

Comment Resolution Tables for DS512 “Borehole Disposal Facilities for Radioactive Waste” at Step 8 / 9

Belguim

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer:		Page.... of....					
Country/Organization: Belgium							
Date:							
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	Title	Borehole Disposal facilities for disused Sealed Radioactive Sources	The title does not reflect the types of waste that are considered in the document.	Y			
2.	3.24 - P18	Addition: “Radiation exposure must be kept as low as reasonably achievable, taking economic and social factors into account.”	The guiding principle of radiation safety is “ALARA” This should be emphasized before the limits are given.	Y	Change implemented at para 3.22 because ALARA applies to both the operational period and the post closure period		
3.	5.41 - P44	Replace “take account of probable changes at the site” by “take account of possible changes at the site”.	It is conservative to consider a group living in autarchy even if this not the habit of present day humans and even if this does not seem likely. The amount of water drunk by this group should also be conservative.	Y			

Canada

		Country/Organization: Canada / CNSC / AECL / CNL Deadline Date: January 28, 2022		RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	Title: Borehole Disposal Facilities for Radioactive Waste	For clarity, consider revising the title to reflect the content. For example: 1- Borehole Disposal Facilities: Application to Disused Sealed Radioactive Sources Or 2- Borehole Disposal Facilities for Disused Sealed Radioactive Sources	The content is specific to the Disused Sealed Radioactive Sources (DSRS), while the title is for radioactive waste (in general). The title should be accurately concise, informative, and stand-alone.	Y			
2.	Annexes	For completeness, consider adding an informative Annex III: Example Application of Borehole Design for typical Disused Sealed Radioactive Sources	The example is to illustrate key applicable requirements and how they should be met. The illustration would provide a straightforward scheme for implementation and a guidance for interpretation of the requirements.			Y	The need for such an Annex was not identified or agreed during development of the DPP. The existing draft safety guide already gives very detailed information on the recommended borehole disposal concept and many references to the generic post-closure safety assessment and related IAEA reports, as well as to relevant references to national safety cases for borehole disposal of DSRS.

3.	General	<p>The standard discusses permanent borehole concepts, but silent about the retrievable concept.</p> <p>The regulatory control/infrastructure is important.</p>	<p>The retrievable concept is a viable option (e.g., retrieve and dispose, as needed) for users/countries with a lack of resources and/or limited waste management infrastructure.</p>			Y	<p>This safety guide is focused on permanent disposal rather than temporary storage. The guidance is to avoid shallow borehole storage facilities for DSRS for several reasons, including that high radiation fields associated with some DSRS can lead to the radiolysis of water and the production of nitric and others acids, which are corrosive to waste containers as has been shown by experiences in various Member States.</p>
4.	Page 81, I4(a)	<p>The site should be geomorphologically stable; this is generally consistent with there being an absence of features such as mountainous terrane with steep gradients or areas with active subsidence or landslip.</p> <p>Put the following sentence under I4(c):</p> <p>Processes and events that might affect facility operations also include flooding and necessitate consideration of climate and extreme weather.</p>	<p>Flooding, climate, and extreme weather should be discussed under I4(c) the hydrological and hydrogeological conditions</p>	Y			
5.	Page 82, I4(e)	<p>Suggest changing “geological setting” to “human intrusion” or “natural resources potential”. Rewrite I4(e) focusing on natural resources potential and</p>	<p>Such events and processes as erosion, tectonic uplift, glaciation, and permafrost melting should be part of</p>	Y			

		consequently human intrusion.	geological or geomorphological characteristics. It is confusing to have both “geological setting” and “geology”.				
6.	Page 82, I4(b)	Suggest to discuss in-situ stress in I4(b). for example, Effort should be made to characterize the in-situ stress. Large differential in horizontal stress at depth can be an indicator of potential difficulties in drilling a vertical hole and of borehole instability (e.g., borehole breakouts and/or an enhanced disturbed rock zone around the borehole).	Tectonic events could cause significant change to in-situ stress. For borehole disposal facilities, in-situ stress plays a significant role in drilling and borehole stability.	Y			
7.	1.2, Page 1	This Safety Guide supersedes IAEA Safety Standards Series No. SSG-12. Since SSG-12 was published in December 2009, relevant safety requirements have been revised, and significant further research and development has been conducted on borehole disposal of disused sealed radioactive sources in preparation for its implementation by Member States. In addition, borehole disposal of disused sealed radioactive sources has been licensed in one Member State and pilot borehole disposal projects are underway. Several other Member States are actively interested in developing their own borehole disposal facilities for disused sealed radioactive sources. It is timely, therefore, to provide revised guidance that properly reflects the current safety	Could DS512 please clarify the purpose of the highlighted text? To convincing the public and encourage them to further protect “people and the environment”?	Y			

		standards and the state of knowledge regarding borehole disposal for these types of radioactive waste.					
8.	2.9, Page 5	When planning waste disposal, consideration should be given to the volumes of waste that need to be disposed of and to the volumes of existing and planned disposal facilities, and their capacities and dimensions to safely dispose of receive safely the radioactive waste that needs to be disposal of	The physical dimensions in selecting the waste and its packaging may be considered a critical component in selecting the waste for disposal in the specified borehole disposal facility.	Y			
9.	2.12, Page 6	Concept for borehole disposal of disused sealed radioactive sources. 2.12. A concept for the disposal of disused sealed radioactive sources in boreholes was described in Ref. [14]. The concept was designed to assist IAEA Member States that have hazardous disused sealed radioactive sources in storage,	The concept was designed to assist IAEA Member States that have hazardous disused sealed sources to ensure it is done safely for people and the environment, for the safety of current and future generations.	Y			
10.	3.1, Page 11	3.1. The development, operation, closure, and institutional control of a borehole disposal facility necessitates the assignment of responsibilities among three types of organization: the national government , the appointed regulatory body (or bodies) and the operating organization of the facility. Recommendations on the responsibilities of each of these are provided in this section.	Please consider including all levels of government. Alternatively “Applicable levels of government.”			Y	The IAEA Safety Standards are addressed to nation states and national governments.

11.	3.5 (a), Page 13	Confirm at the national level the need for disposal facilities of the different types of radioactive waste (including where appropriate borehole disposal facilities);	If not already, it may be a consideration to please qualify and specify the scope of the waste being addressed e.g., “radioactive waste” .			Y	The proposed edits would change the wording of what is a quote from part of the Safety Requirement 1 in SSR-5. Footnote 16 addresses the quantity of radioactive waste under consideration.
12.	3.5 (b), Page 17 of 113	(b) Establish or identify legally responsible organizations for the development,	If not already, would it be a consideration for the IAEA to please qualify the recommendation for legally responsible organizations e.g., so that it is more meaningful?	Y			
13.	3.5 (d), Page 14	Ensure the adequate, and legally binding adequacy and security of financial provisions	As per the previous consideration. Would it be possible to please consider recommendations that may encourage the management of the borehole waste reception facility to further protect “people and the environment”?			Y	The proposed edits would go beyond the Safety Requirement 1 in SSR-5.
14.	3.5 (e), Page 14	radioactive waste disposal facilities	Please consider including the disposal facility specified.	Y			
15.	3.5 (f), Page 14	Including passive monitoring and arrangements	If not already, please consider including “passive”.			Y	The existing wording is general and allows for passive and other types of monitoring in accordance with SSG-31.
16.	3.5 (g), Page 14	Establish a competent authority that demonstrates measurable legally binding responsibilities for the effective	If not already, please consider including recommendations that would be more meaningful and encourage			Y	Except in the Transport Regulations (SSR-6 Rev. 1), the Safety Standards use the term

		oversight of...	them to further protect “people and the environment”?				‘regulatory body’ in preference to ‘competent authority’. The other proposed edits would go beyond the Safety Requirement 1 in SSR-5.
17.	3.5 (k), Page 14	Ensure that the necessary scientific and technical and legal expertise is available	If not already, please consider providing recommendations that are more specific and meaningful.			Y	The proposed edits would go beyond the Safety Requirement 1 in SSR-5.
18.	3.6, Page 14	Each applicable level of the governance body should ensure the regulatory body is effectively independent.	Would there be an effective recommendation to measure regulatory capture?	Y	Reference made to GSR Part 1, Requirement 4		
19.	3.7 Page 14	The government should perform effective independent third-party periodic reviews [e.g., that are open to public scrutiny] to evaluate the effectiveness of the regulatory body (or competent authority) and its ability to fulfil its mission.	As referenced in recent media reports. Would there be a need for effective mechanisms to measure regulatory capture?			Y	The good intent of the comment is understood, but the comment would be better addressed at the level of a Safety Requirements Publication (e.g. GSR Part 1) rather than to a Specific Safety Guide such as DS512. Except in the Transport Regulations (SSR-6 Rev. 1), the Safety Standards use the term ‘regulatory body’ in preference to ‘competent authority’.
20.	3.9, Page 15	The regulatory body (or competent authority) should develop and implement an effective process for ...	If not, already, would it be a consideration to please qualify the recommendation to encourage facilities that are recognized as being			Y	Except in the Transport Regulations (SSR-6 Rev. 1), the Safety Standards use the term ‘regulatory body’ in

			transparent and convinced the public of meeting their legal obligations. [e.g., to further protect people and the environment]				preference to 'competent authority'.
21.	3.23 (b), Page 17	Optimization: Requirement 11 of GSR Part 3 [2] states: "The government or the regulatory body shall establish and enforce requirements for adequate the optimization of protection and safety, and registrants and licensees shall ensure that protection and safety meets more stringent national and international standards accepted by the industry "	To please consider more focused language to suggest the recommendations of DS512 may be applied legally.			Y	The edits are to a quote of a safety Requirement. The good intent of the comment is understood, but the comment would be better addressed at the level of a Safety Requirements Publication (e.g. GSR Part 1) rather than to a Specific Safety Guide such as DS512.
22.	3.25, Page 18	The fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation – SSR-5 [4] and this requires the operating organization to site, design, construct, operate and close a disposal facility so that protection after its closure is optimized, social and economic factors being taken into account . Reasonable assurance also has to be provided that doses and risks to members of the public in the long-term will not exceed the dose constraints or risk constraints that were used as design criteria.	Could you please consider, more concise language that may be more focused and clearer to the reader [e.g., with regard acceptable expectations].			Y	The comment is clear but unspecific. The existing text is consistent with the existing safety requirements.
23.	3.41, Page 22	The operating organization should record and retain all information relevant to the safety	Please consider referencing a recognized standard. As a guide: - For details to be retained - For the storage, retention and	Y			

			disposal of the data and information being collected - There also is an obligation for the licensee to verify the data remains current and valid				
24.	3.41, Page 22	all information necessary details for the continued relevant to the safety of the facility	Would it be a consideration to please consider, use of more concise language, that may further help raise the readers awareness to the expectation.	Y	Implemented with slightly revised wording.		
25.	4.1, Page 22	4.1. Principle 5 of SF-1 [1] states that: “Protection must be optimized to provide the highest level of safety that can reasonably be achieved” . Demonstrating that doses and risks will be below the relevant dose and risk criteria set by the regulatory body is a necessary, but not sufficient objective.	Would it be a consideration to please include? To demonstrate that “duty of care” had been exercised by management to verify the highest levels of safety protection that can reasonably be achieved.	Y	References added to need for effective leadership for safety, culture for safety and management systems [GSG-16].		
26.	4.1, Page 22	Decisions on whether protection has been optimized will be judgmental because of the needs to consider what is reasonable and to balance information on a wide range of quantitative and qualitative factors, including present-day and potential future doses and risks, costs, uncertainties, and the views of interested parties.	Is it possible this may be considered encouraging further unnecessary debate? The objective of this guide is to provide recommendations and guidance on the development ...to fulfil the safety principles and requirements in the IAEA Safety Standards...NO.SF-1...No. GSR Part 3...GSR Part 5...			Y	The comment is clear but unspecific. The existing text is consistent with the existing safety requirements.
27.	4.2, Page 23	The operating organization should consider the following in optimizing protection at a borehole disposal facility:	Could you please consider including? (a) Verify that management demonstrates “duty of care” had been exercised in the roles and responsibilities of their designated positions. To verify	Y	References added to need for effective leadership for safety, culture for safety and management		

			the highest levels of safety and protection of people and the environment.		systems [GSG-16] at para 4.1.		
28.	4.3, Page 23	The operating organization should consider using a software tool such as, SIMBOD , to help refine plans for the placement of sources into disposal capsules and containers; SIMBOD is described in Ref. [37].	Given advancements in AI and Machine learning, it is very possible this recommendation may be considered dated before publication of DS512. Could you please consider including recommendations that are current and valid when this document is released for publication?	Y	The safety guide will continue to be updated until its publication.		
29.	4.43, Page 23	The operating organization should engage with the regulatory body and the public at the start of the development process in order that there is clarity on the direction of the disposal programme and to facilitate legitimate decision making.	Likewise, there should be a similar obligation to ensure there is a similar commitment from the management of the regulatory body. That the necessary expertise and resources are available to effectively meet their oversight obligations.	Y	Interested parties is broader than the public.		
30.	5.6, Page 34	For a small borehole disposal facility,	Would it be a consideration to please clarify, what does small signify and refer too? Would it be the diameter, depth, or the quantity of waste? As referenced in 1.t: The purpose of this document as stated in the scope of DS512 is for narrow diameter boreholes.	Y	Text revised to avoid the term 'small borehole disposal facility'. See new Footnote 2.		
31.	5.14, Page 36	The operating organization should establish and lead a programme of dialogue with interested parties on the disposal facility. This programme of dialogue should be designed to further enhance Trust and Transparency in the operating organization and the regulatory	Would it be a consideration to please include the specific reference.	Y			

		authorities.					
32.	5.50, Page 47	The operating organization should present in the safety case documents arguments, reasoning and supporting evidence (models, parameters, data) in a convincing, traceable and transparent way. The operating organization should prepare the safety case and safety assessment documentation to facilitate understanding of the disposal system and its behaviour and performance, of the models, data and assumptions used in safety assessment, and of the basis for and veracity of the arguments that show that the facility is or will be safe.	<p>Could the publication please consider referencing a standard that may be acceptable to public scrutiny?</p> <p>That may further help convince public opinion of the effectiveness of the performance of the management systems.</p>	Y			
33.	5.53, Page 48	Safety cases for near surface or geological disposal facility are typically developed gradually over a period of several years or more throughout the step by step facility development process. In contrast, the potentially short period between construction and closure at a	<p>Please clarify the rational in referencing a small borehole disposal facility.</p> <p>Would referencing “a small borehole” imply that DS512 will also be addressing</p>	Y	See Footnote 11		

		<p>small borehole disposal facility means that the operating organization should make the safety case documentation as complete and as detailed as reasonably possible at the time of applying for authorization of construction.</p>	<p>medium and large waste reception facilities in this publication?</p> <p>The scope of DS512 states this document addresses narrow diameter boreholes?</p>				
34.	6.9, Page 51	<p>for conducting the activities safely and effectively.</p> <p>The training should provide staff with a high degree of awareness of the design features of the facilities and activities that are safety significant. In further preventing unexpected occurrences and accepted as having effective mechanisms in place to adequately protect people and the environment.</p>	<p>Would it be a consideration to please include the highlighted clarification.</p>	Y	Implemented with minor wording changes		
35.	6.10, Page 52	<p>detection and prevention of unexpected events and accidents</p>	<p>Would it be a consideration to please include “prevention” as mitigation may be perceived as actions taken after an unplanned event had occurred.</p>	Y			
36.	6.62, Page 64	<p>The details as included in this section may be considered basic. It may further raise public concerns as to the adequacy of the effectiveness of safety of the regulatory controls in place e.g., to verify the criteria for management of a bore hole waste reception facility has the</p>	<p>If not already, please consider reviewing to identify the purpose and the audience DS512 had been designed for? Please consider including a welding standard. This may leave the reader questioning the adequacy of the regulatory</p>			Y	<p>The list is not intended to be exhaustive or prescriptive. Assurance of all the technical items mentioned should be addressed in the safety case for the facility and the regulatory body can establish WAC at any</p>

		necessary capability and qualifications.	controls and standards in place to ensure chemical constituents do not interact to emit a gas. Prevents the release of gases from waste packages and the adequacy of the standard and controls on packaging.				level of detail and prescriptiveness that it considers appropriate, given the national legal and regulatory framework and the regulatory approach. Welding is addressed at 6.62(f) and the procedures for the operation of the MHC and MTKF include more detailed reference to welding standards.
37.	6.69, Page 67	In borehole disposal facilities where different types of waste are to be disposed of, it is sometimes suggested that waste packages containing high-activity or long-lived waste should be placed in the bottom part of the disposal zone and waste packages containing low activity short-lived radionuclides at the top of the disposal zone.	Similar, to the considerations provided for section 6.62 above. The details included in this section may be considered basic. It may further raise public concerns as to the adequacy and effectiveness of safety and the regulatory controls in place e.g., to verify the criteria for management of a bore hole waste reception facility has the necessary capability and qualifications.			Y	The guidance is not intended to be prescriptive. It is the responsibility of the operating organization to develop a convincing site-specific safety case that demonstrates safety and optimization.
38.	7.40, Page 71	The regulatory body should review the operating organization's management system and audit its application to activities related to the predisposal management and disposal of radioactive waste. In the case of the borehole disposal system described in Section 2, key areas include:	This statement further leaves the reader with the perception that the basis of the regulatory controls in place for the minimum criteria and qualifications for selecting the operating organization's management may be considered less than adequate . As the IAEA is aware, integrity of the system can			Y	Comment unclear and unspecific.

			only be as good as the weakest link.				
39.	6.62 (i), Page 64	Limits to prevent the release of gasses from waste packages;	Additional considerations: The management of the facility would need to verify the welders are certified . To ensure the welding on the disposal capsule is indeed watertight and gas tight. If not already, please consider referencing a recognized standard.			Y	The operating organization is required to ensure that all staff (including welders) are SQEP – see GSR Part 2 and GSG-16, the requirements need not be repeated here. See also response to comment 36.
40.	I.31, Page 89	The operating organization should in the drilling procedures instruct drillers to record water strikes, water yields, drilling speeds, fractures, and any unexpected events such as the loss of compression air	<p>Could you please clarify is there a need for DS512 to also include drilling safety and instructions?</p> <p>Would this be considered outside the scope, micromanaging, and raising concerns as to the adequacy of the Management of the “Borehole Disposal Facility for Radioactive Waste”?</p> <p>As the IAEA is aware, it is always more about what is not said or included in the safety instructions [about drilling] that may be considered a cause of concern and legal liability.</p> <p>Table A2. Includes details that may be considered outside the scope of [DS512] e.g., the Management of the “Borehole Disposal Facilities for</p>			Y	<p>DS152 and all IAEA Safety Standards address radiological safety. In addition, the operating organization will also have to address other relevant issues such as conventional health and safety and other aspects of environmental protection. It is not the role of the IAEA or DS512 to detail these aspects, however.</p> <p>Even if certain technical services are outsourced / sub-contracted, the senior management of the operating organization remains responsible for safety.</p>

			Radioactive Waste” or even the Drilling company. This is a service that is subcontracted by the Drilling company from specialty companies like Schlumberger. RH Well Drilling Inc., Forage Bigras Drilling				
41.	General	If not already, would it be a consideration to please consider including an annex with an estimated inventory of radioactive waste available for disposal in bore holes.				Y	The need for such an Annex was not identified or agreed during development of the DPP. The existing draft safety guide already gives many references to the generic post-closure safety assessment from which it is possible, as a first approximation, to estimate the inventory of radioactive waste that could be safely disposed of in a borehole disposal facility.
42.	1.10	Para 1.10 states ‘It is recognized that radioactive waste disposal is carried out within a wider process that, for example, includes consideration of financial, economic and social issues, as well as issues of conventional safety, security, planning and aspects of environmental protection not related to protection from exposure to ionizing radiation. These ‘wider’ issues are not specifically addressed in this Safety Guide.’	Suggest that where possible, references to where these topics would be covered within IAEA Guidance may be useful to the user, even if cited in Appendix I, 17 Other Factors section. I.e., for social issues, such as public involvement, the new IAEA Guidance ‘NG-G-5.1 Stakeholder Engagement in	Y			

			Nuclear Programmes' might be suitable?				
43.	6.52	Para 6.52 states 'The operating organization should describe in the safety case how the facility is to be commissioned and operated.'	Suggest also be included, or moved to, under Commissioning (6.48) for correct order of events.	Y			
44.	7.11	Para 7.11 discusses retrieval of waste, if required.	However, disposal is defined as 'the emplacement of waste in an appropriate facility without the intention of retrieval'. Therefore, is it assumed that the capability to retrieve the waste is available (even if this is just a requirement during pre-closure)? If so, suggest this should be more clearly stated.	Y	It is not assumed that the operating organization has to have the capability to retrieve the waste available. Footnote added for clarity.		
45.	1.4, objective	"small amounts of low level waste and intermediate level waste"	Is "small amount" defined anywhere? Also important to note that the scope document doesn't include the "small amount" caveat. This comment applies everywhere else in the document that says "small amounts"	Y	A proposed definition for this safety guide of 'small amount' was given in Footnote 16 "less than ~1 m ³ ; small enough that it could be disposed of in the borehole within just a few disposal containers". This footnote has been moved to the beginning of the document (as Footnote 2) to provide the reader with more immediate understanding.		

					Deleting the words 'small amounts of' would be too large a change to the objective and scope of the guide.		
46.	1.6	<p>Section 1.1 says, “The radioactive waste considered in this Safety Guide comprises disused sealed radioactive sources that have been declared radioactive waste, and low-level waste and intermediate-level waste generated during their management.”</p> <p>Section 1.6 says, “This Safety Guide does not provide recommendations and guidance on the predisposal management or disposal of other radioactive waste; in particular high-level waste is not addressed”.</p>	It highlights high-level waste, which is typically nuclear fuel, as being out of scope but it does not say that other low-level and intermediate-level waste that are not generated during the management of sealed sources are also out of the scope. Consider clarifying.	Y			
47.	2.6, first sentence	A borehole disposal facility at a specific site should include one or more boreholes	<p>This sentence is not needed — obviously, a borehole disposal facility includes one or more boreholes.</p> <p>If you want to keep the sentence, remove the word “should”.</p>	Y			
48.	2.6	“The number of boreholes and the depths of waste disposal should be determined by taking into consideration the existing and planned inventory of waste to be disposed of...”	The size of the facility should be commensurate with current & planned inventory of waste.	Y			
49.	2.7	The term “waste package” is used here and throughout. In SSR-6, the term “package” is a well-defined term (excepted package, Type IP, Type A,	I suggest using a different term than “package” in DS512 or indicating that the term is not used in the same context as in SSR-6.			Y	In this safety guide we do not use the term ‘package’, but we do use the term ‘waste package’. The term

		Type B, etc) and is subject to specific regulatory requirements.					‘waste package’ is a well-defined term. The IAEA Safety Glossary defines ‘waste package’ as <i>‘The product of conditioning that includes the waste form and any container(s) and internal barriers (e.g. absorbing materials and liner), as prepared in accordance with requirements for handling, transport, storage and/or disposal’</i> .
50.	2	<p>“BOREHOLE DISPOSAL OF DISUSED SEALED RADIOACTIVE SOURCES”</p> <p>Although the title of the document is generic to disposal facilities for radioactive waste, section 2 (and onward) focuses on disused sealed radioactive sources that have been declared as waste. However, not all Member States will have integrated the concept of “disused sources” in their regulatory framework.</p>	I suggest adding something to the effect that the information provided in the document is also applicable to “sealed radioactive sources that have been declared as waste.”	Y	In response to this comment and comments from other member states we have revised the title and text to make this point clearer.		
51.	2.14	“...disused sealed radioactive sources should be placed inside a 3 mm-thick stainless steel disposal capsule...”	<p>Is the same process used for low- and intermediate-level waste? This section only refers to the disused sealed sources.</p> <p>Other sections also only refer to disused sources.</p>	Y			
52.	2.14	Is paragraph 2.14 describing what constitutes a “waste package” for sealed sources that have been declared as waste	I suggest clarifying what constitutes a “waste package” versus a “disposal container”	Y	The waste package is <i>‘The product of conditioning that</i>		

		(i.e. is the “waste package” the same as the “disposal container”)?	and a “waste container”. I recommend deleting the terms that can be used interchangeably so that there is consistency in terminology throughout.		<i>includes the waste form and any container(s) and internal barriers (e.g. absorbing materials and liner), as prepared in accordance with requirements for handling, transport, storage and/or disposal’</i> . The waste container is a component of the waste package. We have revised the text to avoid the unnecessary term disposal container’.		
53.	2.14	“The weld should be tested for leaks.”	Consider providing guidance on the type of test and its associated acceptance criteria.	Y	Reference added.		
54.	2.18	“... so that the borehole is undetectable without specialist equipment.”	Should it be “special” equipment, instead of “specialist”? And I’m assuming there’s a security reason for not wanting to provide examples of such “special equipment”?	Y			
55.	2.21	“It is convenient to identify...”	Need to correct the typo.	Y			
56.	3.25	“Reasonable assurance...”	Again, what is reasonable in one Member State may not be reasonable in another member state. I recommend removing the word “reasonable”.			Y	The text is consistent with para. 2.15 of the Specific safety Requirement, SSR-5
57.	3.33 (a)	“Manufacturer, serial number and the dates of manufacture, import (if applicable) and receipt by the operating organization;”	Why is the import date relevant? It could represent undue burden since this information could be difficult	Y	Text clarified		

			to find, especially in cases where the source has gone through multiple users during the course of its working life. If it is deemed as relevant information, I suggest adding “if applicable” as there can be cases where the source has never been imported.				
58.	3.33 (a)	“Manufacturer, source model , serial number and the dates of manufacture, import and receipt by the operating organization;”	Source model can a useful identifier.	Y			
59.	3.33 (b)	Delete this text	Unclear to me why this is relevant for disposal purposes. I also question the need for part (a) of this section as well other than the date of receipt...			Y	This information can be useful if trying to obtain more information on the disused source.
60.	3.34		I think it is unreasonable to request that the operating organization consult with these groups to fill gaps in information with limited added value. Possibly for any gaps in 3.32 information however they should not be accepting any waste that does not include that information.	Y	Have revised the text to focus on filling ‘significant gaps’ rather than any gaps in information.		

61.	3.41	“The operating organization should record and retain all information relevant...”	Consider adding a time period for record retention.			Y	The time period will depend on the situation, and it is the operating organization’s responsibility to assess that and agree a reasonable timeframe for records retention with the regulatory body.
62.	3.35, 6.60, 6.61	“...for producing waste packages suitable for disposal...”	Just a question—has any consideration been given to certifying these waste packages much like is done for transport packages?	Y	Yes, it has been considered and some moves towards standardization (e.g. of capsules) have been made, but the waste packages have to function in the environment potentially for long periods and this has to be addressed in the safety case rather than by relying on a standard waste package. Further R&D is possible, but this would be quite a fundamental change in the approach to waste disposal.		
63.	4.3	The operating organization should in general avoid mixing dissimilar sources (such as those containing short-lived radionuclides and those containing long-lived radionuclides) in disposal capsules and containers.	Question—why is this important? The intent is that boreholes will be sealed “forever” and will not be opened for sending sources to regular waste when decayed...	Y	Text deleted		

64.	6.34	“The operating organization is required to use a multiple safety function approach”	Most other paragraphs use “should” statements; was the use of “required” intentional here?	Y	‘is required to’ is used when referring in a safety guide to a formal safety requirement. This is done to avoid an inadvertent watering down of a requirement to a recommendation (following a ‘should’ statement).		
65.	6.65	The operating organization should make use of the national register of radioactive sources – see RS-G-1.9 [21] – to fill gaps in inventory information.	Not sure of the relevance of the reference to this point....RS-G-1.9 is related to Categorization of Sources and not the maintenance of a national registry.	Y	RS-G-1.9 is the correct reference – it refers to the need to maintain a source register of sources.		
66.	6.71		Is there any labelling requirements identifying the top of the borehole once sealed (even if it is covered with native soil)?	Y	There are no requirements or recommendations for labelling of the top of the disposal borehole.		
67.	References	Ref [11]: instead of referring to the 2018 edition of SSR-6, make it an ambulatory reference (“as amended from time to time”).	The reference to SSR-6 in the safety guide will always be current.			Y	This would go against IAEA editorial rules.

Germany

Note: Blue parts are those to be added in the text. ~~Red parts~~ are those to be deleted in the text.

COMMENTS BY REVIEWER					RESOLUTION			
Reviewer: Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) (with comments of GRS and BASE) Page 1 of 2 Country/Organization: Germany Date: 2022-01-27								
Relevance	Com ment No.	Para/ Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejec tion
3	1	2.5	Borehole disposal offers flexibility concerning the possible depth of waste disposal; the range of depths that may be accessed by boreholes can reach from the surface (but see paras 4.33 to 4.36) down to and beyond the depths typically associated with geological disposal facilities – see SSR-5 [4].	Style.	Y			
2	2	2.7	The size of the waste packages for disposal should be compatible with the diameter of the borehole and the length <u>size</u> of the disused sealed radioactive sources.	Clarification.	Y			
3	3	2.10	The operating organization should optimize the design <u>of</u> a borehole disposal facility so that in combination with appropriate facility siting	Wording.	Y			
3	4	4.25	The operating organization should design the disposal system so that the number and complexity of the barriers and safety functions is <u>are</u> in accordance with the hazards associated with the waste.	Wording.	Y			
2	5	5.56	The Level 2 documents supporting the synthesis should address the main components of the safety case, as illustrated in Fig. 3- <u>FIG.6.</u>	Wrong reference.	Y			
3	6	6.59	The operating organization should use the waste acceptance criteria to control the types <u>and</u> amounts of waste that are disposed of in the disposal facility.	Missing word.	Y			
2	7	8.6(b)	Second, if satisfactory protection is not provided, to inform <u>perform</u> a judgement on whether it is justified to take remedial action to upgrade the safety of the facility, for example, by adding further physical and or administrative protection or by retrieving the waste.	A judgement should be performed rather than informed.	Y	Wording revised		

Hungary

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Levente Gazdag		Page 1 of 1					
Country/ Organization: Hungarian Atomic Energy Authority		Date: 10. January 2022					
Comment No.	Para/ Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1/3	3.24	<p>“For occupational exposure of workers over the age of 18 years, the dose limits are:</p> <p>(a) an effective dose of 20 mSv per year averaged over five consecutive years (100 mSv in 5 years) <i>but 50 mSv in a year at most if the worker has not been received significant exposure in the preceding and the following year.</i>”</p>	The division of maximum occupational exposure is required.			Y	The comment is suggesting a change to text quoted from GSR Part 3 and so we cannot accept the change here.
2/3	4.14	<p><i>(f) The borehole disposal facility preferred to be located on permanent state owned land. Any agricultural, industrial or land development are unadvisable after the restoration procedure.</i></p>	The purpose of amendment is the long-term approach to achieve the maximum safety on that area where the borehole disposal facility is constructed. 7.15 and 7.19 points are also concerned.			Y	The comment is understood, but it would be too prescriptive to recommend that the facility should be sited on state owned land. Having said that, land ownership is addressed in bullet point (e).
3/3	6.67	<p><i>The operating organization should ensure that waste packages are emplaced by embedding in concrete surrounding can not be damaged in case of static vertical load effects in the total height of storage place. Safe resistance needs to be ensured against the vertical and lateral loads of borehole lining. During the planning process also the multidirectional shear force on the bore must also be taken into consideration.</i></p>	Additional criteria are highlighted.	Y	With some re-wording.		

India

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer : INDIA Country/Organization : India/AERB				Date: 25-01-2022			
S.No.	Page No. / Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification / Rejection
1.	Page No.21/3.36/ Line No.3	The operating organization is responsible for safety throughout all of the activities and should ensure that the activities are optimized and performed by suitably qualified and experienced personnel that who have been trained in the procedures to be followed.	To bring clarity and to bring the intended meaning the sentence may be corrected.	Y			
2.	Page no. 24/4.8	In developing a borehole disposal facility, the operating organization should address questions such as the following: a) What is the type and amount of radioactive waste, its potential hazard over time? b) Where should the facility be sited? c) How can the facility layout be designed to take advantage of the natural characteristics and barrier potential of the host environment? d) How should predisposal waste management operations be performed? e) How many boreholes should be constructed? f) In what depth range should waste be disposed of? g) What type of borehole casing should be used? h) What materials should be used as engineered barriers? i) What institutional controls should be put in place? j) What will be the expected/required duration and frequency of monitoring?	As type, activity (e.g. high activity-long lived and low activity –short lived) and expected lifetime for monitoring are prime aspect for developing a borehole disposal facility. Suggested text may be added.	Y			
3.	Page No.47/5.50/ Line 1	The operating organization should present in the safety case documents pertaining to arguments, reasoning and supporting evidence (models, parameters, data) in a convincing, traceable and transparent way	To bring clarity to the sentence, suggested text may be added.	Y	With minor re-wording		
Note: The proposed additions are made in Red Color in Bold font with yellow highlight. The proposed deletion is kept in Red Color with Red-strikethrough.							

Indonesia

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Page 1 of 6 Country/Organization: Indonesia Date: 19 Nov. 21							
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification /rejection
1.	Para 3.4/ line 5	... development, operation, closure and institutional control and supervise of the facility	Term of supervise provides a comprehensive meaning which includes regulatory body tasks on licensing and inspection.			Y	The regulation of the facility is already mentioned in the sentence before the list of steps.
2.	Para 3.12/ line 6	all of its steps (i.e. siting, design, construction, commissioning, operation, closure ...	Searching and constructing site and create design of borehole facility needs a big amount of financial support.			Y	The regulatory body authorizes facilities and activities involving the use of radioactive materials and waste, whereas siting and design of disposal facilities are not necessarily authorized in the same way (under the same legislation) and can be undertaken by the operating organization at its own risk.
3.	Para 3.7/ line 7	The involvement of high capability, trusted and supportive interested parties ...	The interest party should be a person who deserves respect.			Y	The proposed change to limit the range of interested parties involved would not be consistent with the Safety Standards.
4.	Para 3.16/ line 5	The operating organization has the necessary competences and resources (including financial)	Financial aspect should be emphasized because the borehole related activity needs a lot of budgets to realize.	Y			

5.	Para 3.32/ line 7	(c) The size of the sources to be disposed (at least if not applicable);	It may difficult for operating organization to measure the size of the sources after dismantling, especially for high activity sources.	Y	The words 'at least' have been deleted.		
6.	Para 3.32/ line 9	(e) The physical and chemical form of the sources and materials of the containers.	The container shape of DSRS are varies and sometimes there are no information about the dimension size of the containers or the thickness.	Y	The words 'at least' have been deleted.		
7.	Para 4.3/ Line 5	The operating organization should implement information system for borehole disposal, for example: SIMBOD , to help refine plans for the placement of sources into disposal capsules and containers; SIMBOD is described in Ref. [37].	Emphasize the implementation of information system, not only SIMBOD if any.	Y			
8.	Para 4.14/line 21	...radionuclides and external events ;	The structures, systems and components of the facility should also be designed to avoid or reduce the effect of external events such as earthquake, flooding, etc.	Y	Text generalised		

9.	Para 4.14/ subsection additional	e) f) provide instruments to monitor environment condition of disposal facility using real time or incidental approach	Instruments to monitor the environmental conditions is important to guarantee the safety of facility.			Y	The safety of the facility cannot <u>rely</u> on monitoring which is why monitoring is not addressed in Section 4. Monitoring is, however, addressed as an Assurance Measure in Section 7.
10.	Para 4.21/ subsection additional	d) ----- e) provide assurance that the public is protected from the effects of radiation even if a catastrophic event occurs at the facility	Assurance that the public is always be protected from the effects of radiation even if a catastrophic event occurs should be set up at the facility.	Y	The words 'safe and' have been added into bullet point (c) which addresses 'events'.		
11.	Para 4.22/ line 2	... appropriate related, for example, to defence in depth, engineered safety features , multiple lines of reasoning, institutional control,	Engineered safety features is important to be implemented cope with defence in depth principle to assure the safety of facility.	Y			
12.	Para 4.36/ line 6	... operating organization should locate the disposal zone(s) in a borehole disposal facility below 100 at depths greater than 100 m (Annex II).	More clarity, to avoid misinterpretation. Below 100 m may be interpreted as less than 100 m.	Y			

13.	Para 7.3	<p>Guidance on monitoring of near surface and geological disposal facilities (and disposal facilities for waste from mining and mineral processing) is provided in SSG-31 [36]. Monitoring programmes at borehole disposal facilities developed, as recommended, with disposal zones at depths greater than 100 m should have many characteristics that are similar to those for monitoring programmes at geological disposal facilities.</p>	<p>How about borehole disposal with disposal zone <100 m? Will be also similar with geological disposal facilities?</p> <p>There is lack of guidance on monitoring of borehole disposal with disposal zone at depths less than 100 m.</p> <p>Need to be completed with guidance of monitoring for borehole disposal with disposal zone at depths less than 100 m.</p>	Y	The text has been revised due to this comment and those from other MS.		
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14.	Para 7.19	<p>The safety of borehole disposal facilities in which waste has been disposed of at depths greater than 100 m should not depend on active institutional controls and, depending on the safety case, quite short periods of post-closure active institutional control could be justifiable. In such cases it might be possible to convert the disposal site to other uses in just a few years, possibly with some ongoing passive institutional controls, e.g., on land ownership.</p>	<p>There is lack of guidance on dependency on active institutional control of borehole disposal with disposal zone at depths less than 100 m.</p> <p>How about borehole disposal with disposal zone <100 m? Will should not depend on active institutional controls also?</p> <p>Need to be completed with guidance on dependency on active institutional control of borehole disposal with disposal zone at depths less than 100 m.</p>	Y	A new sentence to address the logical gap has been added.		
15.	Appendix I.2	<p>When selecting a site for a disposal facility, the recommended approach is to select a site at which a safe facility can be developed rather than, for example, trying to identify a conceptual ‘best’ or ‘safest’ site. But it will be the best if the best or safest site could be found and used.</p>	<p>Site selection is an effort to select the best or the safest site or to select a site at which a safe facility can be developed</p>			Y	<p>All that is required for safety is a site at which the combination of the characteristics of the waste, the site, and the various barriers are such that an acceptable safety case can be made. There could also be great (philosophical and other) difficulties in finding the ‘best’ site.</p>
16.	Annex II.5/ line 3	<p>... this publication recommends borehole disposal at below depths greater than 100 m to increase ...</p>	<p>More clarity, to avoid misinterpretation. Below 100 m may be interpreted as less than 100 m.</p>	Y			

Israel

COMMENTS BY REVIEWERS				RESOLUTION			
Reviewers: Daniela Rokita, Sivan Shenhar Horesh and Meir Markovits Page 1 of 3 Country/Organization: ISRAEL, Nuclear Licensing and Safety Office, IAEC Date: January 16, 2022							
Comment No.	Paragraph/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	2.6 and 2.7	We suggest to consider rephrasing " should " in: <i>A borehole disposal facility at a specific site <u>should</u> include one or more boreholes</i> and in: <i>The waste package <u>should</u> include one or more waste containers.</i>	Clarity	Y			
2	3.13	Using the word can seems to be more suitable.	Completeness	Y			
3	3.26 d 3.26 e 3.26 f and also 8.5	<p>We suggest to add at to the last sentence: ...and be commensurate with the scale of the changes/modifications and their potential safety related implications.</p> <p>These paragraphs address the possible annual doses to those living around the borehole sites, caused by inadvertent human intrusion <u>after closure</u>. The dose values (including ranges of 1-20 mSv and annual doses "<i>rising towards 100 mSv</i>") are definitely higher than dose limits for members of the public in regular conditions around an operating nuclear facility. We are aware of the reasoning to accept higher dose limits for the post-closure period of boreholes. We also understand that the argumentations are (to certain extent) based on ICRP-81 recommendations (and later also on ICRP-103). Still, in SSG-1 (which DS512 comes to revise), when addressing this issue, the drafters added the following relevant remark: <i>The</i></p>	<p>Completeness</p> <p>Clarity</p>	Y			

4	4.13, 4.14a and 4.14e	<i>recommendation of ICRP-81 is not accepted by all regulatory bodies.</i> We would like to suggest to add the same remark to DS512. (It could be even more useful and informative for some member states to have a footnote listing examples of representative regulatory bodies which have not accepted that ICRP-81 recommendation – if that information is available).		Y			
5	4.19	In order to clarify that passive means by themselves cannot be sufficient – at least during "initial" periods after closure, we suggest to add to these paragraphs a remark (or a footnote) referring to later parts of the present safety standard, where the issues of active and passive institutional control are explained. For example paragraph 5.37 or paragraph 8.2 which includes the following: <i>...a period of active institutional control possibly lasting several decades to a few centuries...</i> .	Completeness	Y	We decided instead to delete the last sentence of the paragraph		
6	6.32	We suggest to add at the end of the last sentence of this paragraph (<i>...the existence of uncertainties is not a reason for not proceeding...</i>), or as a footnote, some kind of reservation regarding extreme cases in which uncertainties found during development are so severe and significant that a temporary hold, on proceeding to the next step in the development, can be considered.	Clarity	Y			
7	6.35	Example of clay or cement based plugs, tens of meters long, placed in the borehole above the disposal zone - is mentioned in this paragraph, followed by: " <i>Such seals or plugs could also be placed at the bottom of the disposal zone</i> ". We suggest to consider adding (in the text or as a footnote) some general remarks as to when such (or maybe shorter?) bottom plugs can or should be considered (for example following geological findings during drilling the borehole?).	Clarity	Y			
8	6.45 and 6.72	We suggest to consider adding a remark at the end of bullet (a), or refer there to a footnote, saying that if an alternative design has <u>no potential</u> to fulfill the relevant dose and risk criteria – than there is no need to continue to the rest of the bullets regarding that specific design alternative.	Completeness	Y			

9	6.46	It could be helpful to include some short basic reasoning supporting borehole construction method without installing (or removing installed) borehole casing – following the reasoning to use such HDPE casings to full depth (except the plugs area) presented in paragraph 2.13 (and Fig. 1).	Usefulness and Completeness	Y			
10	6.57	It could be very helpful if it will be shortly explained whether the restriction preventing construction of new borehole at a disposal site, if previously built disposal boreholes are not sealed yet, applies also to investigation boreholes: Can <u>investigation</u> boreholes be drilled at the borehole disposal facility while a disposal borehole is not sealed yet?	Completeness	Y	New sentence added to para. 7.22		
11	7.16 and 7.21	Regarding the change control procedures mentioned in this paragraph, we suggest to emphasize the need to involve the regulatory body in changes/modifications with safety implications.	Completeness	Y			
12	8.2	We suggest to consider adding to the bullets of paragraph 7.21 (and 7.16 too) a remark saying that if remedial activity becomes necessary during the passive institutional control – the involvement of the original operator organizations (if they still exists..) could be very effective (retrieving old documentation for example). They are not responsible any more, but they can still assist the Government and/or the regulator.	Clarity	Y			
13	Appendix II Par. II.3	The term " <i>several times or more</i> "...? seems to be somewhat fuzzy in this context.	Completeness	Y			

14	Appendix II Par. II.9 and Par. II.10	<p>The secondary title before paragraph II.3 (<i>Generic safety assessment for disposal of Category 3 to 5 disused sealed radioactive sources and further studies</i>), is somehow incomplete, and may even partly mislead, since the <u>further studies</u> do distinctly address <u>Category 1 and 2 sources</u>. Therefore, we suggest to "expand" that secondary title, just before paragraph II.3 to: <i>Generic safety assessment for disposal of Category 3 to 5 disused sealed radioactive sources and further generic studies of Category 1 and 2 disused sealed radioactive sources</i>, (as it appears before paragraph II.11).</p> <p>We suggest to consider adding a remark (or footnote) saying that extremely low corrosion rates measured for the stainless steel are not necessarily enough for containment over hundreds to thousands of years as mentioned in this paragraph). The quality of the welding (and the purity of the weld materials/electrodes) are crucial in this context. Preferential corrosion of welds is shortly mentioned in paragraph IX2.1.5 of Appendix IX of reference [17] of DS512.</p>	Completeness	Y			
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Japan

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer:		Page.... of....					
Country/Organization: Japan/NRA		Date:					
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	Title	Modify the title to “Borehole Disposal Facilities for Disused Sealed Radioactive Sources and Related Radioactive Wastes.”	<p>Although the secretariat claims that this Safety Guide is not waste specific one but facility and activity one, it addressed disposal facilities specific to disused sealed radioactive sources and related radioactive wastes. And the described features of these facilities are closely related to the characteristics of the wastes. This is obvious from Section 2 which mentions detailed specification. It is also obvious from wider scope including predisposal management, and the topical description such as paras. 7.19, 7.35 and 7.42.</p> <p>Hence the title of this document should include the text “Disused Sealed Radioactive Sources and Related Radioactive Wastes.”</p>	Y			
2	SCOPE 1.6 - 1.11 (pp.2-3)	The characters, such as half-lives, inventories, chemical forms etc. of the target radioactive sources should be described in the scope section.	Since the appropriate depth of borehole facility depends on the half-life and specific radioactivity of the target waste, it is necessary to explain them somewhere.			Y	The scope is clear - it includes all DSRS that have been declared waste.
3	1.7/1 (p.2)	There is a potential to develop safe borehole disposal facilities with various designs and different various methods for conditioning waste for disposal. For example, borehole disposal facilities could include different-various numbers of boreholes and boreholes with different various diameters. Further information on such concepts and facilities is provided in Section 2 and Annex I.	<p>Clarification.</p> <p>The word “different” is used to mean different from a recommended borehole disposal concept before the concept is explained.</p>	Y			

4	2.6 (p.3) 2.13 (p.7) 6.39 (p.60)	These paragraphs refer to “dry” condition. However, it deems difficult to hold the dry condition practically, even if in a limited time period, when the ground water table is high. Hence, some description or relevant references should be added to these paragraphs for further clarity.	Clarification.	Y	A cross reference to more detailed information has been added.		
5	2.12 (p.6)	Add “The recommended concept will give a basic instruction to also countries that do not have extensive nuclear power programmes or large radioactive waste disposal programmes.”	The illustration of the specific specifications is useful for disposal of disused sealed radioactive sources especially in developing countries. The text proposed in the left column should be added to avoid unnecessary reduction of the scope of the design illustrated in after para.2.12.	Y	With some rewording		
6	2.13-2.18 (pp.6-8)	Some evidences regarding the detailed specifications should be added.	Clarification.	Y	References [14], [15], and [16] are now cited immediately before these paragraphs.		
7	2.23/4 (p.9)	...with the requirements for radiation protection and safety of radiation sources – see GSR Part 3	Wording.	Y			
8	3.5(k) (p.14)	(k) → (h)	Editorial.	Y			
9	3.25/2 (p.18)	The fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation – SF-1[1]SSR-5 [4] and SSR-5 [4] this requires the operating organization to site, design, construct, operate and close a disposal facility so that protection after its closure is optimized, social and economic factors being taken into account.	Clarification.	Y			

10	4.3/6 (p.23) 6.28/4 (p.57)	...software tool such as, the IAEA Source Inventory Management for Borehole Disposal (SIMBOD) ,using the IAEA Source Inventory Management for Borehole Disposal (SIMBOD) software – Ref. [37]	Editorial.	Y		
11	4.6/4 (p.24) Annex II (pp.107-108)	... greater than 100 m. ⇒ ...greater than a few tens meters or hundreds meters depending on the characteristics of waste. Also, Annex II should not be the basis for the depth of shallow and deep boreholes.	This guide introduces the depth of greater than 100 m as appropriate borehole depth for the long-lived and high-activity sealed radioactive sources based on the discussion in Annex II and paragraph 5.36. In addition, Annex II is not an integral part of the main text, and it is inconsistent with “a few hundred meters” set for geological disposal in the requirement SSR-5. The isolation of the facility is achieved based on the discussion given in SSR-5. If you want to use “greater than 100m” for recommended borehole depth, much clear reason or evidence should be given. For example, it seems that there is a relationship between the 260mm diameter and 100m depth of the borehole. We don’t think the requirement of the depth can be determined only by the depth of the usages underground. Making the rule for the intermediate depth disposal in Japan, we considered the characteristics of the targeted wastes, features of various types of usages underground, and discussed the appropriate ways to isolate those wastes from such usages. Our conclusion is to combine institutional controls, requirement of depth, requirement of the location where no evident natural resources exists, requirement of maximum radiological inventory in a cell.	Y	We have revised the text in response to this comment and comments from other Member States on this topic (minimum depth). We have made sure the text is consistent with SSR-5 in describing the depths for geological disposal. Experiences in Member States some of which are summarized in Annex II suggest we should recommend a deeper minimum depth for borehole disposal of long-lived and high activity sources, i.e. deeper than ‘a few tens’ of meters. We do not assume a relationship between the 260 mm borehole diameter and 100 m depth of the borehole. Following the recommendations in the safety guide will lead to safe disposal based on a combination of factors	

					(brought together in the safety case) - not only the activity / characteristics of the waste, or the depth of the disposal, but also institutional control, appropriate siting away from resources and aquifers etc.		
12	4.8 (p.24)	Add a following item to this paragraph. (i) How can the quality control be implemented from the predisposal management to the emplacement of waste?	Consistent quality control from the predisposal management to the emplacement of waste is important. Especially, the complicated design of the engineered barriers shown in Figure 1 needs to emphasize the quality control of the work procedure.	Y			
13	4.34 (p.30)	The requirement of para.3.43 of SSR-5 “ <i>for near surface facilities, isolation has to be provided by the location and the design of the disposal facility and by operational and institutional controls</i> ” should be considered in this paragraph or elsewhere.	Consistency with SSR-5.	Y			
14	FIG 2 (p.35)	License termination? → License termination * Add new footnote to this figure as follows; * <i>Depending on the national legislation, the licence may be terminated at the end of the period of active institutional control or at a later time.</i> See para.4.8 of TECDOC-1814.	Clarification. Expression “License termination?” deems not appropriate in the main body of Safety Guide.	Y	Licence termination is now addressed in para 5.5.		
15	6.10/8 (p.52)	...are described in Refs [40] and [41] and in Ref. [22]. → ...are described in Refs [22, 40, 41].	Editorial. To avoid redundancy.	Y	Consistent with IAEA referencing style		

16	6.32/4 (p.59)	Such seals or plugs could also be placed at the bottom of the disposal zone).	Editorial.	Y			
17	6.42 (p.60)	In the context of this paragraph, retrievability should be mentioned.	Clarification.			Y	Section 6 is Approach to development of a borehole disposal facility. Retrieval of disposed waste is addressed in paras 7.11 and 8.6.
18	8.6(b)/3 (p.80)	...further physical and or administrative protection... → ...further physical and / or administrative protection...	Editorial.	Y			

Malaysia

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Please refer to Appendix 1		Page ... of..					
Country / Organization: Malaysia		Date: • 10 January 2022					
		/ Malaysian Nuclear Agency					
Comment No.	Para/ Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for Modification/rejection
1.	Para 2.7 / Line 3	The waste package is the product of waste conditioning <u>process</u> .	<p>According to IAEATECDOC-1515 and Radioactive Waste Management Glossary (2003 Ed.) the waste package refers to 'the product of conditioning that includes the waste form and any container prepared in accordance with the requirements for handling, transport, storage and disposal'. However, the para 2.7 Line 3 defines waste package as one or more waste container.</p> <p>Clarification and clear definition of waste package and waste container. This is important specially to assist regulatory body to understand the technical design. Hence, Nuklear Malaysia would like to propose new text for the Para 2.7 / Line 3</p>			Y	<p>The 2003 Radioactive Waste Management Glossary is no longer current. The current Glossary is the 2018 Safety Glossary.</p> <p>The definition of “waste package” in both the 2003 Radioactive Waste Management Glossary and the 2018 Safety Glossary refer “to any waste container(s)...” i.e. the definition allows for more than one waste container. Neither definition uses the word ‘process’</p>

2	Para 2.7 / Line 4	The borehole <u>may</u> consist one or more waste packages.	Based on the abovementioned definition of waste package derived from the IAEA-TECDOC1515 and Radioactive Waste Management Glossary (2003 Ed.), Nuklear Malaysia would like to propose new text for the Para 2.7 / Line 4			Y	As mentioned above, there should be at least one waste container. IAEA guidance on the use of language in safety guides recommends in favour of 'should' statements and recommends against use of the word 'may' because it might seem that IAEA is giving permission for something.
3	Para 2.13 / Line 2	In the recommended borehole disposal concept, the borehole is assumed to be vertical and straight, and to have a <u>minimum diameter of</u> 260 mm this diameter is large enough to accommodate borehole casing, backfill and reasonably sized waste packages.	Nuklear Malaysia in view that the word "around" is contradict with word "minimum". Around may give meaning that size of the diameter can approximately, while minimum is a definite figure. Therefore, Nuklear Malaysia suggests to delete the word <u>around</u> and suggests text for the Para 2.13 / Line 2	Y			
4	Para 2.16 / Line 5-7	The total length of the disposal zone should depend on the number of waste packages.	Nuklear Malaysia suggests to delete the word <u>around</u> . This is because Nuklear Malaysia in views the total length of the disposal zone does not depend on the host rock characteristics. Hence, Nuklear Malaysia would like to propose new text for the Para 2.16 / Line 5-7			Y	We agree that the total length of the disposal zone should depend on the number of waste packages. If, for example, the thickness of the host rock formation is less than the total length of disposal zone needed, then further boreholes would be needed. This is what is meant by the need to consider the characteristics of the host rocks. The safety guide is written to apply to disposal facilities with one or more disposal boreholes.

5	Para 2.18 / Line 4-7	The borehole section above the deflection plate should be backfilled with concrete to the end of the rock zone. The remaining soil zone above should be filled with local soil so that the borehole is undetectable without specialist equipment.	Nuklear Malaysia suggests that soil zone need to be backfilled with native soil. So, Nuklear Malaysia would like to propose new text for the Para 2.18 / Line 4-7	Y	With minor rewording		
6	Para 2.22 / Line 1	The extent of these activities should reflect the situation in the State and can include the characterization of waste in the country and the definition of the inventory of waste for disposal, disposal site investigation, characterization and selection, site-specific disposal facility design, development of the safe case and security plan, and regulatory review, authorization and <u>construction</u> .	Nuklear Malaysia in view that construction is an integral part of the process. Therefore, Nuklear Malaysia suggests to include word <u>construction</u> in the text of Para 2.22 / Line 1.	Y			
7	Para 4.3./ Line 3-5	The operating organization should in general avoid mixing dissimilar <u>radionuclides</u> in disposal capsules and containers.	Nuklear Malaysia in view that the DSRS will be grouped / categorized by the types of radionuclide, accordingly. Thus, Nuklear Malaysia suggests to replace word sources with radionuclides and delete words (<u>such as those containing shortlived radionuclides and those containing longlived radionuclides</u>). Hence, Nuklear Malaysia would like to propose new text for the Para 4.3. / Line 3-5	Y	In response to this comment and comments from other Member States the text has been deleted.		

	Para 4.26 / Line 8	<u>Waste in solid forms</u> that are insoluble and release radionuclides, only slowly;	Nuklear Malaysia in view that words 'solid waste forms' may lead to confusion with radioactive solid waste. In this regard, Nuklear Malaysia suggest to replace the text with <u>waste in solid form</u>	Y			
8	Para 6.62 / Line 3	The operating organization should consider establishing waste acceptance criteria such as the following: (a) A limitation to accept for disposal only <u>DSRS</u> . (b) A limitation to accept for disposal only waste forms with stable chemical and physical properties (e.g. no putrescible, reactive or explosive materials or waste)	Nuklear Malaysia in view that the WAC listed should only for DSRS because the borehole is designed specifically for the disposal of DSRS. Nuklear Malaysia suggests: (a) to delete word solid waste forms and replaced it with DSRS. (b) to delete word no powders. (c) to delete whole text for (c).	Y	The text has been made more explicitly consistent with the scope of the waste covered in the safety guide. The list of items is not comprehensive and is only for guidance. We would like to retain 'no powders' unless there is a very strong reason for its deletion.		
9	Para 6.73	The operating organization should fill the topsoil zone with native soil so that the precise position of the borehole cannot be determined without specialist equipment.	Nuklear Malaysia in view that it will make sense if native soil is filled throughout the topsoil zone considering gradual erosion and weathering. Hence, Nuklear Malaysia would like to propose new text for the Para 6.73	Y	With minor rewording		
10	Para 6.76	Nuklear Malaysia suggests to delete text (b) and text (h)	Nuklear Malaysia in view that the texts (b) and (h) are not applicable for DSRS and borehole.			Y	The list of items is not comprehensive and is only for guidance. The introduction to the list includes the words 'as appropriate'. Items (b) and (h) could be important at some facilities (e.g. for determining the vertical loads on the waste packages in the borehole).

APPENDIX 1

List of contributors/reviewers

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Russian Federation

COMMENTS BY REVIEWER				RESOLUTION			
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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	1.1	It's proposed to specify what exactly include the radioactive waste generated "during their management".	The scope of the document should be defined precisely. The existing wording «... waste generated during their management» allows for a wide interpretation suggesting no clear definition for the type of RW to be disposed of under this concept.	Y			
2.	1.1	<p><i>«The radioactive waste considered in this Safety Guide comprises disused sealed radioactive sources/ that have been declared radioactive waste, and low level waste and intermediate level waste generated during their management».</i></p> <p>Presumably, the disposal concept presented in DS512 document assumes the disposal of small RW amounts with its application considered feasible for countries with no available regional or centralized RWDF and no plans regarding their future construction.</p> <p>In particular, for such countries as Sweden and Finland with available centralized underground RW disposal facilities it's considered infeasible to dispose of radiation sources attributed to RW category under such a (borehole) concept.</p> <p>We suggest to indicate the target countries which the concept was developed for under the DS512 Scope section.</p>		Y	Added as new para 1.7		

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3.	Para 2.12	It's proposed to mention in chapter «Concept for borehole disposal of disused sealed radioactive sources» that «...the borehole disposal concept was developed as a viable alternative for States that do not have extensive nuclear or large disposal programmes (e.g. for the development of large geological disposal facilities)», see para 1.1.1 of IAEA-TECDOC-1928 «Application of the Graded Approach to Post-closure Safety Assessment for the Disposal of Disused Sealed Radioactive Sources in Boreholes».	In compliance with para 1.1.1 of IAEA-TECDOC-1928.	Y			
	Para 2.13	The cement-based material in the recommended borehole disposal concept comprises principally a sulphate-resistant Portland cement or alumina cement and sand with a maximum particle size of 4 mm.	Addition Alumina cement concretes have a higher density, water resistance and resistance in saline waters than Portland cement.	Y	The cement considered in Tecdocs 1644, 1824 and 1928 and in the recommended concept is an SRPC. We have noted that it is possible for the operator to justify the use of other cements.		
	Para 2.13	According to the safety guide in the borehole disposal concept «the borehole is cased to full depth using high-density polyethylene (HDPE)». It's suggested not to be limited to HDPE but also to have opportunity to use steel casing.	Clarification.	Y	The casing considered in Tecdocs 1644, 1824 and 1928 and in the recommended concept was HDPE, but steel is also discussed. We have noted that it may be possible for the operator to justify the use of other types of casing.		

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	2.13	<p>«...In the concept, the borehole is cased to full depth using high-density polyethylene (HDPE) tubing whose purpose is to facilitate operations such as emplacement of the waste packages into the borehole...»</p> <p>It might be better to say that the casing should withstand the overburden load in the disposal depth interval.</p>	<p>The recommendation suggesting the use of high-density polyethylene as a casing material in borehole disposal facilities seems questionable, since the casing should withstand the overburden load, which can be quite significant at a depth of over 100 m.</p>	Y	<p>We have added the thought the casing should be strong enough to withstand expected vertical (and horizontal loads and shear forces) at para 6.45, which deals with the details of casing.</p>		
	2.13/9	<p>«...The bottom of the casing should be sealed with a cement-based plug, and the gap between the casing and the borehole wall is filled with cement-based backfill ...» –</p> <p>«...the spaces around the waste packages in the borehole should be backfilled using cement-based backfill...» – to be replaced by “...clay-based materials...”</p>	<p>P. 6.70 states that potential backfill materials include mixtures of cement and sand, bentonite, and mixtures of bentonite and sand.</p>	Y	<p>The plug and backfill considered in Teccdocs 1644, 1824 and 1928 and in the recommended concept were cement-based materials. We have noted that it is possible for the operator to justify the use of other materials.</p>		
	2,16/2						
1.	Para 2.14	<p>After <i>The thickness of the weld should be at least as thick as the disposal container walls.</i> to add</p> <p>Other types of certified disposal containers may be used if specified in the acceptance criteria and safety case.</p>	<p>Addition: Paragraph 2.14 gives a special case of the requirements for a capsule and container for disposal</p> <p>In different countries other types of disposal containers may be certified, which differ from those specified in the paragraph.</p> <p>It is possible to use without container borehole disposal of spent sealed radioactive sources in stainless steel cylinders without additional filling (filled with liquid lead)</p>	Y	<p>The capsule and containers considered in Teccdocs 1644, 1824 and 1928 and in the recommended concept were stainless steel and the insert was a cement-based material. We have noted that it may be possible for the operator to justify the use of other materials.</p>		

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2.	2.14	<p>«...In the recommended borehole disposal concept, disused sealed radioactive sources should be placed inside a 3 mm-thick stainless steel disposal capsule which should be closed by welding on a 3 mm-thick stainless steel lid. The weld should be tested for leaks. The thickness of the weld should be at least as thick as the disposal capsule walls...»</p> <p>It seems feasible to allow for the use of a threaded cover fastening possibly involving some soft metal seals.</p>	<p>These are complex and radioactively hazardous operations that are difficult to implement, especially when it comes to Category 1 and 2 sources. For instance, how the tightness of a weld can be checked?</p>	Y	<p>The recommended concept includes welded stainless steel capsules and containers. We have noted that it may be possible for the operator to justify the use of other capsule and container materials and designs.</p>		
3.	Para 2.16	<p>In the recommended borehole disposal concept, the waste packages should be emplaced into the borehole and the spaces around the waste packages in the borehole should be backfilled using cement based backfill.</p>	<p>Clarity</p> <p>It is possible to use other type of backfill, for example bentonite, low-melting metal or polymer materials which are justified in a project.</p>	Y	<p>The backfill considered in Tecdocs 1644, 1824 and 1928 and in the recommended concept is a cement-based material. We have noted that it may be possible for the operator to justify the use of other materials.</p>		
4.	2.17	<p>«...Fig. 1 illustrates a disposal facility for disused sealed radioactive sources with two boreholes; the inset highlights the components present in the disposal zone...»</p> <p>It is proposed to upgrade the design.</p>	<p>It seems difficult to implement this design in practice. It's not clear how the backfilling can be done in presence of centralizers and how to attach the centralizers to the casing.</p>			Y	<p>Various trials and Pilot Projects have been undertaken to demonstrate the feasibility of the recommended design. However, an operating organization can develop and justify its own design. This document provides only non-prescriptive guidance.</p>

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5.	2.17/При с 1 FIG. 1	<p><i>FIG. 1. Main components of a borehole disposal system for disused sealed radioactive sources – modified from Ref.</i></p> <p>The figure should indicate the position of the deflection plate.</p>	<p>P. 2.18 – "...a steel deflection plate should be inserted into the borehole above the waste ..."</p>	Y			
6.	2.17/При с 1 FIG. 1	<p>FIG. 1. Main components of a borehole disposal system for disused sealed radioactive sources – modified from Ref.</p> <p>В тексте п. 2.18 необходимо дать описание и назначение «Центраторов» или исключить их из рисунка.</p> <p>Either P. 2.18 should be supplemented with a description and purpose of <i>centralizers</i> or they should be deleted from the figure.</p>	<p>2.17/При 1 2.17/FIG.1</p>	Y	<p>A description of the purpose of the casing centralizers based on Tecdoc 1644 has been added at para 2.13.</p>		
7.	2.18	<p>«...<i>The borehole above the deflection plate should be backfilled with concrete ...</i>»</p> <p>We propose to change it for "backfilled with clay-based materials..."</p>	<p>P. 6.70 states that potential backfill materials include mixtures of cement and sand, bentonite, and mixtures of bentonite and sand.</p>	Y	<p>The backfill considered in Tecdocs 1644, 1824 and 1928 and in the recommended concept is a cement-based material. We have noted that it may be possible for the operator to justify the use of other (e.g. clay-based) backfill materials.</p>		
8.	2.18	<p>The text below p. 2.18 should be supplemented by one more provision, namely:</p> <p>"The emplacement area envisaged for containers with disused sealed radioactive sources should be at least 20 meters below the lower aquifer, which is especially important in case of boreholes reaching a depth of up to 100 meters."</p>	<p>П. 6.43 P. 6.43</p>	Y	<p>In response to this comment and comments from other Member States we have noted in para 2.3 that waste disposal zones should not be located in an aquifer, and we have provided more detail (e.g. on the separation of the waste from an aquifer) in para 6.43.</p>		

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9.	Paras 2.19-2.25, 5.15 (b), 6.3-6.83	It's proposed to clarify the content of the identified periods in borehole disposal - development, operation, closure, post-closure (e.g. whether such stages as siting, design, construction and commissioning belong to development period).	For clarity and consistency.	Y	SSR-5 indicates that the development of a disposal facility includes site selection and evaluation, and facility design and construction. We have indicated this in the title before para 2.22 and revised the text slightly at para. 5.15.		
10.	2.236	Should be supplemented with relevant clarifications.	It's not clear why waste processing is considered as a function of the organization operating the disposal facility.			Y	Waste processing should be conducted by the appropriate operating organization. The waste processing organization need not be the same as the disposal organization. The IAEA Safety Standards do not specify exactly which organizations are responsible because the arrangements vary between States.
11.	Para 3.35	The operating organization is responsible for processing of the radioactive sources and radioactive waste, for producing waste packages suitable for disposal if it is in accordance with national legislation, and for waste disposal. The text should additionally specify the type of organization it refers to.	Clarity For example, in the Russian Federation the operating organization (the national operator) does not process of the radioactive sources, does not produce waste packages suitable for disposal. There are some special organizations which are responsible for these procedures.			Y	Waste processing should be conducted by the appropriate operating organization. The waste processing organization need not be the same as the disposal organization. The IAEA Safety Standards do not specify exactly which organizations are responsible because the arrangements vary between States.

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			<p>The operating organization is responsible for processing of the radioactive sources and radioactive waste, for producing waste packages suitable for disposal, and for waste disposal. It's not clear which operating organization is referred to. The operator of a disposal facility has no appropriate responsibilities and, moreover, cannot "provide the facilities and equipment necessary".</p>				
12.	4.3	<p>We propose to delete the reference to the specified software and to provide for the RW emplacement procedure under relevant designs.</p>	<p>References to any software should be avoided. The procedure for RW emplacement in RWDF should be considered in the designs, since it constitutes the initial data for the safety assessment.</p>	Y	<p>We have modified the text in response to this comment and comments from other Member States so that the suggestion is only to <u>consider</u> using the IAEA software. It is not mandatory.</p>		
13.	4.3	<p><i>«...The operating organization should in general avoid mixing dissimilar sources (such as those containing short-lived radionuclides and those containing long-lived radionuclides) in disposal capsules and containers....».</i> It's proposed to delete this sentence.</p>	<p>The reasoning behind the following recommendation is not clear: «... in general avoid mixing dissimilar sources (such as those containing short-lived radionuclides and those containing long-lived radionuclides) in disposal capsules and containers....». In fact, it's a big disadvantage in terms of the process cost with no clear safety benefits provided. Similarly, under p. 6.62 (L), p. 6.68.</p>	Y	<p>The text has been deleted</p>		

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14.	Para 4.4 (d)	It's proposed to define the term «closure programmes» since it's only once mentioned in the safety guide and there isn't a definition of the term.	Clarification.	Y	Text revise to clarify – we were not proposing a new term.		
15.	4.6	<p>«...An option for the safe, secure and sustainable management of waste of the types identified in para. 1.1 (including long-lived and high-activity disused sealed radioactive sources and their shielding materials) is isolating the waste from the surface environment in a borehole disposal facility at depths greater than 100 m...»</p> <p>It's proposed either to delete it or to provide appropriate clarifications.</p>	<p>The reasoning behind this recommendation is not clear enough, since HLW are not considered under the scope of the document (see p. 1.6 of DS512). Similarly - see p. 4.14 b), 4.36, 7.35, etc.</p> <p>It's not clear why the depth of over 100 meters is insisted upon. There aren't any explicit arguments for this statement. Why not say 50 or 75 meters?</p>	Y	<p>We have revised the text in response to this comment and other comments from other Member States. We are certainly not insisting on anything, and particularly not on a precise figure – this is a non-prescriptive safety guide. However, arguments relating to the minimum recommended depth some of which are summarized in Annex II do suggest that the recommended minimum depth for the disposal of high activity and long-lived DSRS should be increased from the previously used depth of a few tens of meters (e.g. 30 m) to many tens of meters.</p>		

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16.	4.7	<p>«...Options for the safe, secure and sustainable management of some short-lived disused sealed radioactive sources might be provided by borehole disposal at depths shallower than 100 m or by near surface disposal together with low level waste, but this is conditional on there being sufficient confidence in the ability to maintain effective active institutional control at the disposal facility site until the hazard has reduced to safe levels by radioactive decay. In the case of waste disposal at depths shallower than 100 m, even if the post-closure safety assessment suggests that assessed potential doses and risks will be below relevant dose and risk criteria, this alone might not provide sufficient confidence that the disposal facility will be safe in the long-term (as was noted in para. 4.1). The operating organization should in the safety case complement the results from safety assessment with other types of argument to show that the disposal facility will provide a safe, secure and sustainable (permanent) solution for the waste...»</p> <p>We propose to delete this provision.</p>	<p>The generally accepted long-term safety justification approach is questioned as biased. It's not clear what arguments other than the safety ones might be presented for the justification purposes.</p>			Y	<p>The text does not question the generally accepted long-term safety justification approach. It just points out that there has to be sufficient confidence in the various different parts of the safety case used to justify the safety of disposal, including confidence in the effectiveness of institutional control. The level of confidence in this will vary according to the situation; in some cases (Member States) there might be very high confidence that institutional controls could be effective for a long period while in others there would be almost no confidence.</p>

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17.	4.14. c	<p>«...Keeping the operational period short and avoiding keeping a borehole open for an extended period; this should be achieved by drilling and constructing a borehole and emplacing waste and backfill only when sufficient waste has been collected to allow this sequence of activities to be conducted as a reasonably sized disposal 'campaign' ...»</p> <p>We propose to delete this provision.</p>	<p>No arguments (justifications) were provided to support the statement on keeping short the operational period of a single borehole. No information was provided confirming that, for example, its 5-year long operation would decrease the safety level.</p>			Y	<p>This provision was included in the previous version of the safety guide (SSG-1) and further reasoning for it is included there and at para 6.68 of the updated safety guide (relating to reduces the chances of the borehole remaining open for a long time and degrading or being mismanaged between individual waste emplacement operations). But para 6.68 also allows for continuous operation over a longer period. Again, this safety guide is not prescriptive.</p>

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18.	4.32	<p>«...Some disused sealed radioactive sources generate significant amounts of heat as a result of radioactive decay..., high-activity disused sealed radioactive sources, including heat generation, the emission of neutrons and the radiolysis of water...».</p> <p>Clarifications should be provided.</p>	<p>DS512 P. 4.32 runs counter to p. 1.6, since HLW is not considered under the scope of this document. Therefore, how is it possible to refer to "significant" heat release, neutrons and radiolysis? («...Some disused sealed radioactive sources generate significant amounts of heat as a result of radioactive decay..., <u>high-activity</u> disused sealed radioactive sources, including heat generation, the <u>emission of neutrons</u> and the <u>radiolysis of water...».</u> Similar remark can be made regarding p. 6.31. («...Some disused sealed radioactive sources generate significant amounts of heat as a result of radioactive decay..., <u>high-activity</u> disused sealed radioactive sources, including heat generation, the <u>emission of neutrons</u> and the <u>radiolysis of water...».</u></p>	Y	<p>The intention of the statement in the scope on HLW (para 1.6) is not to exclude high activity disused sealed radioactive sources, but to exclude spent fuel and waste from fuel reprocessing. In addition, Appendix 1 of GSG-1 suggests that even very active (1 PBq) Cs-137 sources would not be classified as HLW. Although some high activity disused sealed radioactive sources do generate heat this does not necessarily preclude their disposal in a borehole disposal facility if the operating organization can make a convincing safety case. We have added a sentence to clarify.</p>		

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19.	4.36	<p>«...For waste that will have significant activity at the end of the period of active institutional control (7.23 to 7.29), but the operating organization has to demonstrate that such facilities would provide sufficient isolation and nuclear security. 14 (e.g. long-lived disused sealed radioactive sources that have been declared waste and intermediate level waste generated during their management), the operating organization should locate the disposal zone(s) in a borehole disposal facility below 100 m (Annex II). Disposal at depths shallower than 100 m could be a safe option for short-lived disused sealed radioactive sources and low level waste that are not subject to safeguards (see paras 7.23 to 7.29), but the operating organization has to demonstrate that such facilities would provide sufficient isolation and nuclear security ..»</p> <p>We propose to review these provisions with an account taken of GSG-1 provisions.</p>	<p>The half-life of radionuclides in a radioactive source is not the only parameter driving the need for its deep disposal.</p>	Y	<p>We agree that half-life is not the only factor to consider, and the text does not only consider half-life. We believe that the text is consistent with GSG-1 as it suggests disposal of LLW in near surface disposal facilities and disposal of high-activity DSRS and waste with significant amounts of long-lived radionuclides at greater depths. Please see also Appendix 5 of SSG-45.</p>		
20.	Para 5.6	<p>It's proposed to define the term «small borehole disposal facility».</p>	<p>Clarification.</p>	Y	<p>In response to this and other comments we have removed the term.</p>		
21.	Para 5.7	<p>It's proposed to move para 5.7 to the subparagraph «Understanding of a disposal facility and confidence in safety» of the Chapter 4.</p>	<p>Clarification.</p>			Y	<p>The focus of that part of Chapter 4 is on understanding the physical disposal system, while the text of 5.7 addresses the preparation of the safety case.</p>

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22.	5.30	<p>«...<i>The operating organization should consider using the tiered assessment approach presented in Ref. [18] to establish the scope, complexity and level of conservatism in post-closure safety assessment:</i></p> <p><i>(a) Tier 1 assessment (least complex, extremely conservative) in which the toxicity of the radionuclide inventory for borehole disposal is assessed;</i></p> <p><i>(b) Tier 2 assessment in which the activity concentrations in the radionuclide inventory for borehole disposal are compared against predefined waste acceptance criteria (e.g. as defined in Ref. [18], for example) and clearance level values as defined in GSR Part 3 [2];</i></p> <p><i>(c) Tier 3 assessment in which the Borehole Disposal Concept Scoping Tool – Ref. [43] is used to perform conservative scoping calculations for borehole disposal;</i></p> <p><i>(d) Tier 4 assessment (less complex, more realistic) in which a screening model is used to assess the performance of the disposal system;</i></p> <p><i>(e) Tier 5 assessment (most complex, more realistic) in which the models developed for the generic safety assessment – Ref. [17] are applied to assess the post-closure performance of the disposal system...»</i></p> <p>It's proposed to consider the opportunities for changing the sequence of actions with an account taken of various factors.</p>	<p>An overly "strict" sequence of approaches is considered for the long-term safety justification purposes. It might appear that not all simplified models are to be developed if transition to more "detailed" ones is already possible.</p>	Y	<p>We have softened the text at paras 5.32 and 5.33. It is not mandatory to use the models in TECDOC-1928 at all and, even if they are used, it is not mandatory to use all of the models in the hierarchy.</p>		

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23.	5.37	«...Where waste has been or is to be placed in boreholes at depths shallower than 100 m, the operating organization should assess inadvertent human intrusion as a probable event...»	It's not quite clear why the event is considered probable given the provisions of the above p. 5.35 (discussing the HU risk reduction with depth). Perhaps a "low probable event" was meant as an initiating event for a low probable alternative scenario, as indicated in paragraph 5.38.	Y	Put simply, if the waste is disposed of nearer the surface, then there is a relatively higher probability of inadvertent human intrusion into the waste. The guidance is to assess the consequences of human intrusion assuming it to be a probable event. We do not claim to know the true probability of human intrusion, but the assessment will allow informed decision making of the suitability of the disposal depth / option. We have added text to clarify.		
24.	5.47	«...the regulatory body should consider requesting the operating organization to undertake assessments of present day and potential future impacts of the facility on flora and fauna, in addition to assessing the environmental impacts of noise, traffic, dust and possibly other factors...» Nationally accepted approaches to environmental impact assessment should be referred to.	Different approaches can be applied under different national legal provisions.	Y			
25.	Para 6.14	It's proposed to add references to paras 6.76, 6.77 in para 6.14: «6.14. The operating organization should keep records of all waste management activities and waste, including records of any waste (see paras 6.76, 6.77) other than disused sealed radioactive sources generated during the management of the sources to be disposed of...».	Clarification.	Y			

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26.	Paras 6.29, 6.30	<p>It's proposed to add a subparagraph «Natural barriers» and include a text as in para 6.29: «disposal zone(s) is (are) located in suitable rocks (those having appropriate mechanical, hydrogeological and hydrogeochemical properties)» in it.</p>	In compliance with para 4.30 SSR-5.	Y			
27.	6.42	<p><i>«...The operating organization should ensure that the construction method is sufficiently flexible for dealing with spatially variable rock conditions. The operating organization should monitor rock conditions during drilling and should take appropriate timely actions to counteract unfavourable conditions (e.g. fracture zones) or unexpected events (e.g. failure of the borehole wall). The operating organization should specify in the construction method means either for remediating marginally unsuitable boreholes or sealing such boreholes without emplacing any waste. The regulatory body should consider whether the safety case adequately describes and justifies measures for sealing 'failed' boreholes (i.e. boreholes where waste emplacement proves to be impracticable). ...»</i></p> <p>It's proposed to soften the wording under the recommendations referring to the decisions made on whether to use or "not to use" some particular boreholes.</p>	National regulations can vary significantly. For example, this provision cannot be implemented under Russian construction practice, since construction activities in Russia are performed according to approved designs and the proposed approach contradicts the Russian building codes.			Y	The guidance is provided under IAEA Safety Requirements.
28.	Para 6.59	<p>It's proposed to add the underlined text: «The operating organization is required to operate a borehole disposal facility in accordance with the limits, controls and conditions specified in the authorization <u>and established in safety case and in operating procedures</u>».</p>	In compliance with para 3.14 SSR-5.	Y	With minor wording improvement		

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29.	Para 6.59	It's proposed to add the underlined text: «The operating organization should use the waste acceptance criteria to control the types, amounts <u>and characteristics</u> of waste that are disposed of in the disposal facility».	Waste acceptance criteria specify the radiological, mechanical, physical, chemical and biological characteristics of waste packages.	Y			
30.	Para 6.60	The operating organization should, therefore, develop specifications that the waste package have to fulfil <u>meet</u> .	Editorial remark.	Y			
31.	Para 6.61	When designing a waste package for borehole disposal, the operating organization should consider all of the activities to be performed... should be considered.	Designing of a waste package could be responsibility not only of operating organization but of designers.			Y	The IAEA Safety Standards recognize three types of organization – Government, the Regulatory Body and Operating Organizations. The Operating organization is ultimately responsible for the work of any designers it uses.
32.	Para 6.62 (m)	It's proposed to delete the following phrase from the text: «Controls on the location (e.g. depth, spacing) of the emplacement of certain waste packages within disposal boreholes;».-	Controls on the location of waste package aren't WAC.	Y	The text has been deleted from para 6.62 and the idea has been moved to para. 6.69 which discusses waste emplacement strategies.		
33.	Para 6.62 (i)	It is necessary to clarify the term «limits to prevent the release of gases from waste packages»	For clarification.	Y			
34.	Para 6.66	The operating organization should inform the regulatory body in a timely manner of waste packages that do not conform with the waste acceptance criteria if it is in accordance with national legislation.	Clarity	Y			

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Page 1 of 3 Country/Organization: Russian Federation/State Atomic Energy Corporation ROSATOM Date: 27/12/2021							
35.	Para 6.67	Pilot studies for the disposal concept described in paras 2.12 to 2.18 have found it more effective, in terms of avoiding the formation of unwanted voids in the disposal zone, to emplace each waste package into a measured amount of wet cement backfill that has already been placed in the borehole;	Clarity It is possible to use other type of backfill, for example bentonite, low-melting metal or polymer materials which are justified in a project.			Y	This sentence refers exactly to the Pilot Studies for the recommended borehole disposal concept. We agree that it is possible to use alternative materials and designs, and this is indicated in Section 2.
36.	6.69	«...In borehole disposal facilities where different types of waste are to be disposed of, it is sometimes suggested that waste packages containing high-activity or long-lived waste should be placed in the bottom part of the disposal zone and waste packages containing low activity short-lived radionuclides at the top of the disposal zone...» It's proposed to either delete these provisions or to provide relevant clarifications.	Paragraph 6.69 deals with the disposal of high-level waste, which contradicts the scope of the document (p. 1.1)	Y	The text of para 6.69 is not referring to HLW. We have made a deletion to clarify.		
37.	Para 6.73, Para 2.18	Para 6.73 Unless there are good reasons not to do so, the operating organization should fill the top two metres of the borehole with native soil so that the precise position of the borehole cannot be determined without specialist equipment. Para 2.18 The top five metres of the borehole should be filled with crushed rock and local soil so that the borehole is undetectable without specialist equipment.	Two or five meters?	Y	We have made the two paragraphs consistent and used the words 'a few meters' as is done in TECDOC 1644.		

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Page 1 of 3 Country/Organization: Russian Federation/State Atomic Energy Corporation ROSATOM Date: 27/12/2021							
38.	Para 6.76 (i)	The methods, and instruments equipment and procedures used to describe and characterize the waste and to confirm compliance with established acceptance criteria;	In compliance with para 5.3 SSR-5.	Y			
39.	Para 7.3	It's proposed to delete the phrase from the text: «Monitoring programmes at borehole disposal facilities developed, as recommended, with disposal zones at depths greater than 100 m <u>should have many characteristics that are similar to those for monitoring programmes at geological disposal facilities</u> ». It is incorrect to compare borehole disposal and geological disposal facilities for high-level waste or spent fuel.	In compliance with para 4.28 SSR-5.	Y			
40.	7.35	It's recommended to harmonize the provisions of p. 7.35 and Annex II "ISOLATION AND DISPOSAL DEPTH".	Paragraph 7.35 states that «borehole disposal of disused sealed radioactive sources in accordance with the recommendation provided in this Safety Guide should result in radioactive waste being permanently disposed of at depths greater than 100 m beneath the surface...». It contradicts to paragraph II.5 of Annex II "ISOLATION AND DISPOSAL DEPTH" stating that «...to drill narrow diameter boreholes, this publication recommends borehole disposal at depths below 100 m».	Y	The text has been revised so that it should not cause this type of misunderstanding.		

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Page 1 of 3 Country/Organization: Russian Federation/State Atomic Energy Corporation ROSATOM Date: 27/12/2021							
41.	Annex II	Section 7 "ASSURANCE OF SAFETY" or Annex II "SAFETY ASSESSMENT FOR BOREHOLE DISPOSAL FACILITIES" propose to list safety-important factors that are considered specific for the borehole disposal concept in particular and to suggest relevant requirements on the minimization of such factors during the development of final RW disposal technologies under the borehole disposal concept.	Annex II			Y	The purpose of this safety guide is not to be prescriptive or to detail exactly how disposal can be done – that is the responsibility of the operating organization who has to make a site-specific safety case for the particular circumstances. Having said that, many references are provided to reports where such information can be found.
	Referring to the entire document	It's proposed to consider whether the title of the document could be refined.	Referring to the entire document	Y			
	Referring to the entire document	It's proposed to supplement the text of the document giving consideration to two fundamental issues: a) how to load a (potentially very active) source to such a great depth (over 100 m), providing that it does not "get stuck", and if it gets stuck, to ensure its retrieval. b) how to arrange the EBS providing its minimum thickness along the entire contour and to ensure casing retrievability?	Referring to the entire document	Y	The possibility of a stuck (jammed) waste container is mentioned in para 6.55. We have added further text on this topic in the section on waste emplacement (paras 6.69 to 6.71) and in the section on safety assessment in para 5.28. In the recommended concept the casing and centralizers play a role in reducing the probability of a waste package becoming stuck. The text on casing removal has been reviewed and revised, and some further		

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Page 1 of 3 Country/Organization: Russian Federation/State Atomic Energy Corporation ROSATOM Date: 27/12/2021							
					information has been added e.g. at para 6.33.		
	Referring to the entire document	It's proposed to supplement the text with the following sections: - selection of borehole designs (it should indicate possible borehole designs depending on the geological conditions at the site, rock characteristics, the presence of aquifers and other conditions affecting the disposal safety); - methods used to seal the annular space (applied material compositions and backfilling methods, quality control methods); - requirements to borehole characteristics (verticality, curvature, borehole shape, etc.), relevant control methods and tolerance limits; - provide recommendations on the spacing between the disposal boreholes at the same site.	Referring to the entire document			Y	The purpose of this safety guide is not to be prescriptive or to detail exactly how disposal can be done – that is the responsibility of the operating organization who has to make a site-specific safety case for the particular circumstances. Having said that, many references are provided to reports where such information can be found.

UK

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Denise Varley/Liz Thomas Page.... of.... Country/Organization: United Kingdom/Office for Nuclear Regulation Date: 24 January 2022							
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	General but relates to Sections 2, 4 and 5	N/A	The scope of the draft Safety Guide includes the possible disposal of small amounts of low and intermediate level wastes arising from the management of disused sealed radioactive sources (DSRS). The Safety Guides provides detailed information on the disposal of DSRS in the recommended disposal concept but would benefit from providing more guidance on the disposal of other wastes using the concept. There should also be more guidance on how the disposal of other wastes should be addressed in the safety assessment for a borehole disposal facility.	Y	In response to this comment and similar comments from other Member States we have made various updates to the text, particularly in Sections 2, 4 and 5 to better address radioactive waste other than DSRS.		

2	General	N/A	<p>The recommended disposal concept includes a facility for the pre-disposal management of DSRS and thus such activities would be included in the scope of the safety assessment of the facility. Some borehole disposal facilities may not include pre-disposal facilities so the text of the report should be reviewed to ensure it only addresses pre-disposal management facilities at the borehole disposal facilities where appropriate. Much of the guidance in the draft Safety Guide is relevant to all disposal facilities and not just borehole disposal facilities.</p>	Y	Text revised at paras 5.12, 5.28 and 6.3.		
3	Section 5		<p>Consider the uses of the terms “safety argument” and “operating organisation’s synthesis” and ensure there is clarity in definition and consistency in application in the Safety Guide. Is the “synthesis” the same or different to a non-technical summary of the safety case?</p>	Y	<p>The term ‘safety argument’ appears in existing safety guides such as GSG-3. However, the text has been revised. The term ‘non-technical summary’ is not used.</p>		
4	Para. 1.10	<p>Consider replacing the word “process” with “context”.</p>	<p>“Context” is more appropriate for the subject for the paragraph.</p>	Y			

5	Para. 1.12		Consider adding more information in this paragraph relating to the content of Annex 2 on the relationship between disposal depth and isolation of waste from people and the environment, given the recommended depth of 100 m in this guide differs substantially from that in the current Safety Guide. This would provide better context for the references to the depth of 100 m throughout the Safety Guide.	Y	We have added the additional information as suggested but at para 2.5.		
6	Para. 4.7	Remove “(permanent)” after “sustainable” from the last sentence	“Sustainable” is used a few times but is only explained here. Disposal is defined as emplacement without the intent to retrieve so the word “permanent” is not needed.	Y			
7	Para. 4.14(c)	N/A	Consider clarifying what is meant by a “short operational period” in terms of possible duration, noting what is stated in Para. 5.6.	Y			
8	Para. 5.15	Remove “or boundary conditions” from the first sentence.	The words are not necessary as high-level framework is sufficient in the context of the subsequent text. (note there is also repetition of “safety case” in the first sentence).	Y			

9	Para. 5.20		Consider rewording to address the eventuality that an operating organisation may not be able obtain information on waste disposal at neighbouring sites for the purpose of safety assessment.			Y	This is guidance on what <i>should</i> be done. This is a non-trivial point, and the safety assessments really should take account of all of the disposals, even if this has to be done through the use of estimates in cases where detailed information is not available.
10	Para. 5.31(b)	Replace “making a convincing safety case for” with “ease of demonstrating the safety of” in the first sentence	The use of “convincing” is not necessary as the legal standard is determined by the regulatory framework.			Y	The safety case has not only to meet the legal standards, but also needs to be sufficiently convincing to interested parties.
11	Para. 6.11	N/A	Consider removal as it effectively repeats what is in Para. 1.8.			Y	The text is included for completeness.
12	Para. 6.13	N/A	Are the stainless steel capsules mentioned in the last sentence the same as or different to the stainless steel disposal capsules described in the recommended disposal concept?	Y	Text revised for clarity.		
13	Para. 6.14	N/A	Consider adding information on the recommended packaging for wastes other than sources to be disposed of in the borehole disposal facility.	Y	This information has been added, but at para. 2.14		

14	Para. 6.17	Replace in “parallel with” with “in conjunction with” and remove the parentheses relating to (to run at the same time as) in the last sentence.	Section 5 indicates that site characterization is part of the safety case, not separate to it, and running in parallel may be unduly prescriptive. An operating organisation may choose to start site characterization prior to developing the safety assessment.	Y			
15	Para. 6.28	N/A	This paragraph describes what SIMBOD is, but SIMBOD is first mentioned in Section 4.3 but not described there. Consider moving some of the information here to the place where SIMBOD is first referred to for clarity.	Y			
16	Para. 6.40	N/A	Consider adding examples of what is meant by “features” for clarity, noting the information presented in 6.42.	Y			
17	Para. 6.41	N/A	Consider moving Para.6.41 to immediately below 6.38 to improve ease of reading.	Y			
18	Para 6.48	N/A	There is no mention of the commissioning of any predisposal management facilities in the scope of the borehole facility, which contrasts with the discussion of operations in a subsequent paragraph.	Y			

19	Para. 6.62	N/A	Consider the need to include the specification of waste disposal capsules in addition to waste disposal containers, as they form part of the recommended borehole disposal concept.	Y			
20	Para. 6.73	N/A	Consider whether this para. is fully consistent with the need to minimize the probability of inadvertent human intrusion.			Y	Comment is a little unclear. We believe the text is consistent.
21	Paras. 6.77 and 7.21	N/A	Consider whether some of the information in the list in 7.21 should also be in 6.77, for consistency.	Y			
22	Para. 7.36	Add "in size" after "small" in the second sentence.	For clarity.	Y			
23	Para. I.7	Add "and safeguards" after "nuclear security".	For completeness.	Y			

US

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Country/Organization: USA/US NRC 12/15/2021		Date:					
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	General	The document is well-written and clear.		Y			
2	General	Could a document roadmap be developed showing this document and the key upstream and downstream references?	It can be difficult for Member States to understand all the key linkages and additional documents they must consider.			Y	It is a good suggestion, but not compatible with the Safety Standards normal practice
3	General	The document discusses that the approach should be graded (risk-informed) and we concur. However, in many places language like “any” and “all” is used. Please review these usages throughout to determine if they are appropriate with the graded approach. (examples will be provided in these comments)	Clarity	Y			

4	SURVEILLANCE AND CONTROL OF PASSIVE SAFETY FEATURES	When to have active (e.g., surveillance) and/or passive control; when one stops and the other starts, when both are terminated is getting confusing. A flow chart or additional text to illustrate, would help to make this clearer.		Y	This is really a comment on the overlying Safety Requirement. In short: 1) the operator has to maintain active institutional control throughout the period of Authorization. 2) The design of the facility has to include passive safety features. 3) The operator has actively to check (surveil) that these passive safety features are preserved during the period of Authorization. 4) After the period of Authorization, there may be passive institutional controls – not to be confused with passive safety features. We have made a clarification to para. 4.39.		
5	2.14	“slurry”	The text “liquid grout” is used when in fact a slurry or other international term is likely meant.	Y	‘Grout’ is a standard, internationally-recognized term that was used in the Safety Guide being updated (SSG-1) and is used in other current Safety Guides (e.g. SSG-31, SSG-41). On the other hand, ‘cement slurry’ is also used (e.g. SSG-40, SSG-41). We have added ‘cement slurry’ in parentheses.		
6	3.8	“facility” should be “facilities”				Y	The text is a direct quote.
7	4.1	The text indicates that doses should be taken far below standards. While this is common regulatory language it probably doesn’t reflect what should be a low risk situation associated with borehole disposal. Perhaps consider using the As Low As Reasonably Achievable Concept here. Is there a socioeconomic benefit to going well below standards?		Y	We agree with you, but the text already says: “ <i>The operating organization should seek to reduce doses and risks to levels that are as far below the relevant dose and risk criteria as can be reasonably achieved, taking account of economic and social factors.</i> ”		

8	4.2(b)	The text indicates that radiation shielding should be optimized. Since thicker and thicker shielding can be applied, how would a member state implement this guidance?	Clarity: Suggest explaining that optimization needs some consideration of technical and economic practicality.	Y	Change made in para 4.1.		
9	4.3	The document does not explain why dissimilar sources should not be mixed.	Provide basis for not mixing dissimilar sources or eliminate the text.	Y	Text deleted		
10	4.4(a)(iv)	Please modify para to read “providing sufficient isolation of the waste to minimize the potential keep the probability of inadvertent human intrusion low . Reason for the change: Probability may refer to a value that needs to be calculated, which is difficult to evaluate,		Y	The words ‘potential of’ would relate to consequences whereas we are trying to refer to probability or (<i>sensu lato</i>) likelihood. Probabilities don’t necessarily have to be quantified.		
11	4.5	SSR-5 states that throughout operations the developer should consider the implications for safety of the available options. Considering the very short operations period of some smaller facilities this may not be practical or possible.	Since this document can’t revise SSR-5 perhaps add a new paragraph explaining how the requirement would be implemented for a borehole disposal facility.	Y	We have addressed this comment to the extent possible by expanding on the text at para 4.8(h).		

12	4.6	The guidance document makes a firm distinction about differences between > 100 m and < 100 m. There doesn't seem to be a firm technical basis for the value. At many sites a value of 30 m or 50 m may be more than appropriate to be not impacted by surface processes or human activity such as excavation. All depths could be impacted by drilling.	Provide caveats to the 100 m distinction such as explaining that it is a guideline but other values could be appropriate depending on the site and design.	Y	We have revised the text in response to this comment and comments from other Member States on this topic (minimum depth). The comment is correct in noting that the minimum depth figure is only guidance; it is absolutely not intended to be a precise numerical requirement.		
13	4.7	Line 4: Suggest rewording: ... in the ability to maintain effective institutional controls at the disposal facility site and/or effective engineered features until the hazard has reduced...	Safety can be provided by active institutional controls and robust barriers.	Y			
14	4.14(a)	The text uses the term "unreactive" which is technically not possible. It is a matter of rate of reaction.	Suggest "chemically compatible with"	Y			
15	4.14(c)	Explain "reasonably sized disposal campaign", possibly give an example.		Y	Example added		
16	4.14(d)	Please modify to read "Please reconcile and illustrate the two statements in Para 4.14(d) and 7.14 to explain "closing the facility" and "closure after authorization"			The text of paras 4.4(d) and 7.14 are not inconsistent. There may be a period of active institutional control after (physical) closure of the disposal facility. Para 4.4(d) aims to ensure that future maintenance is not required, whereas 7.14(e) allows and encourages future necessary maintenance to be done.	Y	
17	4.18	"structured uncertainty". Please provide a meaning or description of a structured uncertainty analysis or delete the word "structured".		Y			

18	4.20	“level of understanding”. The “level of” text does not seem to be necessary. Understanding is sufficient.	Delete “level of”	Y			
19	4.26(a)	“thousands of years”. Is there a requirement to take thousands of years to migrate? The risk is likely determined by dilution and not delay.	Suggest something more general like “many years” or explain the concept more fully that thousands is a goal.	Y			
20	4.26(c)	“insoluble”. Solubility is a relative term and the term “insoluble” may be misinterpreted.	Suggest “as low as solubility as practical” or something equivalent.	Y			
21	4.28(b)	Getting sufficient bentonite in the gaps between the casing and the host rock or the container in a 260-mm borehole might be difficult. Please explain experience learned from previous activities, if any.				Y	Rejected only because this is not the correct place in the document to do it – it is more something to do with the practicality of engineering design and implementation – see para 6.31, 4th sentence.
22	4.32	“pay special attention to the need to”. The text is not necessary and can be simplified.	Delete the quoted text.	Y			
23	4.37	“e.g., concrete slabs”. A concrete slab may not be sufficient for some drilling technology.	Suggest change to “deflector plate” consistent with the borehole concept.	Y			

24	4.39	This paragraph should be rewritten with boreholes in mind. An operator will have difficulty observing anything for a buried borehole after closure.		Y	You are correct that there will probably not be much to observe at a borehole disposal facility, but what the operator can do is to look for changes to conditions or human activities at or near the site that could affect the structures, systems and components of the facility – and this is indicated in the text. We have added a clause.		
25	General, example in 4.39	“any passive institutional control”. Use of terminology such as “any” does not agree well with a graded approach. The graded approach should require action for significant features but not any feature.	Please examine the document with this comment in mind and see where the terms “any”, “all”, etc. may be eliminated.	Y	Use of the words ‘any’ and ‘all’ have been reviewed throughout. Most often ‘any’ is used in the sense of ‘if there are any XXX, then...’.		
26	4.43	“legitimate”. It is not necessary to suggest that illegitimate decision making would be supported.	Delete “legitimate”.	Y	There was no implication that there would be illegitimate decision-making. We have revised the text.		
27	5.6	Considering adding text that the regulatory body should be prepared to review the materials in a timely manner to support closure to avoid maintaining the facility in an unclosed state for an extended period.		Y	With slight rewording		
28	5.26	“of all”. The text rational and systematic is unnecessary unless there is a statement that “Procedures for the safety case should be rational and systematic”.	Change to “all of”.	Y			
29	5.32	This is good guidance. Suggest adding pointers to where a member state can find additional information on these topics.		Y			

30	5.34(a)	Please explain if this is the ‘The Design Scenario’ from Section Appendix II.5?		Y			
31	5.34(b)	Consider revising to “Scenarios representing unexpected, disruptive future evolutions of the disposal system that can address uncertainties in, and potential changes to, environmental conditions (e.g. seismic activity, climate, hydrogeology)”;		Y	We do not see these as being ‘disruptive’ scenarios.		
32	5.34(c)	Please explain if this is the ‘The Defect Scenario’ from Section Appendix II.5?		Y	5.34(b) equates to the Defect Scenarios of Appendix II.		
33	5.34(d-f)	Don’t think these are separate ‘scenarios,’ but instead exposure pathways, and are included with the one or more of the other scenarios already. Specific information with regards to these could be obtained through sensitivity and uncertainty analyses.		Y	We agree. The list is introduced as ‘scenarios and potential radionuclide transport and exposure pathways’.		
34	5.34(g)	Please clarify if this is the ‘The Borehole Disturbance Scenario’ from Section Appendix II.5.		Y			
35	5.36(b)	Please edit as “Drilling for natural resources”		Y	Given as an example because there are other reasons for drilling such as research.		

36	5.37	When waste is shallower than 100 m consider human intrusion as a probable event. This seems to be incompatible with the borehole disposal concept. Once waste is placed below the depth of normal excavations and surficial processes, the probability of intrusion from drilling or deep mining for example will be basically the same for depths from 30 m to maybe 200 m. Only at very deep depths is this probability distinction credible.		Y	Experiences in Member States some of which are summarized in Annex II suggest we should recommend a minimum depth greater than 30 m for borehole disposal of long-lived and high activity sources than 'a few tens' of meters. That is we are suggesting that the depth of normal excavations and surficial processes is many tens of meters (possibly 100 m), rather than a few tens of meters (e.g. 30 m).		
37	5.37	The statement "...for waste containing long-lived radionuclides or large initial amounts of radionuclides such as 137Cs..." seems to go against Section 4.36 which states that "Disposal at depths shallower than 100 m could be a safe option for short-lived disused sealed radioactive sources and low level waste..."		Y	This is not a contradiction because although Cs-137 (with a half-life of ~30 years) is regarded as short-lived, some high activity Cs-137 sealed sources contain so much activity initially that even after 10 half-lives (~300 years) they remain significantly hazardous. We have added a footnote by way of explanation.		
38	5.40	Would strongly recommend against using "what-if" cases and instead tying this with Section 5.37. Unlikely, yet plausible, scenarios or sensitivity analyses would be useful, but implausible or "what-if" cases such as meteorite strikes, tidal waves, massive explosions, etc. provide little useful information, and/or may lead to a false sense of confidence.		Y			

39	5.41	Why is there a crop pathway at the site of a borehole? What is the mechanism for waste to reach the surface?			The scenarios and pathways are listed at para. 5.34. The text at para. 5.41 is saying that even if radionuclides did reach the surface at the site it might not be possible to feed people using agricultural produce from the site alone, further implying that any exposures could be small.		
40	5.43	This is defense in depth but is usually not applied in this manner in waste disposal. For example, if the deflector plate "fails" would there be any other barrier to drilling in the borehole concept? In the US there is not a requirement for redundancy of each barrier (safety function).	Suggest deleting 5.43 or modifying to provide the proper context or barrier performance in a disposal system.			Y	Comment is a little unclear. The requirement for multiple safety functions is contained in SSR-5 (e.g. see para. 3.34 and Requirement 7 of SSR-5). Para. 5.43 in this draft safety guide is the logical complement of Requirement 7 in SSR-5 and of para 6.34.
41	5.56, 5.57	Transparent and traceable referencing is important with multiple levels and types of documents. Review can be challenging.	Add the text "Transparent and traceable referencing should be provided, such as using a consistent report referencing system and if data is referenced, provide the page number(s) for the data."	Y	With minor rewording for consistency with IAEA style.		

42	6.20	Are these activities also intended for less than 100 m disposal? Perhaps a sentence or two on the relevant information obtained by these proposed characterization activities will facilitate understanding.				Y	We don't have different guidance for borehole disposal facilities with waste disposal at different depths – the text is general (and the activities are not mandatory)
43	6.20(h)	“Human populations and behaviours at and around the site.” Roughly what radius would this be?				Y	It would be too prescriptive to give guidance on a precise or even a rough distance. That would be a matter for the operator to consider for a particular facility and site.
44	6.29	“safely and securely” is not needed.	Delete the text.	Y			
45	6.31	Borehole casing should be discussed more since they could serve as an important barrier. See HDPE casing in Fig. 1.		Y	But this is done at para. 6.33		
46	6.33	Removing all the casing has not been discussed. Removing the casing after backfilling both sides of the casing may be very difficult and/or cause disrupt the backfill on both sides.		Y	Removal of the casing is discussed at para 6.33 Further words added on the reasons for and potential difficulty and effects of casing removal.		
47	6.39	Removing the casing would leave a long vertical void between the backfills.		Y	See comment immediately above		

48	6.43	“The operating organization should not locate a waste disposal zone in an aquifer” is a major point and has not been discussed before.		Y	The comment is correct. This is not new guidance. It is perhaps a very obvious statement, but it needs to be said. It is very important (for safety) and very relevant to the way some national regulations are written. To give it more prominence we have introduced the idea earlier in the document at para. 2.3.		
49	6.44	Describe how “The operating organization should aim to ensure that the permeability of the backfilled borehole and any disturbed rock around it are no worse than that of the surrounding intact rocks” would be done?		Y			
50	6.45	“...removal of borehole casing.” I can think of reasons for not doing this, but what are reasons for doing this?		Y	See response to comment on para 6.33.		
51	6.48	This is a good point. However, inspectors should also make sure that the backfill is correctly injected in the borehole without leaving voids.		Y	New sentence added		
52	6.67	Please provide examples of “waste packages are emplaced centrally in the borehole(s)?”		Y	Sentence added		
53	6.67 & 6.69	Any studies on allowed void percentage in the backfill disposal zone before isolation is threatened?		Y	This is at too detailed a level and would have to be done by the national operator for its particular circumstances.		

54	6.71	It may be very difficult to achieve permeability as low as the host rock if the host rock is very good. Suggest deleting the last sentence or modifying.	Delete the last sentence.			Y	You are correct that it might be difficult in practice, but this is <u>guidance</u> , and this sentence expresses the correct aim that the operator should have when sealing the boreholes, i.e. it is aspirational not mandatory. The alternative would be specifying a particular permeability value which would not be appropriate in every setting and would likely be hard to get agreement on.
55	6.82	Please provide examples on how “The closure plan should demonstrate that the closure activities will not impair the post-closure performance of the facility” can be done?		Y			
56	7.3	Regarding the monitoring systems for > 100 m being similar to geologic disposal. The risk from a borehole disposal system may be much lower than from a geologic disposal facility, therefore applying a graded approach may result in much different monitoring systems.	Suggest adding clarifying text or otherwise modifying the paragraph.	Y	Text deleted, more emphasis given to the graded approach.		

57	I4(c)	“The operating organization should ensure through appropriate facility design that disposed waste will be sufficiently isolated from any aquifers containing potable water that are present at the site” Does this also include disposed waste be sufficiently isolated (via engineered barriers) from aquifers when the borehole is located in the aquifer?		Y	The comment is a little unclear. Disposed waste does need to be isolated from aquifers. Boreholes that pass through an aquifer are dealt with at Para 6.43. Cross reference to para 6.43 added.		
58	I16.	“The generic safety assessment Ref. [17] identifies the parameters that are expected to have the greatest impact on safety of the recommended borehole disposal concept for disused sealed radioactive sources; these lie in the fields of hydrogeology and geochemistry, which together determine the rate of corrosion of the stainless steel disposal capsules and containers, and the rate of radionuclide migration through the geosphere.”	Good point that should be expanded on.	Y	Thank you.		
59	I17.	“The identification of key parameters – the ones most important to safety – and, from that, an ability to focus the site characterization programme was a key motivation for the development of the tiered modelling approach...”	Good point that should be expanded on.	Y	Thank you.		
60	I19	“long-term”. Suggest providing an example after the text.	“(e.g., years)”	Y	e.g. several years		

61	I28	Detailed characterization helps the perception of robustness but the robustness of the concept is probably weakly reliant on this information. Maybe too much is being asked for here.	Suggest carefully considering what characterization information is necessary for a simple borehole facility using the IAEA concept.		We do already emphasize the graded approach, the use of pre-existing boreholes if possible and the possibility to drill as few as just one investigations borehole if not. The Safety Requirements place a strong emphasis on understanding of the site.		
62	II.1	Why is there no minimum depth in this updated document? E.g., will borehole disposal facilities exist that are no deeper than 4 meters?				Y	The comment is not correct, a new minimum depth is proposed in para II.5
63	II.11.(c)	If a proper site is selected the advanced materials may not be necessary.	Consider adding a caveat.	Y	Good point		
64	I.3	Disposal of GTCC waste in the US is currently prohibited. The waste that was disposed was not GTCC (commercial waste), but rather defense waste. This waste has been recently called "GTCC-like". Suggest clarifying that the waste was defense waste and GTCC-like.	Change "Greater-Than-Class-C (GTCC) low level waste" to "defense radioactive waste similar to commercial Greater-Than-Class-C (GTCC) low level waste."	Y			
65	ANNEX I. OTHER BOREHOLE DISPOSAL CONCEPTS	I.1 through I.# are already used in the appendixes. This makes it difficult to reference.		Y	We will use the correct IAEA format.		