are allocated to implement LQM activities;
* engage with stakeholders (including the regulators) from an early stage;
* develop the safety case/radioactive (and non-radioactive) waste management arrangements for LQM;
* ensure that risks are reduced to as low as reasonably practicable (ALARP); and
* maintain fit-for-purpose records and manage relevant knowledge appropriately.

## LQM strategy and plan

1. The arrangements for decommissioning required under LC 35(1) extend to include the regulatory expectation for the licensee to produce and maintain an appropriate LQM strategy. The LQM strategy may be a stand-alone document or integrated to other relevant strategies (for example, radioactive waste).
2. As a minimum, the strategy should recognise relevant stakeholder expectations or requirements (including those of the local community) for site management and subsequent re-use of the land, including any agreed interim or final site end states and dates. The strategy should set out what is to be achieved through LQM and be supported by an integrated implementation plan that sets out ‘how’ LQM is delivered. The plan should set out key objectives, milestones, timescales and responsibilities, and make clear reference to LQM enabling procedures and arrangements, such as record keeping, quality assurance, decision-making and stakeholder engagement.
3. Production of a site wide LQM strategy will satisfy SAP RL.1, whilst activities to determine the current baseline and inform the plan will satisfy SAPs RL.2 and RL.6. The LQM strategy should be consistent and integrate with other relevant site strategies, such as those for radioactive waste (SAP RW.1) and decommissioning (SAP DC.2) as per paragraph 880 in the SAPs [1].
4. Production of a specific LQM strategy is a regulatory expectation in order to promote RGP. Production of an LQM strategy will enable the licensee to clearly demonstrate its compliance with the LCs and SAPs which underpin ONR’s expectations with respect to LQM.
5. The inspector may consider whether the following factors have been adequately addressed by the licensee’s LQM strategy and plan:

* Has the licensee identified all potential sources of leaks, both historic and future?
* To facilitate appropriate and proportionate remediation to be undertaken, have a range of remediation options been identified for a range of contamination scenarios?
* Has the licensee defined a plan of activities to achieve the objective of LQM which clearly states how the plan will be delivered?
* Is the identified end point satisfactory and does it remediate the radioactively contaminated land so far as is reasonably practicable?
* Has the licensee undertaken suitable stakeholder engagement and incorporated such feedback into development of the LQM strategy and plan?

## Prevention and limitation of new contamination

1. In the first instance, arrangements should be in place to prevent the leak and escape of radioactive material and radioactive waste that could lead to the contamination of land and groundwater. Further information is contained within the LC 34 TIG [31]. Where contamination has already occurred, arrangements should be in place to control or remediate the contamination, whether on or arising from the nuclear licensed site, to reduce the risk so far as is reasonably practicable.
2. All SSCs that are identified as potential sources of contamination should be designed, operated and maintained to prevent leaks. This means considering both fixed and mobile sources of radioactive material and radioactive waste, including those above and below the ground.   
   Priority should be given to those sources that present the highest hazard and risk to people from radioactively contaminated land and groundwater.
3. Options for leak prevention could include adoption of non-liquid processes, conversion of waste to a passive solid form, multi-barrier containment, external bunding, pressure detection, and leak detection (at source and receptor). All potential sources of leaks should, so far as is reasonably practicable, have effective monitoring systems, including leak detection, which are proportionate to the risks and hazards. Contingency plans should exist, ready for implementation in the event of any leak occurring. Arrangements should exist to ensure that leakage control and detection systems (including those that form part of any contingency plans) are appropriately tested and maintained.
4. Assessing the potential sources of leaks and ensuring appropriate systems for leak detection are in place and maintained will satisfy SAP RL.3 and is enforceable under LC 34.
5. In line with SAP RL.3, if new contamination occurs, its effects should be assessed quickly, and appropriate and proportionate remediation undertaken to minimise the impacts on groundwater and land quality. Any leak that is detected should be stopped or otherwise controlled to prevent continuation or recurrence of contamination. Such incidents should be reported to ONR promptly as per arrangements made under LC 34/LC 7, recorded, characterised and the risks assessed. Similarly, such a leak may constitute an unauthorised disposal of radioactive waste in breach of the environmental permit and be reportable under the permit conditions. ONR expects that licensees should implement good practice with respect to learning from experience to reduce the likelihood of similar events occurring in the future.
6. All reasonably practicable measures should be used to minimise the spread of contamination (whether new or existing) and to monitor the extent and consequences of its impacts. Site-wide arrangements should recognise the possibility of accidents occurring and should include activities to mitigate and manage leaks and escapes of any contaminants.
7. The inspector may consider whether the following factors have been adequately addressed by the licensee’s arrangements:

* Is there adequate provision of monitoring systems at potential sources of leaks and of the receptors to those potential leaks?
* Are there adequate inspection and testing arrangements for the monitoring systems, with complete records of inspections to date?
* Has the licensee made appropriate contingency plans in case of a leak, including waste management arrangements?

## Understanding of the land quality characteristics of the site

1. The LQM plan should be based on sound knowledge and understanding of the characteristics of the site and surrounding area, now and in the past, and any contamination that may exist.
2. The extent of site characterisation (including characterisation of any contaminants) should be sufficient to understand the potential and existing sources of contamination, pathways and receptors, as per SAP RL.4.   
   Site characterisation activities should also allow any changes to be managed (including any changes in the influence of external factors on the site, for example landscape change as a result of coastal erosion or increases in risk of flooding owing to climate change). In the event of any contamination occurring or being suspected, site characterisation activities should allow the behaviour and migration of contamination to be predicted, and an appropriate level of control to be exerted.
3. Licensees are not expected to investigate radioactive contamination on an adjoining site that is operated by a separate licensee. However, ONR would expect both licensees to cooperate with control and remediation activities in relation to radioactive contamination which may, or has the potential to, migrate from one site to another.
4. Site characterisation and monitoring should be used to establish and inform the development of a conceptual site model (CSM) which describes the pathways by which contamination from a source could reach receptors, and the risks posed to those receptors. The CSM should also set out baseline conditions against which any subsequent changes can be reviewed, and their potential impacts assessed.
5. Where land quality issues are potentially significant, more detailed characterisation of the source term, pathways and receptors may be necessary. Where appropriate and proportionate, this may also include the use of models to aid understanding of the geology, hydrogeology, geochemistry and contaminant transport mechanism(s).
6. It is essential that immediate investigation and risk assessment takes place on finding any new contamination, whether due to previously undetected sources or worsening impacts from known sources. Where appropriate, proportionate characterisation and on-going monitoring of contamination should be carried out (SAP RL.5). The radionuclide half-lives of some radioactive contaminants may appear to negate on-going monitoring, either because they are very short (contaminant will decay rapidly) or very long (radioactive characteristics will not change rapidly). However, there is a need to perform on-going monitoring to provide confidence that the total quantity and location of known sources of radioactively contaminated land/groundwater are not changing through time due to additional leaks or escapes, or through migration of the contaminant(s).
7. LC 11(1) states that licensees “shall make and implement adequate arrangement for dealing with any accident or emergency arising on the site and their effects”, and ONR expects licensees to make arrangements to mitigate the effects of accidents and emergencies leading to LQM issues, so far as is reasonably practicable.
8. The inspector may consider whether the following factors have been adequately addressed by the licensee’s arrangements:

* Has the licensee undertaken characterisation of the site to develop understanding of the current state of land and groundwater quality?
* Has the licensee identified potential areas of concern through either characterisation or identification of potential leaks?
* Has the licensee established a CSM to aid understanding of potential contaminant migration which identifies the pathways through which contamination may reach receptors from the identified potential sources?
* Are the risks to the receptors identified and quantified?
* Are suitable arrangements in place for continued monitoring to ensure that characterisation is kept up to date and the CSM updated accordingly?

## Manage land quality to mitigate risks

### Assessment of options for LQM

1. LQM decisions should be informed by an assessment of options for remediation that exist for each land and groundwater contamination source term taking account of the overall remediation strategy for the site.   
   Research conducted by ONR provides additional guidance on available remediation techniques most commonly used in the nuclear industry [32], including criteria that should be considered during technical selection of appropriate methods, which will help assessment of the licensee’s optioneering process. An appropriate level of stakeholder dialogue should occur early in the process of identifying, screening and selecting remediation options.
2. The inspector may consider whether the following factors, which are not intended to be an exclusive list, have been adequately considered and assessed by the licensee during assessment of LQM options:

* the physio-chemical nature and current state of contaminants
* the actual or potential risks to people and the environment under current conditions
* the benefits and detriments that implementation of each option would bring
* the impact that any delay in implementing the option might have upon the spread of contamination
* the actual or potential risks, and the costs of each option
* the radiological protection risks to people for each option
* the nature and volume of wastes that would be generated, and availability of disposal routes
* the lifecycle impacts on people and the environment
* the practical issues of implementation associated with each option
* the intended site end states (interim and/or final) and options identified to achieve the proposed state
* the extent to which each option addresses any concerns raised by stakeholders
* whether the selected option has been chosen on a suitable basis, with due consideration of RGP and safety benefits, such that risks will demonstrably be reduced so far as is reasonably practicable

### Prioritisation of LQM activities

1. The outcome of the assessment of remediation options should be a strategy which should form the basis of a prioritised programme of work to implement the selected option.
2. LQM activities should integrate fully with other site restoration and waste management activities, both current and future. Unless otherwise justified, contaminated areas of land should be remediated to appropriate standards before any new construction is started (SAP RL.8). Where appropriate, opportunities should be taken for remediation when civil works are being undertaken. Plans for other site activities should take account of the potential impact that any new development might have upon any land and groundwater contamination (for example, impacting on local groundwater flows and so changing contaminant migration rates or pathways).
3. ONR expects that the licensee’s LQM plan is appropriately prioritised.   
   The order in which remediation work is undertaken will generally reflect the risk posed to people and the environment from the area of concern.   
   In general, the highest priority for action should be given to those areas posing the greatest hazard and risk, however, it should be recognised that this may not always be possible. Any change to planned management activities should be justified and the reasons for the changes clearly recorded. LQM activities should continue throughout the period that the site remains under regulatory control, including any periods of monitoring.
4. SAP DC.3 states that:

“where adequate levels of safety cannot be demonstrated, prompt decommissioning should be carried out and, where necessary, prompt remedial and operational measures should be implemented to reduce the risk.” [1]

1. In such instances, ONR would expect, so far as is reasonably practicable, that appropriate and prompt remedial measures be taken to reduce risks posed by radioactively contaminated land or groundwater. Where prompt action cannot be undertaken, the licensee must justify the safety of the radioactively contaminated land.
2. The inspector may consider whether the following factors have been adequately addressed by the licensee’s arrangements:

* Have LQM activities been prioritised so as to reduce the greatest hazard and risk?
* Are any risks from identified potential future hazards adequately integrated into the prioritised plan?

### Development of LQM arrangements (safety and waste management)

1. All land and groundwater contamination should be managed in accordance with an appropriate safety case and waste management arrangements, to demonstrate that risks to operating staff, to other persons and to the environment are avoided, so far as is reasonably practicable.   
   Although radioactively contaminated land is not deemed to be radioactive waste whilst *in situ*, waste may be generated during characterisation or remediation and so the licensee must have suitable arrangements to plan for management of such waste arising in the future.
2. The environmental permit requires dutyholders to produce and maintain a SWESC and WMP. ONR would not expect a licensee to produce a separate land quality safety case where the SWESC addresses all of ONR’s requirements.
3. SAP RL.9 states ONR’s expectation that licensees provide a safety case to demonstrate the safety of the plan for managing the control and remediation activities associated with radioactively contaminated land and groundwater. The safety case should be kept up to date as the work progresses to implement the plan, as per SAP SC.7. Further guidance on safety case assessment is provided in the relevant TAG (NS-TAST-GD-051) [33]. It is up to the licensee to decide how the LQM safety case is presented and documented, for example as a stand-alone document or forming part of an operational facility’s safety documentation.
4. The expectation that licensees develop suitable arrangements in relation to their LQM activities forms part of the requirements upon licensees under   
   LC 23 (operating rules), LC 17 (management arrangements), and LC 35 (decommissioning) and further guidance on compliance with these conditions is provided in the relevant TIGs [34, 32, 35].
5. The safety arrangements for LQM should take account of the radiation protection SAPs RP.1 to RP.7 and the requirements for compliance with IRR17. Licensees’ arrangements should provide adequate protection for members of the public and workers against exposure to ionising radiation, including radioactive contamination. Further guidance on this topic is provided in the relevant TAG (NS-TAST-GD-038) [26].
6. In addition, paragraph 817 in the SAPs states that:

“appropriate and sufficient capacity should be provided for temporary storage of radioactive waste”, which includes “allowance for waste resulting from incidents.” [1]

1. Potential waste arising from land and groundwater remediation required as a result of an incident or emergency should be considered in the licensee’s arrangements.

### Application of the waste management hierarchy

1. It is a requirement of LC 32 that licensees minimise “so far as is reasonably practicable the rate of production and total quantity of radioactive waste accumulated on the site at any time”. In order to achieve this, the LQM plan should implement the waste management hierarchy:

* production of radioactive waste should be avoided;
* where radioactive waste is unavoidable, in order of priority:
  + its production should be minimised;
  + it should be reused;
  + it should be recycled;
  + only as a last resort should it be disposed of.

1. LQM activities should avoid the unnecessary generation of waste   
   (SAP RW.2) and measures to minimise the volume of waste arising from LQM should be implemented (SAP RW.3). It is important that licensees consider the potential types and quantities of wastes which may arise from a particular remediation option and implement measures so as to minimise secondary waste. Any wastes generated should be managed, stored and disposed of in a safe and environmentally responsible manner   
   (SAPs RW.4 and RW.5).
2. The inspector may consider whether the following factors have been adequately addressed by the licensee’s arrangements:

* Has the licensee identified the potential waste production routes for each remediation technique considered during optioneering?
* Has the licensee undertaken early containment or removal of the source term to minimise spread of contamination and protect groundwater?
* Has the licensee given due consideration to alternative management options? Examples could include but are not limited to the following:
  + In situ alternatives to excavating material for management as waste (for example monitored natural attenuation);
  + Re-use of excavated material, for example via in-fill or landscaping on site or elsewhere, ensuring that any necessary permit or authorisation is obtained;
  + Sorting, segregation and treatment of excavated material, where practicable; and
  + Implementation of sentencing arrangements and protocols to exclude or exempt material or waste from regulatory control.

## Work with stakeholders and other interested parties

1. To ensure achievable, cost effective and acceptable solutions for remediation it is important to identify, at an early-stage, stakeholders with an interest in LQM; including, but not restricted to, the regulators (ONR, relevant environmental regulators and local authorities), other sites, the supply chain, and the public. Once identified, stakeholders should be engaged and given the opportunity to contribute in a proportionate way during the development and implementation of LQM plans.
2. To achieve this, the process of developing LQM plans should be supported by an engagement plan that reflects the range of needs of stakeholders. Early, open, continued and transparent involvement of, and communication with those with an interest in LQM plans should help develop trust. Engagement should occur from the outset, focused on an agreed set of objectives and any hold points that may be appropriate. Invitation to the regulators to observe the process and have input if necessary is encouraged, but the licensee should be aware that to maintain their regulatory independence the regulators will not be directly involved in any decision-making processes.
3. SAPs paragraph 882(e) states that ONR expects the LQM strategy to be subject to appropriate stakeholder engagement, promoting RGP through closer working relationships between all parties who have an interest in LQM [1]. It is in the licensee’s interest to involve the regulators from the outset to ensure expectations for compliance are understood and achieved.
4. Appropriate stakeholders could include, but are not limited to:

* Regulators and other enforcing authorities (for example ONR, EA, SEPA, NRW, Local Authority);
* Other facilities on the site;
* Other sites;
* The public.

## Maintenance of records

1. Arrangements should be in place to ensure records are made of any leaks and incidents resulting in land and/or groundwater contamination and all management actions subsequently taken. All records should be kept and updated as necessary. Care should be taken to ensure that transfer of LQM information between operators, including any contractors, is carried out in a responsible manner, following any transfer in responsibilities at a site.
2. SAP RL.7 sets out ONR’s expectation that arrangements are made such that information needed for the safe and effective control and remediation of radioactively contaminated land and groundwater, now and in the future, is recorded and preserved. Information relating to radioactively contaminated land and groundwater may also be recorded along with information held regarding safe management of radioactive waste or decommissioning, as per SAPs RW.7 and DC.6, respectively [1]. Further detailed guidance on the keeping and preservation of records is provided in the relevant TAG   
   (NS-TAST-GD-033) [25].
3. The requirement for licensees to make such records of radioactively contaminated land and groundwater upon the site is stipulated in LC 25(2), which states that the licensee’s records:

“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”. [8]

1. Note, however, that licensees may instigate monitoring regimes under their LC 28 arrangements, for regular and systematic testing of the ground conditions to ensure that safety of persons is maintained.
2. The inspector may consider whether the following have been adequately addressed by the licensee’s recording arrangements:

* the nature and extent of radioactive contamination, including records from surveys, investigation, monitoring and surveillance work and the analysis of their results;
* the processes used for deciding management options and the setting of strategies;
* records of any incidents, leakages or accidents resulting in radioactively contaminated land, and of the management actions taken in response;
* remediation activities that have been or are planned to be carried out;
* the methodology for, and results of, validation of the remediation work;
* relevant information related to the history and use of the site; and
* aspects concerning records for radioactive waste relevant to LQM.

# Appendix 1 – Additional relevant licence conditions

1. The following LCs may have relevance when undertaking assessment of the adequacy of LQM arrangements and activities, depending upon the scope of the assessment:

* **LC 11: Emergency arrangements** – “the licensee shall make and implement adequate arrangements for dealing with any accident or emergency arising on the site and their effects”. Licensees’ accident and emergency arrangements should include adequate provision for dealing with aspects of accidents and emergencies capable of resulting in radioactively contaminated land or groundwater on the site.
* **LC17: Management systems** – “the licensee shall establish and implement management systems which give due priority to safety” and “within its management systems, make and implement adequate quality management arrangements in respect of all matters which may affect safety”. Adequate LQM arrangements should be incorporated within the licensee’s management systems.
* **LC 18: Radiological protection** – “the licensee shall make and implement adequate arrangements for the assessment of the average effective dose … to such class or classes of persons as may be specified in the aforesaid arrangements”. Dose assessments should include adequate consideration of effective dose arising from any radioactively contaminated ground and groundwater.
* **LC 19: Construction or installation of new plant** – “the licensee shall make and implement adequate arrangements to control the construction or installation”. Arrangements should include reasonably practicable provision for the control of the potential impact to the quality of land and groundwater from construction and installation operations.
* **LC 22: Modification or experiment on existing plant** – “the licensee shall make and implement adequate arrangements to control any modification…carried out on any part of the existing plant or processes which may affect safety.” Modifications to the safety case to demonstrate safety of persons from radioactively contaminated land and groundwater should be managed under the licensee’s LC22 arrangements.
* **LC 32: Accumulation of radioactive waste** – “the licensee shall make and implement adequate arrangements for minimising so far as is reasonably practicable the rate of production and total quantity of radioactive waste accumulated on the site at any time and for recording waste so accumulated”. Licensees should therefore have adequate arrangements for LQM to minimise the generation of radioactive waste from LQM activities, including the control, monitoring and remediation of radioactively contaminated land or groundwater.

1. The following LCs may also have relevance, depending upon the particular scope of the assessment:

* **LC 6** - Documents, records, authorities and certificates
* **LC 7** - Incidents on the site
* **LC 12** - Duly authorised and other suitably qualified and experienced persons
* **LC 24** - Operating instructions
* **LC 26 -** Control and supervision of operations
* **LC 27** - Safety mechanisms, devices and circuits
* **LC 28** - Examination, inspection, maintenance and testing

1. Inspectors should ensure that the LQM arrangements take appropriate account of the licensee’s arrangements for compliance with the relevant LCs, however, it is not expected that LQM would necessarily be included during operational inspection of compliance with those LCs.
2. The presence of radioactively contaminated land or groundwater on a nuclear licensed site is not normally considered by ONR to be “storage” of nuclear matter. Storage would imply that the contamination is subject to some form of engineered containment, and in a form and manner that allows it to be retrieved or inspected within a reasonable timescale. Whereas, in reality the nature of the contamination is generally uncontrolled and without any means of confining the contamination to that location. Hence, ONR considers such contamination to be an accumulation of nuclear matter [**Error! Bookmark not defined.**]. Consequently, radioactively contaminated land would not be considered a breach of LC 4(2), which requires licensees to “ensure that no nuclear matter is stored on the site except in accordance with adequate arrangements made by the licensee for this purpose.”
3. Any migration of radioactively contaminated groundwater across a nuclear licensed site boundary in either direction is not considered by ONR as nuclear matter being brought onto the site, as per LC 4(1), nor nuclear matter being consigned from the site, as per LC 5(1). This does not preclude ONR from taking enforcement action under LC 34 in respect of a leak or escape leading to radioactively contaminated land or groundwater.
4. LC 33 (directed disposal of radioactive waste) is not relevant to the regulation of radioactively contaminated land or groundwater *in situ*, as ONR does not consider it to be radioactive waste in *situ*.   
   Radioactively contaminated land and groundwater may become radioactive waste after it has been removed during characterisation or remediation activities, at which point ONR has the power to direct its disposal under   
   LC 33 in accordance with an EPR16 environmental permit or EASR authorisation, if that is appropriate and after discussion with the relevant environmental regulator.

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# Appendix 2 – Sources of relevant good practice

1. In instances where a shortfall exists between ONR’s expectations and the performance of a licensee, the inspector will need to determine the extent of the risk gap by reference to relevant good practice (RGP), as per the Enforcement Management Model (EMM) [36]. Where examples of RGP are less well defined, inspectors should influence licensees through engagement and provision of advice, to achieve ONR’s regulatory expectations.
2. The following sections provide potential examples of relevant good practice (RGP), when implemented for particular circumstances in an appropriate context and in the appropriate way. For further guidance on determining what may constitute RGP, refer to [10].

**Remediation techniques for radioactive contaminated land on nuclear licensed sites**

1. ONR commissioned a report to provide a comprehensive guide on techniques available for the remediation of radioactively contaminated land on nuclear sites and their effectiveness and applicability [24]. The report explicitly does not identify which techniques should be used in any particular case, but it does provide the inspector with a guide on what remediation techniques are available and what factors it would be reasonable to expect the licensee to have considered when determining the most appropriate remediation technique to use. As such, the report is particularly useful to inform ONR judgements around the robustness of the licensee’s optioneering approach and conclusions in relation to selection of remediation techniques.

**Nuclear Industry Codes of Practice and Good Practice Guides**

1. Nuclear Industry Codes of Practice (NICoP) and Good Practice Guides (NIGPG) may be considered to be ‘established standards’ when considering the application of the EMM, and as such ONR would normally expect licensees to have regard to the guidance given in the relevant NICoP or NIGPG. However, ONR has not formally endorsed any of the guidance contained within the NICoPs or NIGPGs and does not prescribe that they should be implemented. It is the responsibility of the licensee to justify use of such standards; inspectors should judge the applicability and adequacy of use in each case.

* NICoP for Routine Water Quality Monitoring [37]
* NICoP for Qualitative Risk Assessment for Land Contamination, including Radioactive Contamination [38]
* NIGPG on the Application of ALARP to Radiological Risk[[4]](#footnote-5) [39]
* NICoP on Best Available Techniques (BAT) for the Management of the Generation and Disposal of Radioactive Wastes[[5]](#footnote-6) [40]
* NICoP on Clearance and Radiological Sentencing: Principles, Processes and Practices for use by the Nuclear Industry[[6]](#footnote-7) [41]

**SAFEGROUNDS+ - A CIRIA learning Network**

1. The SAFEGROUNDS+ programme ran until 2013 [42], producing guidance documents on issues relating to managing contaminated land on nuclear and defence sites and non-active/low activity waste from nuclear and defence site decommissioning. Guidance documents published by SAFEGROUNDS included:

* Approach to managing contaminated land on nuclear licensed and defence sites – an introduction
* Good practice guidance for the management of contaminated land on nuclear licensed and defence sites
* Good practice guidance for site characterisation
* Guide to the comparison of contaminated land management options
* Community stakeholder involvement
* Good practice guidance for land quality records management for nuclear licensed and defence sites

1. At the time of publication, these guidance documents were considered to present relevant good practice. However, whilst they may still contain useful guidance, it should be recognised that as they were published some years ago, they may no longer present contemporary good practice in these areas.

**British Standards**

1. ISO 21365 provides a definition of the CSM for contaminated sites consistent with other ISO standards related to contaminated land, providing general guidance on the application of CSM, how they are developed and how they can evolve [43].
2. BS 10175 provides recommendations and guidance intended to ensure that the objectives of an investigation are achieved and that appropriate data for risk assessment are obtained [44].

**Drinking water indicator parameters and screening values**

1. Many licensees use drinking water indicator parameters and screening values as a benchmark for groundwater quality. Information is provided here for context to inform inspectors of the significance of such values.
2. In the UK, regulations pertaining to the quality of water supplied for public use specify screening values for total indicative dose and an indicator value for tritium. The indicative dose is normally monitored by proxy through measurement of gross alpha and gross beta activity against screening values of 0.1 Bq/l and 1.0 Bq/l, respectively. If either of these screening values is exceeded, monitoring must be carried out to establish which radionuclides are present and to inform further action.
3. Tritium is listed as an ‘indicator parameter’ with a specification of 100 Bq/l. Tritium was included on the basis that it provides an indication of other artificial sources of radioactivity in drinking water. If the indicator parameter value is exceeded, it should be reported to DWI as an event and there should be further investigations to identify the source and monitoring to identify additional radionuclides present. More detailed information is available in the DWI guidance on implementation of the regulations in England and Wales [45].
4. The World Health Organisation (WHO) prescribe ‘screening levels’ and ‘guidance levels’ for radioactivity in drinking water which represent the concentration that, if present in drinking water throughout the year, would result in an individual dose of 0.1 mSv [46]. These guidelines are based on the approach proposed by the ICRP in situations of prolonged radiation exposure of the public.

**IAEA Safety Standards**

1. The fundamental safety objective set down in the IAEA Fundamental Safety Principles is “**to protect people and the environment from the harmful effects of ionising radiation**” through control of exposure of people and release of radioactive material to the environment, restriction of likelihood of events that could lead to such instances and to mitigate the consequences of such instances if they were to occur [47].
2. The fundamental safety principles flow from the fundamental safety objective, and from those principles, the general safety requirements are derived. Both the requirements and the guides which support them are considered as relevant good practice by ONR and they should therefore be consulted, where relevant.
3. Principle 7 states that “people and the environment, present and future, must be protected against radiation risks” whilst Principle 10 states that “protective actions to reduce existing or unregulated radiation risks must be justified and optimised.” Together these principles frame the requirement to protect people and the environment through effective LQM, by reducing the risk posed by radioactively contaminated land using a planned approach, which is optimised to the particular situation.

*IAEA General Safety Requirements (GSR)*

1. Radioactively contaminated land and groundwater constitute an ‘existing exposure situation’, defined in GSR Part 3 [27] as areas contaminated “by residual radioactive material deriving from…past activities that were never subject to regulatory control or that were subject to regulatory control but not in accordance with the requirements of these standards.” In respect of public exposure, Requirement 48 stipulates that remedial and protective actions are justified and optimised, whilst Requirement 49 lays out the responsibilities for remediation of areas with residual radioactive material and the actions to be taken by those with whom the responsibility rests.   
   With regards to occupational exposure, Requirement 52 refers to protection for the workforce.
2. The requirement for a safety assessment to be conducted, and the components to be included in such an assessment, is laid down in GSR Part 4 [28], for which more guidance is given in the relevant TAG.   
   ONR expects that dutyholders and licensees produce a land quality strategy, which is supported by safety assessments and is integrated with other relevant strategies, such as those for radioactive waste management and decommissioning.
3. GSR Part 5 covers all the steps in the management of radioactive waste from its generation up to disposal, including processing (pre-treatment, treatment and conditioning), storage and transport [29]. The requirements for predisposal management of radioactive waste apply to aspects of land quality and should be taken into consideration appropriately.   
   Further guidance on management of radioactive waste is provided in the relevant TAG (NS-TAST-GD-024) [23].
4. LQM activities will be integrated with decommissioning activities and as such LQM will contribute to satisfying the requirements under GSR Part 6 [30]. Further guidance on decommissioning is provided in the relevant TAG   
   (NS-TAST-GD-026) [24].

*IAEA Safety Guides*

1. The following safety guides form part of the IAEA Safety Standards Series and provide supporting recommendations and guidance in order to achieve compliance with the requirements set out in the International Basic Safety Standards (BSS):

* GSG-17, ‘Application of the Concept of Exemption’ [48], and GSG-18, ‘Application of the Concept of Clearance’ [49], which together replace RS‑G‑1.7 [50] and include derivation of activity concentration levels used for exemption and clearance of bulk amounts of material which provide useful bounding limits for LQM activities.[[7]](#footnote-8)
* RS-G-1.8, ‘Environmental and Source Monitoring for Purposes of Radiation Protection’ [51], provides guidance on programmes for monitoring radionuclides in the environment, including aspects of generic and detailed programme design, interpretation of the data they generate, quality assurance and recording.
* WS-G-3.1, ‘Remediation Process for Areas Affected by Past Activities and Accidents’ [52], provides guidance on the process to be undertaken during remediation planning and implementation (since superseded by GSG-15 [53]).
* WS-G-5.1, ‘Release of Sites from Regulatory Control on Termination of Practices’ [54], this guide is more applicable to delicensing of nuclear sites but is a useful guide to the end-state requirements which should be the ultimate aim of LQM.

*IAEA Safety Report Series and Technical Report Series*

1. The IAEA Safety Reports Series (SRS) and Technical Reports Series (TRS) underpin the IAEA Safety Guides. The safety and technical reports listed here are not formally endorsed by ONR and are included for information purposes only but may provide inspectors with additional background information:

* SRS No. 44, ‘Derivation of Activity Concentration Values for Exclusion, Exemption and Clearance’ [55], provides the methodology and parameters that were used to develop the activity concentration values provided in Safety Guides GSG-17 and GSG-18 [48, 49].
* SRS No. 64, ‘Programmes and Systems for Source and Environmental Radiation Monitoring’ [56], provides detailed practical information on the design and operation of source and environmental monitoring programmes and systems, supporting Safety Guide RS-G-1.8 [51].
* SRS No. 67, ‘Monitoring for Compliance with Exemption and Clearance Levels’ [57], provides practical information on the application of the exemption and clearance levels set out in Safety Guides GSG-17 and GSG-18 [48, 49], and activities for the demonstration of compliance with these levels.
* SRS No. 72, ‘Monitoring for Compliance with Remediation Criteria for Sites’ [58], provides practical advice on the development and implementation of strategies for monitoring for compliance with remediation criteria set out in WS-G-3.1 [52] after completion of remediation activities.
* TRS No. 424, ‘Remediation of Sites with Dispersed Radioactive Contamination’ [59], describes remediation techniques that are applicable to dispersed radioactive contamination at a variety of sites, including surface soil, the vadose zone, surface water, sediments and groundwater.
* TRS No. 445, ‘Applicability of Monitored Natural Attenuation at Radioactively Contaminated Sites’ [60], discusses the mechanisms effecting natural attenuation, the applicability or otherwise of natural attenuation strategies, uncertainties in parameter estimation, Monitored Natural Attenuation (MNA) assessment methods and related monitoring requirements.
* TRS No. 475, ‘Guidelines for Remediation Strategies to Reduce the Radiological Consequences of Environmental Contamination’ [61], provides information on available management options for remediation of land contaminated with radioactive substances, guidelines on the formulation of sustainable remediation strategies and guides readers to other relevant IAEA publications providing detailed information on different aspects of remediation.

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# Glossary and abbreviations

ALARP As Low As Reasonably Practicable

BAT Best Available Technique

CSM Conceptual Site Model

DWI Drinking Water Inspectorate

EA Environment Agency

EASR18 Environmental Authorisations (Scotland) Regulations 2018

EMM Enforcement Management Model

EPA90 Environmental Protection Act 1990

EPR16 Environmental Permitting (England and Wales) Regulations 2016

GSG General Safety Guide (IAEA)

GSR General Safety Requirement(s) (IAEA)

HSWA74 Health and Safety at Work etc. Act 1974

IAEA International Atomic Energy Agency

ICRP International Commission on Radiological Protection

IRR17 Ionising Radiations Regulations 2017

LC Licence Condition

LQM Land Quality Management

MHSWR99 Management of Health and Safety at Work Regulations 1999

MNA Monitored Natural Attenuation

MoU Memorandum of Understanding

NDA Nuclear Decommissioning Authority

NIA65 Nuclear Installations Act 1965

NICOP Nuclear Industry Code of Practice

NIGLQ Nuclear Industry Group for Land Quality

NIGPG Nuclear Industry Good Practice Guide

NRW Natural Resources Wales

PHE Public Health England (previously Health Protection Agency, HPA)

RGP Relevant Good Practice

RSR Radioactive Substances Regulation

SAP Safety Assessment Principle(s)

SEPA Scottish Environment Protection Agency

SFAIRP So Far As Is Reasonably Practicable

SRL Safety Reference Level (WENRA)

SRS Safety Report Series (IAEA)

SSC Structures, Systems and Components

SWESC Site Wide Environmental Safety Case

TAG Technical Assessment Guide(s)

TIG Technical Inspection Guide(s)

TRS Technical Report Series (IAEA)

WENRA Western European Nuclear Regulators’ Association

WHO World Health Organisation

1. The term ‘radioactively contaminated land’ used in this TAG and within the SAPs is defined as “land containing radioactive contamination at levels that would preclude its delicensing“ and is distinct from the statutory definition of ‘radioactive contaminated land’ as defined under the Environmental Protection Act 1990 Part IIA regime. [↑](#footnote-ref-2)
2. The environmental regulators are: in England, the Environment Agency (EA); in Scotland, the Scottish Environment Protection Agency (SEPA); and in Wales, Natural Resources Wales (NRW). [↑](#footnote-ref-3)
3. “*upon the site*” has the meaning of a modified version of the principle of *cuius est solum*, whereby the licensed site boundary is considered to extend below ground to the Earth’s core and above ground to an altitude of 100 km. [↑](#footnote-ref-4)
4. The NIGPG should be read in conjunction with the TAGs on ALARP [10] and radiological protection [26]. [↑](#footnote-ref-5)
5. Although ONR does not recognise BAT in its judgements, radioactive and non-radioactive contamination is often co-located on nuclear licensed sites and licensees may utilise arrangements for environmental permit compliance to achieve compliance with LCs. [↑](#footnote-ref-6)
6. This guidance should be read in conjunction with ONR’s guidance on delicensing [18, 19]. [↑](#footnote-ref-7)
7. Table 2 in Part 2 of Schedule 23 to EPR16 lists concentrations of radionuclides (in Bq/g) below which a substance is considered to be ‘out of scope’, which is similar to the values contained within GSG-17 and GSG-18, with some differences. Where Table 2 and GSG-17/GSG-18 differ, it is the value in Table 2 that should be used. [↑](#footnote-ref-8)