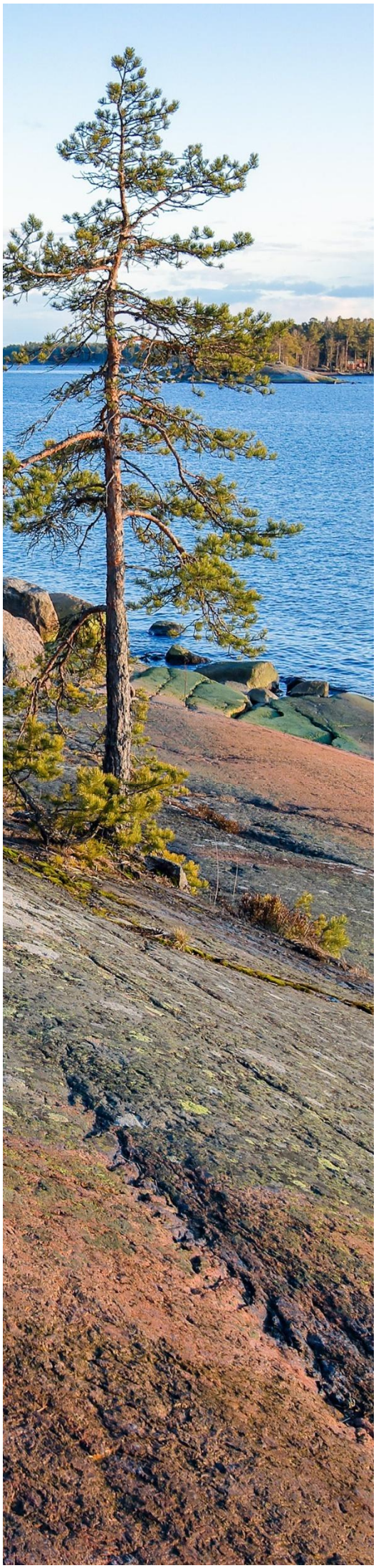

Technical Note

Requirements Table Description Note

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PREFACE

This technical note is part of the contract that Norwegian Nuclear Decommissioning (NND) has with the Finnish AINS Group together with subconsultants VTT Technical Research Centre of Finland and BGE Technology GmbH of Germany. The group assists NND with the concept development and technical design for their disposal solution for radioactive waste in Norway.

The note has been written by Annika Hagros, Taina Karvonen and Timo Saanio from AINS Group, and they have also participated in the compilation of the Excel table including the requirements. In addition, Paula Keto, Timothy Schatz and Ville Ranta-Hiiro (VTT) as well as Toivo Wanne and Michael Jobmann (BGE TEC) have participated in the compilation of the requirements table. Michael Jobmann (BGE TEC) has also reviewed the draft report. AFRY/Advansia has provided comments to the requirements table.

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1 Project objective and key input

The objective of this project is to develop a systematic approach to a generic requirements-management system for the Norwegian National Facility (as described in the Ikonen et al. (2020) and Fischer et al. (2020) reports). This work is intended to guide the further development of the disposal concepts and to support the development of a safety case for either a specific or a generic site.

The main outcome of the work is an Excel table that lists safety and technical requirements for the different repository types in the National Facility. The work relies on information available in Norwegian regulations (provided by NND) and the following international documents as defined in the contract:

- IAEA Safety Standards (including Fundamental Safety Principles, Safety Requirements and Safety Guides, especially those in categories GSR, SSR, GSG and SSG[1]),
- Relevant standards from ICRP and OECD-NEA.

As to OECD-NEA publications, emphasis is given to general NEA reports and statements over country-specific overviews, detailed handbooks and conference proceedings, although the latter are occasionally included as further references.

A few IAEA documents from series other than those listed above are included because they are referenced in the listed documents and contain important information supporting the requirements. The list of all included regulations and documents is given at the end of this note. The list does not contain regulations or documents that were checked but not quoted or referenced in the table. Such documents were not used because no applicable requirements were found or because the document has been superseded by a newer document.

The level of detail and applicability vary a lot between different documents. For example, IAEA document SSR-5 applies to all repository types, whereas additional guides, SSG-1, SSG-14 and SSG-29, repeat the SSR-5 requirements and discuss them from the point of view of a certain repository type. In the Excel table, the requirements are not repeated on more than one row, but the repository-specific discussions are extensively quoted. Guide SSG-1 on borehole disposal focuses on depths beyond a few tens of metres and up to a few hundred metres and does not consider the disposal of spent nuclear fuel/high level waste directly, but it is included in the table as its requirements are considered a necessary, while not a sufficient, basis for borehole disposal of HLW.

It should be noted that the waste currently planned to be disposed of in the landfill repository is classified as non-radioactive, but the landfill repository is designed so that it could be capable of accepting very low-level waste, in case there is a need for this in the future. The Norwegian regulatory requirements on hazardous waste and the IAEA guidelines for near surface disposal of radioactive waste are, therefore, considered to apply to the landfill repository.

The requirement table is intended as a preliminary catalogue of requirements and a tool to present the connection between the regulatory requirements and the design solutions. To best serve its intended purpose, outdated references in the requirements included in the table have been replaced with documents that have superseded the obsolete documents. The official regulatory requirements, in their proper context and with their original wordings, can be found in the actual regulatory documents.

[1] GSR = General Safety Requirements, SSR = Specific Safety Requirements, GSG = General Safety Guides and SSG = Specific Safety Guides.

2 Structure of requirements table

The Excel table (sheet “Table”) includes requirements that may have a direct effect on the design of the Norwegian National Facility and the four different repository types that may be a part of the facility. The table includes the following columns:

- Document reference,
- Document title (with a web address),
- Section/paragraph number of the requirement in question (in case several numbers are given, the requirement is usually included in the first one, and the other sections/paragraphs give further information about the issue),
- Requirement in Norwegian (in case this is the original language),
- Requirement in English (for the Norwegian requirements, here an unofficial translation is given),
- Relevant repository types (whether the requirement applies to the Landfill Repository, Intermediate Depth Repository, Deep Geological Repository (abbreviated as DGR in the Excel table) or Deep Borehole Repository),
- Repository-specific columns to facilitate the filtering of requirements according to a certain type of repository,
- Design solution fulfilling the requirement (if available),
- Further references with a similar requirement (or with more information about the topic).

The purpose of the final column (“Further references with a similar requirement”) is to document the other occurrences of the (essentially same) requirement as the one presented on the row in question, so that very similar requirements do not need to be repeated on several rows, unless some new information is provided. In this column, also full documents giving more information about the requirement subject may be referred to. The intention of this column has not been to refer to requirements that are presented elsewhere in the table but to ensure that no information is lost even though a similar requirement is not repeated several times on different table rows.

Note that some entries in the requirements column are not formulated as requirements, but they are included as they can be used for justification of requirements formulated later by NND. For example, in IAEA documents the actual requirements are often rather general, but useful details are given in the text paragraphs discussing the requirements.

In the table, the requirements from the Norwegian regulations are given first, and the requirements from international standards and other documents come next.

Another sheet (“References”) lists all the documents mentioned in the requirements table. All regulatory documents are also amended with an Internet link.

3 Scope of requirements table

The scope of the work has been to cover regulatory requirements related to the long-term safety of radioactive waste disposal and requirements regarding radiation protection, safeguards and other safety requirements specific to nuclear facilities. Normal construction aspects and all operations outside the National Facility gates/fences prior to disposal (e.g. packaging of the waste, transport) are out of the scope. Underground construction aspects are considered insofar as they apply to nuclear facilities specifically. It should be noted that there are many important regulations that will have to be taken into account in the National Facility project, even though they do not discuss nuclear issues specifically and thus are not quoted as explicit requirements in the Excel file. For example, LOV-2008-06-27-71 (Lov om planlegging og byggesaksbehandling, i.e. Act on Planning and Building Case Processing) is relevant because it regulates zoning. All nuclear facilities must be within the appropriate industrial zone. The Act on Planning and Building Case Processing is, therefore, an essential part of the regulatory framework affecting this project, but as it applies to construction projects other than nuclear projects as well, its requirements are not listed in the Excel (it is, however, mentioned as a further reference for more detailed, nuclear-specific requirements given in FOR-2017-06-21-854, Regulation on impact assessments).

The focus is on requirements that are expected to guide the design of the disposal facility, its components and operations. The work applies to the National Facility, so all general nuclear requirements that may apply also to disposal are included but not those that only apply to power plants, ship's reactors, laser pointers or medical use of radiation sources, etc.

More specifically, it has been decided with NND to **include** requirements related to:

- nuclear waste disposal facilities specifically and nuclear facilities generally (when disposal facilities may be assumed to be included),
- disposal specifically and nuclear waste management generally (when disposal may be assumed to be included), including waste acceptance and retrievability,
- management of hazardous waste, as this applies to the landfill repository,
- safety principles of disposal (containment, isolation, etc.),
- design and construction of disposal facilities and host rock suitability,
- design and installation of engineered barriers,
- safety functions and performance targets of natural and engineered barriers,
- other structures, systems, components and procedures, including monitoring, maintenance and configuration management (in disposal facilities),
- commissioning and decommissioning/closure (of disposal facilities),
- handling of radiation sources/radioactive waste,
- institutional measures after closure,
- responsibilities of the operator ("enterprises", "agencies", "applicant", "holder", "owner", "proprietor"), when the requirements may apply to the operator of a disposal facility,
- site selection, site investigations, land use restrictions, land ownership, real estate, socio-economic factors, infrastructure (however, only general requirements or if directly discussing suitable site characteristics),

- emergency preparedness plan, prevention of accidents, rescue work, risk assessment (only high-level requirements and only if directly related to nuclear facilities, including disposal facilities),
- dosimetry or other surveillance of doses, dose register or dose reporting (only a general requirement to have dosimetry, not the detailed requirements),
- facility design related requirements regarding situations where dose limits are exceeded and high-level requirements on required actions,
- personnel/employment/human resources and their management/training/safety culture, organisational structure (only high-level requirements),
- operational/occupational safety issues (only if directly related to design and high-level requirements),
- safety analyses, safety reviews, reports and other documentation that the operator must provide related to long-term safety (only high-level requirements),
- storage of radioactive waste (only if applies to temporary storage within the National Facility site),
- transfer of radioactive waste, i.e. transport (moving) of radioactive waste within the National Facility site.

Storage is discussed in more detail in Section 4.2 and retrievability in Section 4.4.

For the issues above where only high-level requirements are intended to be included, the detailed requirements are not included in the table, although references to more detailed requirements may be given in the last column. In addition, it has been decided with NND to **exclude** requirements related to:

- nuclear facilities that are not disposal facilities (e.g. power plants),
- “use of radiation” (the requirements relevant for this work are covered by other, more specific requirements),
- construction (also underground), when not related specifically to nuclear facilities,
- tasks defined for the King, the Norwegian Radiation Protection Authority, “government”, “Ministry”, “inspectors”, “municipality” or other regulators/authorities (note that many IAEA regulations formally apply to states, but relevant requirements are included regardless, if there are not yet any corresponding requirements in Norwegian legislation for operators),
- the process of licensing/authorisation/registration/permission/approval or complaint/appeal, insofar as licensing is a separate activity from the design of the facility, and Environmental Impact Assessment process,
- storage/treatment etc. of radioactive waste that is not subject to disposal,
- radioactive waste at a time before entering the National Facility (e.g. requirements related to packaging, encapsulation, marking or transport to the disposal site from outside),
- generation of waste, as it is assumed that the National Facility does not generate significant amounts of new radioactive waste (it may generate radioactive “pollution”, however),
- returning radiation sources to other countries, export/import of radioactive wastes or their dumping in the sea,

- open radioactive radiation sources,
- non-ionising radiation,
- notifications, certificates, registers, declaring or reporting that the operator needs to accomplish or information it needs to submit (e.g. on materials), or about otherwise contacting the Norwegian Radiation Protection Authority, police or other authorities, or the public,
- detailed investigations or other actions that should be carried out by the operator in case dose limits are exceeded or in accident situations (if it does not affect facility design),
- obligation to preserve secrecy (confidentiality),
- compensation and insurance (nuclear liability),
- penalties, sanctions, fines, fees, dues, compensation or other payments or confiscation,
- companies' general quality systems, management systems, information systems, cryptosecurity (management systems directly related to disposal facilities are, however, considered),
- who is allowed to do work related to radiation (e.g. a requirement that pregnant women are not), about appointing persons to certain tasks or about which employee is responsible for which task,
- supplier clearance, costs and finances/financial security,
- appendices (or annexes) of regulations (tables of radionuclides, specific activities, etc.), except if key requirements are given in appendices.

Generation, packaging and transport of radioactive waste is discussed in Section 4.1.

Regarding confidentiality, it should be noted that some details of disposal facilities are not public information, but in the regulations this issue was not discussed in detail.

4 Specific issues related to the National Facility development

4.1 Generation, packaging and transport of waste

Above, it is proposed that the packaging and generation of radioactive waste is excluded from the requirements presented in the Excel table. It is planned that low and intermediate level waste will be packaged in an on-site packaging facility, but the Concept Description report (Ikonen et al., 2020) did not include a design for the plant (only an area reservation; Ikonen et al., 2020, Section 5.7), as that was out of the scope of work. The report also concluded that although there might be some minor amounts of radioactive waste produced in this on-site packaging plant, these were not considered to be significant at the concept description stage (Ikonen et al., 2020, Section 2.2.5). Requirements for packaging are included in the table insofar as the waste packages are considered to contribute to the long-term safety of disposal, but no detailed requirements for packaging plants are included.

In case encapsulation (emplacement of e.g. spent fuel in a canister) will be changed to occur at the National Facility site, requirements related to packaging, encapsulation and marking should be included in considerations. The same applies to generation of waste, as there is bound to be at least hot-cell-derived, polluted materials to dismantle after operations. However, at this design phase, these issues were excluded and encapsulation assumed to occur elsewhere.

As for “transport to the disposal site from outside” mentioned to have been excluded, the exclusion applies to transport of nuclear waste, not topics concerned with admitting the waste at the site. However, requirements directly concerned with accepting and receiving the waste at the site were not identified during work. From design perspective, such requirements relate to being able to identify the canisters’ identification markings. Document inspections are not related to the scope of this work, which is on the design of the National Facility.

4.2 Storage of nuclear waste

As for storage of radioactive waste, there will most probably be a short-term storage phase before disposal at the site. This is assumed to be limited from a few hours to several months, depending on the disposal methodology. The disposal operations can be designed for a stepwise process, in which a certain amount of waste is gathered first on site and disposal is carried out as campaigns. Another option is that the waste can be transferred to disposal right after admitting it on site, which limits the holding time at the site as short as possible. The design of operational phase processes will define the exact need for storage. When storage is discussed in requirements, it usually refers to situations such as interim storage for spent fuel, where storage duration is substantially longer (years/tens of years). Requirements related only to those kinds of storages are excluded from the table, but any relating to short holding at the site are included. It is to be noted that safeguards are a strong regulating body that confine the storage phases.

4.3 Safeguards

Any programme needs to consider nuclear material safeguards. A recent IAEA publication was developed to assist facility designers and operators in considering at an early stage the safeguards activities relevant to particular nuclear fuel cycle facility types (IAEA, 2018). Safeguards should be considered early in the design process to minimise the risk of impacts on scope, schedule or budget, and to facilitate better integration with other design considerations such as those relating to operations including retrievability actions as well as safety and security. An international status of safeguards approaches is compiled in Mongiello et al. (2013). From Norwegian regulations, it is a requirement that the licence holder must provide appropriate arrangements for material accounting.

4.4 Reversibility and retrievability

Regarding retrievability, there is no general requirement from the IAEA that the waste should be retrievable, but it is acknowledged that in some cases this may be required or at least discussed. Including the option for reversing the disposal or retrieving the waste after facility closure is not, however, allowed to jeopardise the long-term safety of disposal (cf. SSR-5 (IAEA 2011), paragraph 1.25). By definition, disposal is meant to be final.

Even though there is currently no requirement for retrievability in Norway, it is possible that such a requirement is formulated at some later date. In Finland, retrievability was originally not required and not a design goal, and it became only later necessary to investigate the possibilities to retrieve the spent nuclear fuel (Saanio & Raiko, 1999). On the basis of the plans produced, retrieval of the spent fuel canisters from the repository to ground level was concluded to be possible at every stage of the project. The plan for the repository facilities contained features that made it easier to subsequently retrieve the canisters. The spent fuel is encapsulated in massive copper-iron canisters that are mechanically strong and very long-lasting. The repository facilities will be constructed by excavation into rock, which, according to experience, makes them very long-lasting, and the subsequent opening of the facilities is technically possible (Saanio & Raiko, 1999; Saanio et al., 2013, Section 5.4). These conclusions apply to the KBS-3V concept with short, vertical deposition holes for the canisters.

Reversibility and retrievability was studied considering three different phases: (1) before the closure of the deposition hole, (2) after closure of the deposition tunnel and (3) after closure of all facilities. If required, it is technically possible to retrieve the canisters to the ground level even after the underground disposal facility has been closed. For more detailed plans for this, see Saanio & Raiko (1999) and Saanio et al. (2013, Section 5.4).

In Finland, the Government's decision-in-principle of 21 December 2000 applying to Posiva's disposal project requires, in accordance with the Government's decision 478/1999, that *"…disposal must be designed so that ensuring long-term safety does not require monitoring of the repository site and that the repository can be opened if made appropriate by developing technology."* In accordance with the decision-in-principle, opening the repository means that the retrievability of the canisters from the repository facilities must be technically possible with reasonable resources for so long enough, however, that long-term safety is not compromised (Posiva, 2010, p. 274).

In the construction licence granted to Posiva Oy, there is a licence term stating that Posiva shall deliver an account of the retrievability of the spent nuclear fuel, updated in the context of the operating licence application (Finnish Government 2015). Finnish Radiation and Nuclear Safety Authority (STUK) has stated that facilitation of retrievability may not impair the long-term safety, in their evaluation on Posiva's pre-construction licence application and Posiva's nuclear waste programme 2009 (Posiva, 2010), in a statement to TEM issued on 5th October, 2010. *Reversibility*, i.e. possibility to return the waste to ground surface before the facilities have been closed, is, however, specifically mentioned in STUK's guide YVL D.5, which states that:

- Facilitation of reversibility of waste packages from the emplacement rooms for safety reasons shall be provided for the operating stage of the disposal facility.
- The disposal shall be designed so that the facilitation of reversibility does not compromise long-term safety.
- Reversibility shall not compromise operational safety or long-term safety of other waste disposed of (STUK, 2018, Section 5.5).

5 Conclusions

5.1 Overall conclusions

The Norwegian regulations applying to disposal facilities are currently at a very general level, and there are no specific requirements for the design of disposal facilities or the desired properties of disposal sites. The general requirements for nuclear installations apply, however, also to disposal facilities. Whenever there is an applicable requirement in the Norwegian legislations, it is prioritised in the table over the international requirements. For example, dose limits are mentioned in Norwegian regulations and, therefore, no dose limits or dose constraints given in international documents are listed in the table, although they are referenced in the last column in the context of the equivalent Norwegian regulations.

Organising the requirements in a rough order of priority, i.e. starting with Norwegian regulations, is only one possible way to present the requirements. The requirements could also be shown according to repository type. This can easily be done by using the Filter function. In the future, it may be useful to separate the requirements applying to the different repositories to individual files or sheets, after which it is also possible to re-arrange the requirements based on topic. In this way, similar requirements would be grouped, and repetition would be easier to reduce.

At some point, it is recommended that NND would establish a requirements management system. A requirements management system would help at various licensing stages to show how the regulatory requirements are fulfilled. The requirements in the Excel file would then be directly usable as the highest level of requirements, under which it is possible to formulate lower levels of requirements by NND. A hierarchical requirements management system would allow the long-term safety issues to be followed from the highest-level regulatory requirements all the way to the design solutions.

A requirements management system (for example, see Posiva, 2012a) is also a useful tool in post-closure safety assessment. Long-term safety can be evaluated by studying the fulfilment of safety requirements defined for repository barriers (cf. Posiva, 2013). The initial state of the disposal system would be defined based on lower-level design requirements (cf. Posiva, 2012b) and would form a starting point for the modelling of the repository evolution (Posiva, 2013).

Regulatory requirements are often updated and changed, and new documents replace earlier documents, whereby some requirements in the table become obsolete. It is important to keep the table up to date also in the future.

5.2 The most relevant requirements for the current phase

There are more than 600 requirements in the table, and not all of them are necessary to consider explicitly at the current phase of NND's National Facility project. Many of them apply to the procedures and features of the disposal facility that have been considered in the current conceptual design at a general level and can be designed in detail at a later stage. Thereby, these requirements will not have a direct effect on the current design phase. Also, many requirements apply to safety assessments and safety cases, which will be carried out at a later stage. In the generic safety assessment started in 2021, the general requirements for safety assessments will be considered.

On the other hand, many high-level, general requirements have already been taken into account in the definition of the overall waste management strategy, for example, the selection of geological disposal for high-level radioactive waste and the decision to dispose of all the waste within Norway. What is, however, not yet done and what is, therefore, considered the most important issues for the current phase are planning of a site investigation strategy, setting up of a Quality Management System and related procedures and plans, as well as further development work (e.g. of the design basis).

The requirements that are considered to be the most relevant for *the current phase* of the National Facility project are proposed in Table 5-1. Note that site selection related requirements are not included in the table, as there are about 50 requirements in the Excel file related to the site and since these are already indicated by the word "site" in column F of the Excel table. These site-related requirements should be taken into account in developing the site investigation strategy and the related detailed plans.

Table 5-1. Requirements considered to be the most relevant for the current phase of the National Facility project, excluding site selection related requirements. All regulations, including the quoted ones, are listed at the end of this note.

Document Section/ paragraph	Requirement	Comments
Strålevernforskriften/Regulation on Radiation Protection and Use of Radiation (FOR-2016-12-16-1659)		
Section 30	The undertaking shall classify the workplace as a controlled area if a) employees may be exposed to effective doses above 6 mSv per year, b) equivalent dose to the skin and extremities may exceed 150 mSv per year, or c) equivalent dose to the lens of the eye may exceed 15 mSv per year.	The general design of controlled and supervised areas is assumed relevant at this stage (detailed requirements not included here).
Section 30	The undertaking shall classify the workplace as a supervised area if employees may be exposed to effective doses in excess of 1 mSv per year, or equivalent dose to the skin and extremities may exceed 50 mSv per year.	See above.
Section 30	The undertaking shall ensure that exposed employees outside controlled and supervised area cannot be exposed to radiation doses exceeding 1 mSv per year.	See above.
Section 30	The controlled area shall be physically delimited. If physical delimitation is not possible, it shall be clearly marked by other means.	See above,
Regulation on physical protection of nuclear material and nuclear installations (FOR-1984-11-02-1809)		
Section 14	Class I nuclear material can only be used or stored within a vital area.	Needs to be clarified in terms of the National Facility.
Section 14	Class II nuclear material may be used or stored within a vital or protected area.	See above.
Section 14	Class III nuclear material may be used or stored within a vital, protected or controlled area.	See above.
StrålevernHefte 2018:33/General terms for assessment of applications on license after nuclear energy act		
13.1	The holder shall have and update a waste management programme that documents handling, waste minimization, processing, transport, storage and safeguards of radioactive waste, nuclear waste and used nuclear fuel, including spent nuclear fuel and nuclear waste mixed with other dangerous substances.	Considered relevant in the near future, even though the requirement applies, strictly speaking, to a licence holder.
Avfallsforskriften/Regulation on recycling and treatment of waste (FOR-2004-06-01-930)		
Section 9-6	Only hazardous waste and waste that meets the pollution authority's criteria for disposal of hazardous waste are allowed to be deposited at hazardous waste landfills.	
Section 16-4	Radioactive waste should not be mixed with other waste and various types of radioactive waste should not be mixed if this can lead to a risk of contamination or cause problems for the further handling of the waste.	
Section 17-7	The operations manager shall prepare a waste management plan for minimizing, processing, recycling and disposal of mineral waste based on the principle of sustainable development. The purpose of the plan is to prevent or reduce waste production and its negative environmental consequences, to promote the use of mineral waste if this makes environmental sense and to ensure the safe disposal of mineral waste in the short and long term.	Assuming this refers to the waste to be disposed of in the National Facility (not waste produced during the National

Document Section/ paragraph	Requirement	Comments
		Facility operations).
Section 17-7	The waste management plan shall provide sufficient information so that it is possible for the pollution authority to assess the ability of the operations manager to achieve the objectives of the waste management plan and the obligations in accordance with this chapter. In particular, the plan will explain how the chosen method used for mineral extraction and treatment reduces waste production and its environmental consequences.	See above.
Section 17-7	The waste management plan shall contain at least the following: a) a characterization of the mineral waste in accordance with Annex II to this chapter b) a description of how the environment and human health can be harmed by the disposal of mineral waste c) proposed measures to minimize environmental impact, including measures to prevent water quality deterioration and to prevent or minimize air pollution d) suggestions for monitoring and control procedures e) proposed plan for termination, including rehabilitation f) relevant, proposed plan for post-operation and proposed procedures for monitoring and control after termination.	See above.
INFCIRC/546 (24 December 1997): Joint Convention on the Safety of Spent Fuel Management and Safety of Radioactive Waste Management		
Article 11(i)	Each Contracting Party shall take the appropriate steps to: (i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed.	
Article 14(iii)	Each Contracting Party shall take the appropriate steps to ensure that: (iii) at the design stage, technical provisions for the closure of a disposal facility are prepared.	
Article 14(iv)	Each Contracting Party shall take the appropriate steps to ensure that: (iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.	Additional analysis needed for the deep borehole concept before it can be selected.
SF-1 (IAEA 2006): Fundamental Safety Principles		
3.12	Effective leadership and management for safety must be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risks.	
SSR-5 (IAEA 2011): Disposal of Radioactive Waste		
Requirement 25	Management systems to provide for the assurance of quality shall be applied to all safety related activities, systems and components throughout all the steps of the development and operation of a disposal facility. The level of assurance for each element shall be commensurate with its importance to safety.	
SSG-1 (IAEA 2009): Borehole Disposal Facilities for Radioactive Waste		
4.18	The operator should be responsible for conducting or commissioning the research and development needed to support the feasibility and safety of the facility design. This should include site investigations. The operator also has the responsibility for carrying out or commissioning all the investigations of sites and materials necessary to assess their suitability and to provide data for safety assessments. In the case of borehole disposal facilities, it is envisaged that the designs will rely almost entirely on tried and tested materials and working practices. This will largely confine research to desk studies and will shift the emphasis of the work towards demonstrations of the operability of the design and the suitability of the site.	A similar requirement applying to all repository types is in SSR-5 (IAEA 2011), paragraph 3.13.

Document Section/ paragraph	Requirement	Comments
ICRP Publication 81 (1998): Radiation Protection Recommendations as Applied to the Disposal of Long-lived Solid Radioactive Waste		
67(b)	A comprehensive system of quality assurance should ensure that the repository system is constructed as planned and designed.	
ICRP Publication 122 (2013): Radiological Protection in Geological Disposal of Long-lived Solid Radioactive Waste		
68	The design basis considers a range of incidents, accidents, and natural events, and attempts to ensure that these events are prevented if possible and/or consequences are mitigated.	Design basis work has been partially started in the current project.
87	The general implementation of the Commission's recommendations on the disposal of radioactive waste requires that organisational and managerial structures and processes are put into place, and that technical principles are applied. Organisational structures and processes can differ between countries, but should be based on the principles laid down by the International Atomic Energy Agency in its fundamental safety principles and safety standards on management systems [SF-1 (IAEA 2006), GS-G-3.4 (IAEA 2008)].	
88, 89	The Commission recommends that management principles and requirements should be applied to the disposal system development and implementation process to enhance confidence that the protection of humans and the environment will be ensured for as long as needed. This requires the implementation of a management system that integrates safety, health, environmental, security, quality, and economic elements, with safety being the fundamental principle upon which the management system is based [NEA No. 6182 (OECD/NEA 2007), NEA/RWM/RF(2009)1 (OECD/NEA 2010)].	

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