Achieving the End State of a Nuclear licensed site

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End State

The condition of a nuclear licensed site (or part thereof), following all physical decommissioning and clean-up activities required to make the site (or part thereof) available for its next use.

Requirement R10. Risk guidance level after release from radioactive substances regulation Operators should demonstrate through the SWESC that, after release from radioactive substances

Release from Radioactive Substances Regulation (RSR)

Site operators must apply to the environment agencies for agreement for a nuclear licenced site to be released from radioactive substances regulation.

A guidance document, known as the GRR¹, on the release of nuclear sites from RSR was published in July 2018. The operators should demonstrate that they have met all the requirements set out in the guidance before a site can be released from RSR.

Among other requirement, the guidance requires operators to:

- Produce a waste management plan (WMP) (Requirement R2)
- Produce a site wide environmental safety case (SWESC) (Requirement R7)
- Make sure the conditions of their sites meet the environment agencies' standards for protection of people and the environment, now and into the future.

Figure 1 shows a typical timeline for a nuclear site and shows how operation of the site tends to be followed by decommissioning activities that may take several decades. After completion of planned work involving radioactive substances (CWRS), a period of control may need to be exercised on the site to ensure radiological protection of people and the environment, until the site reference state (SRS) is reached, so it can be released from RSR.

It is important to note that achieving the End State may not necessarily result in a SRS (suitable for release from RSR) being achieved, because there maybe a need for a period of control for the purpose of radiological protection that extends beyond achieving the End State.

Defueling and Decommissioning Transition from including Possible

Controls for

regulation, the assessed risk from the remaining radiological hazards to a representative person should be consistent with a risk guidance level of 10⁻⁶ per year (that is, a risk of death or heritable defect of 1 in a million per year due to exposure to ionising radiation).

Requirement R11. Inadvertent human intrusion dose guidance level after release from radioactive substances regulation

Operators should assess the potential consequences of inadvertent human intrusion into any local concentrations of radioactive substances on the site after release from radioactive substances regulation. The GRR specifies the assessed effective dose to any person during and after the assumed intrusion should not exceed dose guidance levels of:

- 3 mSv/year for prolonged exposures
- 20 mSv/year for short term, transitory exposures

Performance assessment calculations

As part of the assessment of waste disposal options, the GRR requires that operators assess potential consequences of inadvertent future human intrusion into the site and aqueous releases from features on the site after the site end state has been reached.

Calculations of potential impacts from human intrusion and aqueous release scenarios are carried out and compared against guidance levels specified in the GRR.

These assessments should also show that the consequential effects on non-human species are acceptable.

Results of these assessments help identify implications of leaving radioactivity associated with particular components of the site and inform comparison of alternative end state options.

Inadvertent human intrusion



Figure 1: Typical timeline for a generic nuclear site

Optimisation of waste management options

A site-specific assessment of the benefits and detriments of clean-up and radioactive waste disposal options must be carried out as a requirement of the GRR.

This involves identification of potential disposal options, assessment and comparison of options with stakeholder engagement, and optimisation of the preferred option if any waste is to be left on site.



Potential disposal options include various combinations of the following (Figure 2):

Figure 2: Different final disposition routes for radioactive waste and in-situ contamination of ground

Future human intrusion is assessed on the basis that it is likely to occur.

Exposure to radioactivity as a result of human intrusion could occur at the time of intrusion, during processing or transport of excavated material, and after excavated material has been distributed.

Modelling considers a range of excavation sizes and potential scenarios for processing and uses of excavated material, for example (Figure 3):

People undertaking excavation and postexcavation activities may be exposed to radioactivity through exposure pathways such as inhalation of dust, ingestion of dust and food, skin contamination and external exposure.



Figure 3: Examples of inadvertent human intrusion and subsequent use of excavated material

Aqueous releases

Modelling considers aqueous release of radionuclides from features left on the site and transport of these radionuclides to areas where members of the public might be exposed in the future.

Potentially exposed groups could include campers, farmers, anglers and recreational users through exposure pathways such as:

- External exposure to contaminated ground or water
- Ingestion of fish or water
- Ingestion of plant or animal products
- Inadvertent ingestion of soil

Addressing the radiological requirements

There are three quantitative radiological requirements in the GRR, with a dose constraint for the period prior to release from RSR, and two guidance levels, for natural evolution and human intrusion, for the period following release from RSR.

Requirement R9. Dose constraints during the period of radioactive substances regulations During the period of radioactive substances regulation the effective dose, from the authorised site, to a representative person shall not exceed a source related dose constraint and a site-related dose constraint.

0.3 mSv per year from any source from which radioactive discharges are made; and

• 0.5 mSv per year from the discharges from any single site





Figure 4: Example of potential dose to public from aqueous releases



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References

SEPA, EA, and NRW. Management of radioactive waste from decommissioning of nuclear sites:

Guidance on Requirements for Release from Radioactive Substances Regulation Version 1.0, July 2018.

¹ Management of radioactive waste from decommissioning of nuclear sites: Guidance on Requirements for Release of Nuclear Sites from Radioactive Substances Regulation