NUSSC Member	COMMENTS BY REVIEWER				RESOLUTION			
	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
Canada	1	Para 1.3/line 6	"… recommendations for applying a graded approach to geotechnical site~~ing~~ investigations and activities for other types of nuclear installation."	Inadequate wording	x			
Canada	2	Para 1.7/line 1	"This Safety Guide provides recommendations on the geotechnical ~~engineering~~ aspects necessary…"	Remove the term "engineering" to be consistent with the use of the term "geotechnical" in a broader sense, as stated in para. 1.6.	x	It is noted that para. 1.6 was re-written to provide additional clarity related to the term 'geotechnical aspects'.		
Canada	3	Para 1.7/line 2	"This Safety Guide provides recommendations on the geotechnical engineering aspects necessary for evaluation of site suitability and for the establishment of parameters used in the development of the design basis for nuclear installations."	Evaluation of site suitability is one of the important aspects that geotechnical engineering aspects will deal with, as stated in the following sentences in the para.	x	Incorporated, but with minor modification.		
Canada	4	Para 2.2/line 3	"The purpose of such investigation is to obtain information and basic data on the physical and mechanical properties of the subsurface materials, to be used when making decisions about the suitability of the site for a nuclear installation."	Physical properties are important data to be obtained in such investigations.	x			

Canada	5	Para 2.5/line 1	"Generally, data related to geophysical, geological, ~~geotechnical~~ and engineering information…"	The use of the term "geotechnical" in this para is redundant since para. 1.6 defines "geotechnical" as a broader term, "which covers some geophysical, geological, geomorphological and geomechanical aspects"			x	Para 1.6 was re-written to define the scope of 'geotechnical aspects'.
Canada	6	Para 2.5 (c), Para 2.9 (a), Para 2.10, and Para 2.14	Replace "structural" with "geologic structure" for instance, in "structural geometry" or "structural heterogeneity"	To avoid ambiguity with the use of the term "structural" in a geotechnical safety guide, I suggest using "geological structure" instead of merely "structural," for instance, in "structural geometry" or "structural heterogeneity.	x			
Canada	7	Para 2.7 (a)/line 5	"The potential for geotechnical hazards associated with faulting, ground motion, uneven bedrock movements, liquefaction ~~potential~~, flooding, volcanic activity, landslides, permafrost, swelling, erosion processes, subsidence and collapse due to underground cavities…"	The sentence starts as "The potential for geotechnical hazards" and lists the different hazards, so "potential" is unnecessary.	x			
Canada	8	Para 2.7 (b)/line 2	"The site should be classified for the purposes of seismic response analysis, using the seismic velocities (Vs30) as criteria"	The shear-wave velocity of the upper 30 m, or Vs30, is what is used for site classification.	x			
Canada	9	Para 2.7(b)/ line 6	"If applicable, the rock at a rock site should be further classified as hard rock~~, rock~~ or soft rock."	As a rough classification, the classification of hard rock and soft rock should suffice at this stage.			x	Comment from WASSC wants 'medium rock' included. So instead of deleting, the paragraph was modified as suggested by another reviewer.
Canada	10	Para 2.9/line 3	"In addition to the features stated in para. ~~2.4~~2.5, the following factors"	Para. 2.4 is cited as stating the features to be considered in the verification stage, but para. 2.4 lists the stages of site evaluation. Para. 2.5 should be cited instead.	x			

Canada	11	Para. 2.9	Add a bullet to para. 2.9 as: (k) liquefaction potential	Liquefaction potential is one of the important geotechnical hazards that should be verified at this stage.		x Added liquefaction potential to the list (as bullet item (c))		
Canada	12	Para 2.10 (b)	Include "in-situ stress monitoring" as an example of a possible use of investigation holes.	To provide further concrete examples.	x	Included at the end of third to last sentence.		
Canada	13	Para 2.10 (b)/line 13	"These investigations should be used to determine and map the soil profiles. Borehole numbers and depths should be sufficient to verify the site suitability with no unacceptable subsurface conditions. In addition to the extraction of cores or other samples…"	At this stage, the site investigation drilling should have sufficient borehole numbers and depths to verify the site suitability, e.g. no large karstic features or voids in bedrock.	x			
Canada	14	Para 2.11	"… sufficient for the purposes of final layout planning. The results of the site confirmation stage should address geotechnical parameter variability and uncertainty and provide sufficient geotechnical parameters for detailed design of nuclear installations."	Another purpose of this stage is to produce sufficient information to address variability and uncertainty of geotechnical properties of the site and sufficient/adequate geotechnical data for detailed design of nuclear installation	x			
Canada	15	Para 2.39	Add a bullet: (n) Borehole locations and surface elevation referenced to a Geodetic Triangulation Surveye (GTS) benchmark, or geodetic datum.	The accuracy of where the soil information is being gathered is important to high-risk buildings			x	These are included within other bullets. See items (f) (g) and (h)
Canada	16	Table 2	Add one type of test to Table 2 as follows: Type of test: Overcoring test; Type of material: Rock; Parameter: In situ stress state; Area of application: deformability, convergence; Remarks: Difficult to implement in highly fractured rock.	Overcoring is one of the common methods for in situ stress state measurement of rocks and should be included in Table 2.	x			

Canada	17	Para. 3.3/line 7	" The review should include consideration of the potential for slow movements between juxtaposed bedrock blocks, due to glacial rebound, ~~and~~ tectonism, groundwater extraction, and other industrial activities."	Current list does not account for all possible causes of slow movements between juxtaposed blocks.	x			
Canada	18	Para. 3.13/line 4	"~~An increase~~Changes in the vertical pressures due to structural loads or seismic events could cause instability of the roof of the cavity."	Decreases in vertical pressure due to excavation, erosion, or glacial isostatic rebound can also cause instability of the roof of a cavity.	x			
Canada	19	Para 3.15/line 4	" If it has been found necessary to make improvements in the subsurface conditions due to the risk of slope failure or other unfavourable soil or ground conditions, the improvements (e.g. jet grounding, ground cementation) should be designed and conducted during the ongoing stage of site characterization and/or site preparation and construction, and their effectiveness should be verified by in situ testing"	Some improvements might need to be done at the stage of site preparation.	x			
Canada	20	Para 3.18/line 4	"If a slope is ~~judged~~ determined to be distant enough that it would not affect…"	Inadequate word used	x			
Canada	21	Para 4.1/line 2	" The term dyke is used to describe a structure running along a water course and the term earth dam applies to a structure ~~higher than 15 m~~,…"	15 m is used to define a large dam by International Commission on Large Dams. A dam lower than 15 m may pose a large risk to the safety of nuclear installations downstream of the dam and should be assessed. Therefore, it is suggested to remove wording "higher than 15 m".	x			

Canada	22	Para 4.6	"Surveillance (periodic inspection and monitoring of dams and dykes) and maintenance work should be performed continually during construction and operation of the nuclear installation to prevent and predict potential damage such as internal erosion of dykes. Dam safety review should be conducted periodically to demonstrate that the dam is safe, operated safely and maintained in a safe condition, and that surveillance is adequate to detect any developing safety problem."	The dam safety review is a systematic review and evaluation of all aspects of design, construction, maintenance, operation, and surveillance, and other factors, processes and systems affecting a dam's safety, which reflects best practice in the dam industry.	x			
Canada	23	Para 4.14 (d)	"(d) Rock removal;" Replace "Rock removal (when blasting is to be used for rock removal, controlled blasting techniques should be used to minimize blast-induced fractures below foundation)"	Blast-induced fractures could impact on the safety of foundation and should be controlled.	x			
Canada	24	Para 4.18 (a)	"(a) Characterization of the existing in situ profile and determination of relevant soil parameters pertinent to the selected ground improvement technology"	In order to apply some ground improvement measures, there should be high confidence in the relevant soil parameters	x			
Canada	25	Para 4.20/lines 5 and 6	"In the case of weak soil conditions, deep foundations should be used to transfer the loads to stiffer soil layers at depth. ~~Owing to the complexity of the design, shallow foundations are usually considered first, with the option of deep foundations being considered as a last resort.~~"	Sentence not necessary.	x			

Canada	26	Para 4.21 (d)	"(d) All risks associated with groundwater ~~The risks associated with possibly 'aggressive' underground water~~ should be taken into account;"	It is important all risks associated with underground water are considered for nuclear installations.	x	To keep consistency in the list the comment was incorporated as: 'The risks associated with undeground water should be taken into account' The language in these bullets imply 'all' for every item.		
Canada	27	Para 4.21 (f)/line 2	"The choice of the type of foundation should depend on the type of building, for example a continuous raft should be used under the nuclear island (either supported by piles~~d~~ or ~~directly lying~~founded on competent ground)…"	To improve clarity	x			
Canada	28	Para 4.23/line 5	"Additionally, special consideration should be given to environmental and meteorological conditions and construction activities because they can lead to foundation damage ~~due to heave~~."	Heave is not the only damage mechanism in this case.	x			
Canada	29	Para 4.25/line 1	"Rock property characterization should include rock ~~genesis~~type…"	What is being referred to as "rock genesis" (sedimentary, igneous, volcanic or metamorphic) is actually "rock type."	x			

Canada	30	Para 4.25/line 2	"Rock property characterization should include rock genesis (i.e. sedimentary, igneous, volcanic or metamorphic), lithology (e.g. mineralogy, ~~metamorphic fabric~~texture),…"	It is not evident why "metamorphic fabric" is singled out as an example of "lithology" in rock property characterization. It is also better to use texture rather than fabric to represent characteristics of lithology.	x			
Canada	31	Para 4.25/line 3	"Rock property characterization should include rock genesis (i.e. sedimentary, igneous, volcanic or metamorphic), lithology (e.g. mineralogy, metamorphic fabric), overall geometry (e.g. strike and dip of bedding), discontinuities (e.g. joints, shear zones, fractures), …"	"shears" is not standard term used in geologic or geotechnical characterization.	x			
Canada	32	Para 4.71(a)	"(a) ~~Settlement without drainage, due to shear, for fully saturated soil~~Undrained shear settlement;"	It seems like what they are trying to say is undrained shear settlement.	x			
Canada	33	Para 4.78/ line 7	"The available solutions are generally limited to those developed for the rigid plastic solid ~~of the classical theory of plasticity~~."	Improve readability.	x			
Canada	34	Para 4.106/ line 3	"… Areas that are susceptible to inundation by floods or tsunamis should be avoided for buried pipes or conduits. Buried piping should also be placed at a sufficient depth to prevent damage or non-functionality from freezing or frost heaving."	This is common in winter regions	x	A statement consistent with the proposal was added to para. 4.103.		

Canada	35	Para 4.109 (d)	“(d) Ground failures such as surface fault rupture, liquefaction, landslides, settlements and discontinuous displacements.”	"surface fault rupture" is one of the most important "ground failures" and should be a priority for assessment.	x			
ENISS	1	2.22 2.26 3.18 3.5 4.7 4.31 4.50 4.96 4.108 4.116 5.6 5.16	The term “safety related” should be replaced by “items important to safety”.	The definitions are given in glossary https://www-pub.iaea.org/MTCD/Publications/PDF/IAEA-NSS-GLOweb.pdf under heading plant equipment. According to these definitions the safety related item is defined in following way: An item important to safety that is not part of a safety system or a safety feature for design extension conditions”. Use of term "safety related" in the mentioned paragraphs is wrong.			x	Safety related is intended and in these cases it is the preferred term.
ENISS	2	2.25	All boreholes not needed for monitoring purposes (see Section 5) should be filled and sealed with suitable materials ~~which will not interact with the environment~~.	Filling material is not a nuclear specific issue and is probably regulated by national requirements. Also interaction will always happen, but of course should not be harmful. We propose to remove the part of the requirement on interaction with environment.	x			

ENISS	3	4.60	For static loading, stability against sliding and overturning analysis should provide an adequate factor of safety against sliding and overturning ~~greater than the values specified by national regulations5~~. The analysis should consider variations in loading during the life of the structure consistently with the safety requirements and safety analysis assumptions ~~report due to such factors as rise in groundwater level, removal or reduction in passive forces downslope (for any reason), increase in driving forces upslope (for any reason), liquefaction potential, or other factors~~	It seems inappropriate to refer to “national regulations”. First, there are national regulation for nuclear facilities, and it is assumed that the regulations referred to here are those for conventional buildings. Second, there is a large variety of codes and standards, and it is not obvious to claim that any of them provide relevant safety factor for nuclear constructions.			x	National Regulations have been removed as suggested.The suggestion to change the test in the second sentence is not accepted because the list draws attention to specific items that need to be treated with caution, and the last part 'other factors' implies any other variations in loading that may be encountered or of concern in specific situations.
ENISS	4	4.61	Remove this clause ~~For evaluation of overturning, a ground contact ratio, defined as the ratio of the minimum area of the foundation in contact with the soil to the total area of the foundation, may be used. The seismic response computed over the entire duration of the seismic ground motion should be considered to determine the minimum value of this ratio. If a minimum contact area of 80%6 is not achieved then the non-linearity due to the foundation uplift should be assessed and, if found to be important, should be accounted for in the design~~	This clause deals with structure seismic response more than geotechnics. In addition it seems that the minimum area of the foundation to remain in contact with the ground varies depending on the countries. Moreover, this clause seems redundant with 4.62			x	Section 4 deals with design of structures and foundations, overturning and sliding calculations are applicable in this Section. 4.61 is about overturning and 4.62 is about uplift. We need both statements to be listed as depending on topics of interest, one could potentially be overlooked. It is also important to highlight the contact area expectations, as the overturning criteria is 75%-80%, whereas the uplift threshold may be as high as 30%. Additionally, the use of the safety standards is becoming more and more electronic, and this allows for topic specific searches to be easily found.

ENISS	5	4.62	Under certain combinations of ground motion, groundwater level and geometrical configuration of the building, conventional computing procedures might give rise to a potential uplift. This does not mean that the foundation will necessarily lift up, but rather that conventional procedures to compute the structural response might not be applicable under these circumstances. If the estimated surface area of the uplift of the foundation is larger than ~~20~~30% of the total surface of the foundation, a more sophisticated method should be used in the analysis of the dynamic soil–structure interaction. The estimated uplift of the foundation should be limited to a value that is acceptable in consideration of the bearing capacity of the soil and the functional requirements.	This is the section 4.38 of the previous N-SG 3.6, which seems to be a balanced agreement among different countries practices. However there are countries where the threshold of the ratio (surface area of the uplift / total surface of foundation) triggering the use of a more sophisticated method is 30%			x	This language was drafted as a result of numerous discussions with the drafting experts, it is not intended to be limiting, therefore, differing practices are also included. However, the aim of this Safety Guide is to present the most current and proven engineering approaches and methodologies within the text (aimed at embarking coutnries).
ENISS	6	General	Regarding Soil Structure Interaction (sections 4.28 to 4.50), there is a significant rise (+15) of the clauses as compared to previous N-SG 3.6 IAEA standard. Some of them are very detailed and equally concern both soil and structure. It may be out of the scope of the document to address structure (for instance, description of direct and substructuring methods, SSSI…).				x	There is no clearly suggested proposal with this comment. Soil-structure interaction and Structure-soil-structure interaction are not covered in any other IAEA safety guide, but are very important aspects in safety evaluations, assessments and design. These discussions have been located within the Design section of this Guide and should remain.

Germany	1	1.1	Requirements for site evaluation for nuclear installations are established in IAEA Safety Standards Series No. SSR-1, Site Evaluation for Nuclear Installations [1]. This Safety Guide provides recommendations on geotechnical characteristics and the evaluation of geotechnical hazards as part of ~~this~~ such site evaluation.	Editorial	x			
Germany	2	1.2	Seismic aspects also play an important role in this field, and relevant recommendations are provided in IAEA Safety Standards Series No. SSG-9 (Rev. 1), Seismic Hazards in Site Evaluation for Nuclear Installations [~~1~~2].	SSG-9 (Rev. 1) should be Reference [2], as SSR-1 is the first one. Please check these reference numbering all over the text, for both SSR-1 and SSG-9 (Rev. 1).	x			
Germany	3	1.3A New para	The terms used in this Safety Guide are to be understood as defined and explained in the IAEA Nuclear Safety and Security Glossary [X].	Please add a new para.			x	The beginning parts of the document (standard) include a section called 'Interpretation of the text' where the applicability of the IAEA Glossary is explained
Germany	4	1.5	This Safety Guide is intended for use by ~~safety assessors~~ experts assessing the safety of nuclear installations and regulatory bodies involved in the licensing of nuclear installations as well as designers of such installations.	”Safety assessors” seems to be an unusual wording, we suggest to clarify.		x		

Germany	5	1.10	This Safety Guide provides recommendations on methodologies for the development of the design basis of nuclear installations. It should be verified that ~~T~~the collected data and interpreted information from site investigations, (considering their variability and the analysis methodologies described in this Safety Guide) are appropriate for use in the evaluation of structural response to both design basis and beyond design basis events. ~~The acceptance criteria for the assessment of beyond design basis external events may be relaxed provided they are consistent with the provisions for beyond design basis external hazards described in IAEA Safety Standard Series Nos SSG-67, Seismic Design for Nuclear Installations [3], and SSG-68, Design of Nuclear Installations Against External Events Excluding Earthquakes [4]. Furthermore, t~~These evaluations need to consider the potential for cliff-edge effects and provide adequate margin to protect items ultimately necessary to prevent an early radioactive release or a large radioactive release	As a statement, the second sentence seems not to make much sense. Therefore, we propose to change it to a recommendation. The sentence regarding acceptance criteria should be deleted (or revised) because the paragraph seems to address the data needed for the assessment. And with respect to the quality of the database no distinction should be made between design basis and beyond design basis.			x	This paragraph defines the scope of the safety guide, and does not provide recommendations. The importance of the sentence related to collected data is intended to inform the reader that following the Safety Guide recommendations will result in data which is appropriate for use in evaluations related to design and beyond design events. As stated in the reason provided for the change - the data is not any different for both types of events and the collected data sentence states precisely that. The following sentence is necessary to identify that although the data is valid for both design and beyond design events, acceptance criteria does not need to be identical for the evaluations, therefore, this sentence is necessary, as it addresses the beyond design basis events inputs. Per the DPP this Safety Guide needs to address beyond design basis events and lessons learned from the Fukushima accident - so this statement will not be deleted.
Germany	6	1.11	Section 2 provides recommendations on geotechnical site investigation, addressing different stages of the geotechnical evaluation programme, sources of data, special considerations for investigation of complex subsurface conditions, and site considerations for nuclear installations.	It should be specified which programme is meant.			x	The programme here refers to the site investagation programme, as stated in the opening phrase of the paragraph. It would be repetitive and redundant to repeat the phrase after the comma
Germany	7	2.2	Investigations of the subsurface conditions at potential sites for a nuclear installation should be performed at all stages of the site evaluation process as specified in para. 2.4.	The stages have not yet been introduced. Therefore a reference to the paragraph specifying the stages should be made.	x			

Germany	8	2.3	The geotechnical investigation programme for a nuclear installation should provide the data necessary for an appropriate characterization of the subsurface at each stage of the site evaluation. ~~The various methods of investigation are typically applicable to all stages of the site evaluation process, but will vary from stage to stage, as necessary.~~ In general, the investigations should become more detailed in character when approaching the later stages of the investigation programme. Furthermore, some analysis specific considerations may apply only to datasets used as input data in soil and rock characterization and analysis.	It is not clear what “various methods” are meant. Therefore, the sentence should either be deleted or more details on the methods should be provided. One could perhaps reference to Table 1. “Techniques for geophysical investigations of soil and rock samples”, will it be helpful here?		x The sentence was modified as follows: "The various methods of investigation - that is, the use of current and historical documents, geophysical and geotechnical exploration, in situ and laboratory testing - are typically…"		
Germany	9	2.4 (d)	Operational stage. Selected ~~investigations~~ regular re-assessments and monitoring of soil parameters are pursued over the lifetime of the installation.	“Investigations” and “monitoring” is quite un-specific. Therefore, we propose a rewording of this paragraph.		x Updated text to: 'Selected geotechnical investigations and monitoring of geotechnical parameters, conditions and changes are pursued over the lifetime of the installation.'		
Germany	10	2.5	Generally, data related to *geophysical, geological, geotechnical and engineering information* should be collected for use in safety evaluations or analyses.	There is not always a clear distinction between “geophysical, geological, geotechnical and engineering information”. Therefore, it might be useful to give definitions (w.r.t. their meaning in this Safety Guide) in a footnote or some kind of Appendix/Glossary.			x	This is generic and widely understood engineering terminology. Definitions or appendices are not considered necessary.

Germany	11	2.7Line 4	… Subsurface information at this stage is usually obtained from current and historical documents (see paras. 2.30 and 2.31) and by means of field reconnaissance, including geological, geophysical and geomorphological surveys (see para. 2.32), and this information is used in the following ~~assessments~~ considerations: …	As the following bullet points address, e.g., exclusion criteria and soil classification, the notion of "assessments" might be too limited. We think "considerations" is more appropriate.	x			
Germany	12	2.10 (b)	Rotary borehole drilling, coring or sounding. These techniques are used to define the overall site conditions, and to collect basic information about the subsurface materials. The method selected ~~(i.e. the type of investigation hole drilled)~~ should be justifiable by the site conditions.	As "sounding" does not involve hole drilling, the examples in brackets should be deleted.	x			
Germany	13	2.11	The purpose of the site confirmation stage is to confirm the results obtained in the previous stages and ensure that the spatial and thematic coverage of the site characterization data and interpretations is sufficient for the purposes of the assessment/safety analyses ~~or~~ and the ~~ultimate~~ detailed design ~~final layout planning~~.	Re-wording is proposed to be consistent with para. 2.4 and to cover all purposes of the geotechnical investigations.				
Germany	14	Footnote 2	Additional information about the significance of such findings can be found in ~~Ref.~~ US NUCLEAR REGULATORY COMMISSION, A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion [7].	Please give the name of the reference in the text of the footnote as it is mentioned for the first time.			x	Referencing National Regulations in a Safety Guide is not acceptable by other Member States, typically a footnote can be used to make such references and maintain consensus - this is the case here.

Germany	15	2.27	The geotechnical site investigation programme for a nuclear installation should consider the potential presence of particularly undesirable subsurface conditions, i.e. which could have serious implications for the integrity of the foundation of the installation due to ground instability and/or collapse, bedrock block movements and changes in groundwater conditions.	Please clarify, that geotechnical site investigation programme is meant here.	x			
Germany	16	2.28 Line 4	… For this reason, the recommendations in Section 3 of this Safety Guide should be followed to address any undesirable subsurface conditions for which the potential for their occurrence has been indicated during the standard site characterization. ~~The basic elements of investigation should include prediction, detection, uncertainty analysis, evaluation and treatment.~~	The site characterization activities have been described in paras. 2.1-2.27. If the last sentence of this para. refers to these activities, the aspects mentioned here should be included in these paras. If the last sentence refers to some additional activities / investigations, these should be specified more clearly. Alternatively, the sentence should be deleted.		x The sentence was modified as follows: "Investigation programmes for complex subsurface conditions should include prediction, detection evaluation and treatment." This sentence is in line with the text presented in Section 3 related to undesireable subsurface conditions.		
Germany	17	Title after 2.39	GEOTECHNICAL CONSIDERATIONS FOR SITING OF NUCLEAR INSTALLATIONS Geotechnical considerations for siting of nuclear installations include: 1) parameters of the geotechnical profiles; 2) seismic site categorization 3) free field seismic response and site specific response spectra	We would like to suggest to make a small introduction just after this title to make a text easier to comprehend.			x	Introductory statements do not contain recommendations and therefore are not advisable by the technical editors. Considering that the suggested text does not add any content, this comment is rejected; however, the presentation of this section could be improved during the layout phase of the publication process.
Germany	18	2.41(c)	S (secondary or shear) and P (pressure or primary) wave velocities, stress–strain relationships, static and dynamic strength properties, consolidation, permeability and other mechanical properties obtained by in situ tests and/or laboratory tests;	An explanation for comprehensibility for the general public might be recommendable.	x			

Germany	19	2.42	Even though conceptually the profile is unique to a particular site, various related design profiles for *different purposes should be adopted* to allow for different hypotheses in the analysis.	Can you please clarify what to understand by different purposes and how should the process of adaptation be carried out?	x	Purposes has been replaced by 'uses or assessments'. The uses or assessments implied are included in the bullet list of that paragraph.		
Germany	20	2.43	For the purpose of seismic site response analyses, the following categorization ~~should~~ could be used — Type 1 sites: Vs,30m > 1100 m/s; — Type 2 sites: 1100 m/s > Vs,30m > 360 m/s; — Type 3 sites: 360m/s > Vs,30m.	This is not a should-requirement, but suggestion (good praxis) from this Safety Guide. Additionally, it is noted (see also para. 3.14 of SSG-9, Rev.1), that such site categorization is valid assuming that the shear wave velocity does not decrease significantly with depth; if this is not the case, particular analyses should be carried out in accordance with best practice.	x	should' was changed to 'could' The paragraph below the categorization covers the assumption stated in SSG-9 Rev. 1, consistency is ensured.		
Germany	21	2.49	There are alternative methods to assess the idealized layered soil–rock systems, including wave mechanics, finite element, finite difference, discrete element, and hybrid methods. To assess the site response, the following models are acceptable: (a) A viscoelastic soil system overlying a viscoelastic half space; (b) A horizontally layered system; ~~(c) Materials that dissipate energy by internal damping;~~ …	Item c) seems not to fit. Therefore, it should either be deleted or the intended modelling approach should be specified more clearly.	x	Modified introductory statement for clarity to state '...models with the following properties are acceptable'		

Germany	22	Title after para 3.1	*UNDESIRABLE SOIL CONDITIONS* AT NUCLEAR INSTALLATION SITES	The issue had already been addressed in para. 2.27. Maybe para. 2.27 should be moved to this chapter or referenced. Please verify.			x	Section 2 addresses the details of the investigation for undesirable soil conditions, while in Section 3 we address the 'hazard' that is undesirable soil conditions. No changes made as a result of this comment
Germany	23	3.4	The ~~subsurface exploration~~ investigation programme at a site outlined in Chapter 2 should provide for the detection of subsurface cavities and should allow the extent of cavities to be evaluated.	Does this refer to the investigation programme outlined in Chapter 2? If so, it should be made clear. If not, it should be explained what subsurface explorations are meant here.	x			
Germany	24	3.9	It might not be possible or practicable to detect and delineate every possible cavity or solution feature at the site. Consequently, a decision should be made on the largest possible undiscovered cavity that would be tolerable, on the basis of the potential effects of such cavities on the performance of structures, systems and components important to safety.	There might be also systems and components that could be directly impacted by ground failures.	x			
Germany	25	3.12	The greatest risk to the foundation safety of a nuclear installation is from the existence of filled or open cavities, solution filled features at shallow depths (relative to the size) and mechanical discontinuities below the foundation of the building structures at the site.	Add explanation to make clear what is meant.		x structures, systems and components instead of 'building'		

Germany	26	3.19	The stability of slopes surrounding structures, systems and components that are important to the safety of a nuclear installation should be assessed with regard to the safety of the installation. In particular, the effects of earthquakes (e.g. ground motion, liquefaction, ~~landslides, tsunamis~~) as well as the effects of heavy rainfall, and flash floods, and thawing of permafrost should be considered in the assessment of slope stability	This paragraph is about slope stability. Therefore the list of “effects of earthquakes” affecting slope stability should be modified. “Landslides” are a loss of slope stability in itself, therefor they don’t really fit. But ground motion might also directly lead to slope failures and should therefore be included. With tsunamis, the situation is tricky, yes, they might induce slope failures, but is the slope failure then the effect endangering the NI or the tsunami itself? We would prefer to delete tsunamis as an example.An additional reason for slope failures is the thawing of permafrost. This will become a increasing problem due to climate change. Current NIs might not be affected by that, but future SMRs in more extreme locations might.		x Accepted additions and included in the text. Did not delete landslides and tsunamis, as those are consequences of earthquakes which could trigger slope instabilities too.		

Germany	27	3.20	For pseudo-static slope stability calculations, the *safety factor* is based on the consideration of seismic effects as equivalent static inertial forces by means of seismic coefficients. To determine the equivalent static inertial forces, the seismic amplification in the slope should be modelled. Peak ground acceleration should be used in the estimate of inertial forces; however, a lower value may be acceptable, if justified by additional calculations and studies. In slope stability calculations, *the safety factor calculated* based on the pseudo-static equilibrium should be at least 1.1.[4]	Which exact safety factor is meant here? According to SSG-25 "Periodic Safety Review for Nuclear Power Plants" there are at least 14 different safety factors. How to define one, relative to DS531 and how to calculate it? Additionally, in para. 4.87 another safety factor - local safety factor - is mentioned. Our suggestion is: please give an overview of safety factors, used in this Safety Guide (as Attachment, for example).		x Added text for clarification. Overview of safety factors would not add value, as all of the mentioned safety factors within the text are typical in these engineering analyses. Additionally, this is a high level document (Safety Guide) that does not typically include such details because of consensus concerns.		
Germany	28	4.14	Preliminary foundation work is those geotechnical activities conducted prior to the placement of the concrete foundations. These activities directly affect the performance of the foundation under the anticipated loading conditions and are therefore essential to safety, and ~~might~~ should include the following, as appropriate:	„Might“ is very vague for a safety guide. Making it a recommendation restricted only by the appropriateness seems more suitable.	x			
Germany	29	4.19	Foundations should not be ~~supported~~ build on expansive or collapsing soils unless mitigating measures are implemented and it is demonstrated that these phenomena do not adversely impact foundation performance.	Please check if „supported“ is suitable here.	x			

Germany	30	4.24	The soil and rock characterization should include classification, stiffness and strength, and hydrogeologic properties. Engineering properties should include index, density, shear strength, seismic wave velocity, elasticity moduli, compressibility, stress state and cyclic resistance. Some of these properties may be strain dependent; testing and reporting of these properties should cover the strain range expected from design analysis	Clarification	x			
Germany	31	4.87	Where fractured rock is present as foundation material, a *local safety factor* should also be included. The local safety factor is defined as the ratio of the strength to the working stress at each point where there might be yielding or local sliding along the existing fracture zones and weathered zones beneath the foundation.	Is this another safety factor, in addition to the one, mentioned in para 3.20? Please give an overview of safety factors, used in this Safety Guide (as Attachment, for example).			x	The local safety factor discussed here is described in the following sentence.Overview of safety factors would not add value, as all of the mentioned safety factors within the text are typical in these engineering analyses. Additionally, this is a high level document (Safety Guide) that does not typically include such details because of consensus concerns.
Germany	32	4.94	At sites that are expected to experience inundation caused by a flood or tsunami, potential ground erosion including changes in geometry and material properties should also be taken into account for evaluations according to the nature of the event (duration, peak flow, maximum water height). This holds in ~~In~~ particular for, considerations for phenomenon related to water flows leading to the failure of earth structures or soils foundations such as internal and external erosion, scouring.	Clarification.	x			

Germany	33	4.103	The layout of buried pipes or conduits should be considered in the geotechnical site investigation programme.	Please clarify, that geotechnical site investigation programme is meant here. Same for para 4.105.	x			
Germany	34	5.3	The monitoring of actual loads and deformations enables a field check to be made of the predicted behaviour of the foundations and ~~earth~~ burried structures. Since the construction stage is generally lengthy, the monitoring data allow the settlement models to be revised on the basis of actual performance. Predictions of long term performance can therefore be made with reasonable confidence.	This paragraph is about building structures below the surface. To avoid misunderstandings buried structures should be used instead of earth structures, as "earth structures" could also be understood as structures made of earth, e.g. some types of dykes.	x			
Germany	35	5.16	Monitoring of safety related building structures should include total and differential settlements, lateral displacements and deformations, earth and pore pressures, and inclinations along sloping ground surfaces. Monitoring of the performance of other structures with a potential impact on safety related structures, systems and components should also be considered.	Please clarify that „building structures" are meant, just to distinguish from term "structures, systems and components important to safety". Same for paras. 4.5, 4.75 and 4.76.			x	5.16 - is OK as is, not all safety related structures are buildings, they could be tanks. 4.5 - is OK as is 4.75 - is OK as is 4.76 - is OK as is
Germany	36	Table 4 Purpose	~~*~~- Monitoring of water table, - positive and negative pore pressure monitoring, - hydrogeological characterization, - monitoring of water level in reservoirs, - drainage channels and weirs	Enumeration in form of a bullet list will make the text more clear and more user-friendly. Same for all items in this table.			x	A bulleted list here would be incosistent with the rest of the table. Furthermore, the layout will further be discussed with editors in later stages of document development.
Germany	37	Chapter 6 Title	APPLYING A GRADED APPROACH TO GEOTECHNICAL ~~SITE~~ INVESTIGATIONS in Siting and Design of ~~AND EVALUATIONS FOR~~ NUCLEAR INSTALLATIONS OTHER THAN NUCLEAR POWER PLANTS	We suggest to adjust the title of this chapter to the title of the Safety Guide itself.	x	Title of Section has been modified for consistency with document title.		

Germany	38	6.2	Basis for graded approach should be Requirement 22 of SSR-1 [1] which states: “Geotechnical hazards and geological hazards, including slope instability, collapse, subsidence or uplift, and soil liquefaction, and their effect on the safety of the nuclear installation, shall be evaluated” (see also para.3.1). The application of a graded approach to the geotechnical site investigation and characterization might increase the uncertainty in the geotechnical parameters derived for the design bases. This larger uncertainty might result in a reduction of the reliability of the design. It should be ensured that any reduction of reliability is considered acceptable with respect to the overall safety objectives.	Please indicate that basis for graded approach is Requirement 22 of SSR-1, which should be evaluated for nuclear installations other than nuclear power plant.Similar methodology has become established by the last development of SSG-22 (Rev. 1) “Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors”.	x	Added reference to SSR-1 Requirement 22		
Germany	39	Table 5 Remarks	Hazard category of nuclear power plants. ~~The application of a graded approach to geotechnical site investigation is not recommended.~~ Graded approach is not applicable.	Graded approach should not be applied to geotechnical site investigation in case of nuclear power plants.	x			
Germany	40	6.5	The radiological consequences of potential failures depend on the nature of the nuclear installation and the characteristics of the site. The following factors should be considered (see also para. 9.5 of SSG-9 (Rev. 1) [~~1~~2]): *Please use the same list as in also para. 9.5 of SSG-9 (Rev. 1)*	Factors, listed here, are very similar to those, listed in para. 9.5 of SSG-9 (Rev. 1), but not the same. Are there reasons, why not the same list is used? If such reasons are essential, they must be explained. If not – please use the same list, otherwise confusing.	x	Reference number has been fixed. This list has been adapted to the needs of this Guide, and does not include specifics that may be related to the seismic hazard. Furthermore, this list has been modified based on the drafting experts' opinions and the IAEA internal reviewers and remains as presented at this time.		

Germany	41	6.7	Consequence analyses for *radiological hazard categorization* of a nuclear installation, in which a design-dependent set of source terms is used and credit is taken for some engineered mitigating features, should be considered acceptable, provided the source terms reasonably envelop all potential accident scenarios, and the robustness of the mitigating features for design basis events can be clearly demonstrated[10].	We are missing safety requirements dealing with radiological hazard categorisation, please add.	x	Added reference to para. 4.3 of SSR-1		
Germany	42	New para 6.11A on base of footnote 11	Defining an appropriate geotechnical site investigation programme for a nuclear installation is very site-specific and it is common that the programme is developed in several phases, in which the level of detail is progressively increased, based on the outcome of the previous phase. The application of a graded approach may be achieved by eliminating or reducing the effort in the final phases	We suggest to incorporate the statement from footnote 11 in the main text of current Safety Guide			x	As there is no recommendation in this text, it cannot be given a paragraph number. We find that there is value in including this note in the guide, and a footnote can serve this purpose
Germany	43	6.13	If, as a result of the site evaluation, one geotechnical hazard cannot be screened out, then a more detailed investigation and characterization should be conducted, in order to refine the evaluation. As a result of this refinement and further evaluation, the site may be considered suitable *on the basis of specific established suitability criteria*, and corresponding specific design bases should be established to ensure the safety of the nuclear installation through design, construction and operation measures	We are missing safety requirements concerning specific established suitability criteria and definition of "suitability criteria" as well, please add.	x	Added SSR-1 Requirement 4		

Germany	44	7.2	Organizations in the supply chain are required to either have their own arrangements for managing safety (see Requirement 11 of GSR Part 2 [10])~~. They may have their own management system approved by the main contractor,~~ or else adhere to the management system of the main contractor.	Clarification			x	The second sentence is necessary as the first rephrases an existing requirement, which does not concern main contractors. No changes have been made to the text as a result of this comment.
Germany	45	Title after 7.2	SCOPE OF THE MANAGEMENT SYSTEM IN RELATION TO THE GEOTECHNICAL EVALUATION and monitoring OF SITES FOR NUCLEAR INSTALLATIONS	Monitoring is missing	x			
Germany	46	After 7.20 New chapter	**Control of screening procedures with respect to geological und geotechnical hazards for graded approach**	Requirement 22 of SSR-1 [1] states: "Geotechnical hazards and geological hazards, including slope instability, collapse, subsidence or uplift, and soil liquefaction, and their effect on the safety of the nuclear installation, shall be evaluated." Screening procedure for any nuclear installation should be carried out with respect to this requirement and documented. Please add a chapter on this topic.			x	Safety Guides are consensus documents based on existing Member State practices and experiences. Screening procedures details would be too specific to incorporate in a Safety Standard. No clear proposal for content has been provided, and at this time, the proposed 'title' for a 'chapter' does not seem warranted or feasible. No changes have been made to the text as a result of this comment.

Germany	47	REFE-RENCES	[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSR-1, IAEA, Vienna (2019). [~~1~~2] INTERNATIONAL ATOMIC ENERGY AGENCY, Seismic Hazards in Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSG-9 (Rev. 1), IAEA, Vienna (2022). ~~[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSR-1, IAEA, Vienna (2019).~~	SSR-1 should be Reference [1], as mentioned first in the text. SSG-9 (Rev. 1) is then reference [2].	x			

Japan	1	1.7.	This Safety Guide provides recommendations on the geotechnical engineering aspects necessary for the establishment of parameters used in the development of the design basis for nuclear installations. It covers the programme of site investigation that should be performed to obtain appropriate understanding of the subsurface conditions, which is necessary for determining whether the conditions are suitable for the construction of a nuclear installation. It provides recommendations on the characteristics of the geotechnical profiles and the parameters that are suitable for use in performing the geotechnical analyses for the design of a nuclear installation. In addition, these recommendations should be applied appropriately, considering the environment around the site of nuclear installations such as the characteristics of the foundation ground. In addition, these recommendations should be appropriately applied in consideration of environment surrounding the nuclear installations site and characteristics of the foundation ground etc. It also addresses the approach to monitoring of geotechnical parameters, the application of a graded approach and the application of a management system.	As stated in 2.7(b), there are various types of ground on sites where nuclear reactor facilities are located, and the recommendations proposed in this safety guideline do not necessarily apply to all ground types. Therefore, the recommendations in this guide need to be applied appropriately depending on the environment around the site of the nuclear reactor facility and the characteristics of the foundation ground of the nuclear facility.			x	Although the comment raised is very good, environmental considerations are out of the scope of this Safety Guide and therefore the proposed text will not be accepted for this Guide.

Japan	2	1.9.	This Safety Guide also considers foundation works, including consequences for the geotechnical profiles and parameters, the possible improvement techniques of foundation material and the appropriate choice of the foundation system in accordance with the soil capacity. Also discussed are ~~E~~earth structures, including natural slopes, and buried structures ~~are also considered, including natural slopes and buried structures,~~ the safety of which need to be assessed in the site safety assessment. The Safety Guide provides recommendations on appropriate methods for the analysis of the behaviour of such structures under static and dynamic loads.	Clarification. In this sentence, both of natural slopes and buried structures are included in earth structures. Only 'natural slopes' should be included in earth structures.	x			
Japan	3	2.10.	(b). Rotary borehole drilling, coring or sounding. These techniques are used to define the overall site conditions, and to collect basic information about the subsurface materials. The method selected (i.e. the type of investigation hole drilled) should be justifiable by the site conditions. Borehole drilling and ~~sedimentary~~ coring involve extraction of cores or other samples for rock or soil qualification and laboratory testing. Sounding measures the resistance offered by the soil and is used for determination of the soil profile. ………	Clarification. The target of borehole drilling and coring is soil and rock. There is no reason to limit coring to 'sedimentary'.	x			

Japan	4	2.14.	A subsurface investigation and laboratory testing programme should be conducted at the site using a drilling scheme that is suited to the planned layout of the nuclear installation, in order to adequately characterize the geotechnical conditions of the site. Where the site is relatively uniform soil and bedrock conditions, aA uniform grid method can be applied to a site with relatively uniform soil and bedrock conditions. In other cases, the grid spacing and orientation should be defined based on the extent, heterogeneity and structural geometry of the subsurface units and discontinuities. Where heterogeneity and discontinuities are present, the usual investigation process should be supplemented with investigation holes at spacings small enough (and depths large enough) to permit detection of the geological and geotechnical features and their proper evaluation.	For better understanding.It is easier to understand if the text has the same structure as the text that follows (line 6: Where heterogeneity and discontinuities are present, ・・・・・).	x			
Japan	5	2.30. (o)	(o) Observational Seismic and historical seismic data, including as well as relevant seismological studies;	Clarification for the difference between observational (instrumental) and historical data. Seismological studies do not necessary belong to “seismic data.”	x			
Japan	6	2.34.	Geotechnical tests address the near field area (to a depth of at least the shorter dimension of the structure’s base). The tests can be performed by many different techniques, such as using boreholes or working directly from ground level. Techniques for geotechnical investigations of soil and rock samples are shown in Table 2.	Clarification for the underlined sentence.	x	Text was updated per other comments on this paragraph.		

Japan	7	2.40./L7	In these parametric studies, the state dependency (e.g.,~~i.e~~. density, stress ~~and~~, strain, and stiffness) of the responses should be considered.	Not only density, stress and strain but also stiffness of the ground is an important parameter for structural design.	x			
Japan	8	2.42. (h)	Even though conceptually the profile is unique to a particular site, various related design profiles for different purposes should be adopted to allow for different hypotheses in the analysis. These include design profiles for the assessment of the following: ……… (h) Earth pressure and deformation in buried structures.	Clarification for the deformation.	x	Added 'or displacements' after deformation. We are refering to deformations of buried pipes, or risidual/differential displacements.		
Japan	9	2.43.	For the purpose of seismic site response analyses, the following categorization should be used: — Type 1 sites: Vs,30m > 1100 m/s; — Type 2 sites: 1100 m/s > Vs,30m > 360 m/s; — Type 3 sites: 360m/s > Vs,30m. This site categorization is based on the assumption that the shear wave velocity smoothly increases with depth. If this assumption is not fulfilled (i.e. Vs decreases or abruptly increases with depth in the upper 30 metres or if there is a strong impedance contrast at any depth) , specific analyses including site response assessments should be performed in accordance with best practices, independent of the site type. If this site categorization is not applicable, soil investigations should be performed to determine the soil type for the site, or to provide comprehensive data for further analyses.	Although VS30 is globally accepted method for geotechnical analysis, it seems that it has not been adopted in IAEA Safety Standard Series so far. Why IAEA choose VS30 in this guide? Also, will there be any impact on other Guide?		x Vs,30m is consistent with the guidance provided in SSG-9 Rev.1. It was chosen because it is more specific, and less vague (confusing) for the reader, and as accurately stated in your reason, it is widely accpeted. This specification will not impact any other Safety Guides.		

Japan	10	2.47.	Depending on engineering practices, the seismic scenario-compatible outcrop motions recorded at a reference site (e.g. a site with a reference Vs,30m value) should be selected from available ground motion databases. These outcrop input motions should be chosen in accordance with the event type, magnitude, distance to the seismic source, and directivity effects, which govern the intensity, frequency content, duration and other relevant seismic parameters. If necessary, these records should be ~~intensity or duration~~ scaled in intensity or duration, or ~~spectrum~~ modified in spectrum to match the target seismic scenario, while maintaining consistency with the ground shaking characteristics. Synthetic records can be also tailored based on a combination of Fourier amplitude spectra and random vibration theory.	Clarification for "ground motion database".Modified for better understanding.	x	Ground motion database clarification provided in paranthesis:databases that include strong motion recordings and associated metadata		
Japan	11	2.52.	When the site is in the near field of a seismic source, the site response model should be carefully determined so that the frequency content of the input motion ~~generated~~ affected by the earthquake mechanism may be appropriately assessed considering the directivity effects. For these cases, time histories should be selected to include pulse like motions in the ensemble of input motions.	Ground motions are generated by the earthquake rupture and may be affected by its mechanism especially when the site is close to the fault.	x			

Japan	12	3.15.	If it has been found necessary to make improvements in the subsurface conditions due to the risk of slope failure or other unfavourable soil or ground conditions, the improvements (e.g. jet ~~grounding~~grouting, ground cementation) should be designed and conducted during the ongoing stage of site characterization and/or site construction, and their effectiveness should be verified by in situ testing (see also paras 3.48–3.50 and 4.16–4.19).	'Jet grouting' is more common notation for the method of improving soil or ground conditions.	x			
Japan	13	3.21.	If the safety factor is not greater than the specified minimum (regulatory expectation), a dynamic response analysis should be performed based on the design seismic ground motion to evaluate the seismic effects more precisely. If necessary, the permanent displacements should be evaluated to assess safety and stability in cases where the safety factor is close to unity.	Since there are various methods for evaluating "permanent displacements," an explanation of the assessment methods for "permanent displacements" should be added.		x Added alternative wording in paranthesis. From para 5.5 of NS-G-3.6. Permanent displacement = residual deformation.		
Japan	14	3.36.	It is generally possible to compute a lower bound solution in all of the three approaches to liquefaction engineering assessments outlined in paras 3.41–3.43 by using conservative assumptions for the design profile parameters. For loose sands, a slight increase in the seismic stresses could bring the soil into an unstable condition, with possible large deformations, while in medium to dense sands even a large increase in seismic stresses would generate only limited deformations despite 100% pore pressure may possibly buildup. Hence, cliff edge effects should be considered.	"limited deformations" should be described as the possible feature of deformations.	x	Sentence is rephrased for clarity."…in medium and dense sands even a large increase in seismic stresses might only generate limited deformations, even if pore pressure is 100%."		

Japan	15	3.37.	For deterministic assessments, the safety factor against liquefaction triggering should be greater than the limit value considered for the calculation and should be consistent with the methods used (regulations or standardized codes). For probabilistic assessments, the frequency of liquefaction triggering can be set to be acceptably low value. should be less than 10^{-6} per year.	The background of 10^{-6} is unclear. It is assumed that this value is not widely used in member states. Thus, the last sentence should be modified.	x	Text was changed to …should be established sufficiently low to satisfy performance targets.		
Japan	16	3.38.	Fulfilling the minimum safety factor or annual probability of liquefaction triggering might not guarantee an acceptable displacement or deformation performance. Thus, the rest of the liquefaction engineering assessments should be performed independent of the liquefaction triggering evaluation outcome.	Since, in case of liquefaction triggering of the interest ground, its consequences (i.e., settlement or lateral spreading or impact to structures etc.) should be evaluated based on the purpose of the assessment, the type of the liquefaction engineering assessments should be described.	x	Added the relevant parts of the text that after liquefaction engineering assessments.		

Japan	17	3.44.	If it is concluded that soils could liquefy during the design basis seismic event, post-liquefaction residual strength and overall post-liquefaction stability assessments should be performed, taking into consideration the uncertainties associated with the parameters and methodology used. Semi-empirical, analytical and calibrated constitutive model based assessments can also be used to assess post cyclic residual strength. Post-liquefaction stability assessments should include the applicable potential failure modes, including slope stability, bearing capacity, uplift, sliding and toppling, and others if relevant. These assessments should also consider ~~earthquake aftershocks during transitional phases (pore water pressures have not dissipated) and~~ all changes of soil states after the main shock (see para. 4.93).	It is not necessary to evaluate aftershocks for all ground types. Some member states carry out safety margin assessments only for the main shock. The description about the aftershocks is not necessary. See “Reason” in para. #24			x	The statement is worded as 'should consider', the consideration it does not intend to mandate the evaluation if the ground type does not require it; however, a consideration of aftershocks is necessary and therefore the text has not been deleted. However, 'if applicable' was added at the end of the sentence.
Japan	18	4.15.	Testing requirements ~~for proper control and documentation~~ of preliminary foundation work should be specified for proper control and documentation. Testing should include both field and laboratory tests and be performed throughout the construction period.	Modified for better understandings.	x			
Japan	19	4.24.	The soil and rock characterization should include classification, stiffness and strength, and hydrogeologic properties. Engineering properties should include index parameter, density, shear strength, seismic wave velocity, moduli, compressibility, stress state and cyclic resistance. Some of these properties may be strain dependent; testing and reporting of these properties should cover the strain range expected from design analysis.	Clarification. A term "index term" has are used in this guide.		x Engineering properties is stated at the beginning of the sentence. Index properties is what is implied, but in order to avoid repetitions it the 'properties' word was removed by editors. Index parameter isn't what is inteded here. The word 'properties' was added after index instead.		

Japan	20	4.27. (a)	(a) The best estimate value for body wave (compression and shear) velocity profiles with a range of variation as determined by in situ measurement techniques. These values should be consistent with the strain levels anticipated from the design ~~earthquake~~ <u>basis ground motions</u>.	To keep a consistent with the terminology used in SSG-9 (Rev. 1).	x			
Japan	21	4.43. (b)	(b) Assuming no connectivity between the structure and the lateral soil <u>over the upper half of the embedment or 6 metres</u>, whichever is less. Full connection between the structure and lateral soil elements may be assumed if adjacent structures founded at a higher elevation produce a surcharge equivalent to at least 6 metres of soil.	In case citing the specific values used in Member States, a cautionary statement regarding their applicability should be written in a footnote rather than in the document's main body. The same comment for para 4.58 and 4.62.			x	This embedment assumption has been extensively discussed with the drafting experts, and it was identified as universally applicable (normal engineering methodology). If there are specific incidences where this does not apply, please provide a suggested value to replace this depth and the text will be modified as necessary.

Japan	22	4.58.	For structures founded above the groundwater table level, the angle of shearing resistance between soil and structure should be less than or equal to the angle of effective shearing resistance for cast-in-place foundations and should be less than or equal to two thirds of the angle of effective shearing resistance for precast foundations. If the sliding resistance is the sum of shear friction along the foundation and the soil lateral pressure (i.e. up to the full passive ~~pressures~~ pressure capacity induced by embedment effects), a consistent lateral displacement criterion for activating the passive soil pressure should be used. This involves the use of a static (as opposed to dynamic) coefficient of friction consistent with the use of partial versus full passive pressure.	In case citing the specific values used in Member States, a cautionary statement regarding their applicability should be written in a footnote rather than in the document's main body. The same comment for para 4.43 and 4.62. Typo. It seems that “pressures” can be deleted.		x Two thirds is not a Member State specific number, but a geometrically important value here (used in normal engineering practices). No change will be made to this section. "pressures" was deleted.		
Japan	23	4.62.	If the estimated surface area of the uplift of the foundation is larger than 20% of the total surface of the foundation, a more sophisticated method should be used in the analysis of the dynamic soil–structure interaction.	In case citing the specific values used in Member States, a cautionary statement regarding their applicability should be written in a footnote rather than in the document's main body. The same comment for para 4.43 and 4.58.			x	This language was drafted as a result of numerous discussions with the drafting experts, it is not intended to be limiting, therefore, differing practices are also included. However, the aim of this Safety Guide is to present the most current and proven engineering approaches and methodologies within the text (aimed at embarking coutnries).
Japan	24	4.91.	The effects of heave due to excavation and unloading, expansive soils or rocks, and glacial rebound should be evaluated where applicable.	This subsection (*Heave effects on foundations*) mainly deals with frost heave. Guidance on heave due to expansive soils or rocks and glacial rebound should also be included.	x			

Japan	25	4.93.	~~The time, extent and duration of seismic aftershocks are unpredictable: consequently, changes of soil states after a main shock should be taken into account for aftershock safety assessments and evaluations. For example, degradation of soil rigidity and strength might result from decreased confining pressure caused by excess pore water pressure that could take considerable time to dissipate.~~	It is not necessary to evaluate aftershocks for all ground types. See “Reason” in comment #1			x	should be taken into account' is not a limiting phrase. Therefore this language will not be changed at this time. See response to comment #1
Japan	26	4.94.	At sites that are expected to experience inundation caused by a flood or tsunami, potential ground erosion including changes in geometry and material properties should also be taken into account for evaluations according to the nature of the event (duration, peak flow, maximum water height). In particular, considerations for phenomenon related to water flows leading to the failure of earth structures or soils foundations such as internal and external erosion~~,~~ and scouring should be given to.	Uncomplete sentence.		x Updated text to: 'This holds in particular for considerations of phenomenon related to water flows...'		

Japan	27	4.99.	The input parameters for the assessment of embedded structures are similar to those for foundations and retaining walls, and information on them should be obtained accordingly. Supplementary information should be obtained on the safety and serviceability criteria for the underground walls (particularly in relation to leaktightness) to be met under different loading cases. For this purpose, the possible cracking of concrete (limiting the stresses in reinforcement bars and concrete) should be taken into account in the design of the foundation and the construction joints of buildings. Recommendations in relation to containment considerations are provided in IAEA Safety Standards Series No. SSG-53, Design of the Reactor Containment and Associated Systems for Nuclear Power Plants [9].	Specify the relation between crack evaluation of buried structures and the content of SSG-53. It is not clear what parts of SSG-53 should be confirmed.	x	Added a clarification statement at the beginning of the sentence.		
Japan	28	5.1.	Field monitoring, in particular quantitative measurements of performance outputs, should be implemented to define and monitor the geotechnical parameters necessary for the safe design, construction and operation of the nuclear installation. Electrical devices have become the standard method of monitoring, and widely used in geotechnical monitoring applications.	Consistency of terminology. 'Geotechnical monitoring' is used in other paragraphs (e.g., para. 5.10, 5.11).			x	The term geo here is used as a wider category that covers geotechnical, geological, geomechanical, geochemical and geophysical. It is a widely used term; however if it is unclear - a change can be made to the text.

Japan	29	6.2.	The application of a graded approach to the geotechnical site investigation and characterization might increase the uncertainty in the geotechnical parameters used as input ~~derived~~ for the design bases. This larger uncertainty might result in a reduction of the reliability of the design. It should be ensured that any reduction of reliability is considered acceptable with respect to the overall safety objectives.	The meaning of 'derived for' seems unclear. It is better to use the same expression as "used as input for the design bases" in para 6.14.	x			
Pakistan	1	1.5/1st	This Safety Guide is intended for use by ~~safety assessors~~ **operating organizations, licensees** and regulatory bodies involved in the licensing of nuclear installations, **research organizations** as well as designers of such installations.	Safety assessors is a general term and does not reflect any particular organization. Moreover, term safety assessor is not used in IAEA latest glossary.		x		
Pakistan	2	1.6/1st	~~In this Safety Guide, the word 'geotechnical' is used as a broader term, which covers some geophysical, geological, geomorphological and geomechanical aspects relevant to siting of nuclear installations (as specified within the text).~~	Para 1.6, may be deleted as it is not consistent with universal definition and attributes of term "geotechnical". In all earth science and civil engineering disciplines, term "geotechnical" is used specifically for soil/rock characteristics and focuses on the engineering behaviour of earth materials. Therefore, it may be used for its intended purpose rather using in broader sense.			x	The paragraph was re-written to provide scope clarity for geotechnical aspects.

Pakistan	3	General comment (Para 2)	It is proposed that under Para 2 all the text related to siting process like from site investigation stage to site conformation may be deleted.	It has been observed that various stages from site investigation to site confirmation have been mentioned in detail which is already covered in SSR-1. Further, this guide is intended to provide guidance on geotechnical aspects related to siting of nuclear installations. Other sister guides like SSG-9 also provides guidance specifically. However, current draft seems to have extra details which may be deleted.			x	This comment is not clear. Based on current understanding, the comment requests that Section 2 is deleted. Section 2 contains geotechnical site considerations that are essential and the most relevant part of geotechnical investigation, data collection, geotechnical parameter development, etc. Additionally, without section 2, the rest of the document would be irrelevant.
Pakistan	4	Table 5	In table 5, guidance about applying graded approach for hazard categories medium and low is not mentioned.	Application and need of geotechnical studies for these hazard categories is important, however, no information in this regard has been given. However, the same has been reflected in para 6.10. Therefore, the same may be included in the table.	x			
Sweden	1	2.4c	Pre-operational stage. Studies, **monitoring** and investigations started	Establishing a baseline of geological condition, such as rock deformation (seismic and aseismic monitoring), is e.g. of importance before construction begins and gives information of value when assessing the long term safety of geological repositories.	x			

Sweden	1	General	Since the proposed SG is an evolution of the standard for NPP:s, the text seems to be more directed towards surface facilities. See comments below for suggestions to clarify application to other nuclear installations.				x	Comments by Sweden have been addressed, there is no clear proposal or reason given in this comment - no changes to the document.
Sweden	2	2.5d	(e.g. faults, fracture**s** ~~zones~~, cavities)	Faults and fractures zones are essentially the same.			x	Faults can be interpreted as fractures zone; however, not all fracture zones may be faults. Therefore, the original language is clearer. No changes have been made as a result of this comment.
Sweden	3	2.5e	Hydrogeological**,** hydrological and **hydrochemical** information (e.g. groundwater regime, hydrostratigraphical and hydrogeological model, quality of the groundwater, **water composition**, connections between groundwater and surface water).	Changes is groundwater composition can affect the stability of the soil (i.e. clay) and is vital when siting a geological repository.	x			It is noted that geological repositories are out of the scope of this Safety Guide.
Sweden	4	2.7	In this stage, geological, geomorphological, geotechnical**, hydrochemical** and hydrogeological aspects are considered, and some regions or areas may be excluded from further consideration.	As mentioned above, when siting a geological repository the groundwater composition is of vital importance. The text seems to be more directed towards surface facilities.			x	The text is directed at surface facilities. Underground geological repositories are out of the scope of this document.

Sweden	6	2.13b	A revised estimation of **mechanical stability of underground openings and** the bearing capacity of the soil and bedrock underlying the nuclear installation;	Mechanical stability of underground facilities is equally important, for example storage facilities for spent nuclear fuel and geological repositories.			x	Underground deep geological repositories are out of the scope of this document. Scope
Sweden	7	2.14	Missing information.	Any drilling campaign to investigate the bedrock should be based on geophysical investigation that guides the drilling.			x	The first sentence of this paragraph is inclusive of the information provided in the reason for this comment. No changes have been made due to this comment.
Sweden	8	2.19	If ~~the site is a rock site or if~~ competent rock **is exposed on the surface, or** encountered at a shallow depth,	The original text is rather confusing: please consider rewriting.	x			
Sweden	9	2.1 2.19	drilling should enable the discontinuities ~~or zones of weakness~~ or alteration to be adequately characterized	Zones of weakness are per definition discontinuities.			x	Although typically 'zones of weakness' are considered disconitnuities, stating this ensures that zones of weakness will not be overlooked as such. No change will be made as a result of this comment.
Sweden	10	2.27b(iii)	Faults ~~and fracture zones,~~ and associated complex fracture systems	Same comment as comment 2, a fault is a zone with increased fracture intensity=fracture zone.			x	Faults can be interpreted as fractures zone; however, not all fracture zones may be faults. Therefore, the original language is clearer. No changes have been made as a result of this comment.

Sweden	11	2.30	Hydrochemical maps	Suggests to include hydrochemical maps to the list. This is of particular interest for geological repositories.			x	Underground deep geological repositories are out of the scope of this document.
Sweden	12	2.30o	Seismic data, historical earthquake and **paleoseismic** records, including seismological studies;	Historical records are rather limited in time, please consider adding paleoseismic records which can address long recurrence times as well as better constrain the temporal and spatial variation in seismicity. This is of particular interest in stable continental regions with limited seismic data.	x			
Sweden	13	Table 1	Magnetic techniques.“Area of application”**Site categorization**, areas of humidity."Remarks"**Identification of surface lineaments.**	Magnetic techniques is of vital importance characterizing a site in remote areas, i.e. lacking infrastructure that disturbs the magnetic measurement, in a crystalline basement, such as the Baltic shield. It detects magnetic lineaments that many times are the surface trace of vertical-subvertical deformation zones where the alteration have created a magnetic linear anomaly. Seismic refraction and reflection are not as efficient in detecting these structures in these areas. Please consider adding Site categorization to the “Area of application”.	x			
Sweden	14	3.3	~~deformation zones (e.g~~. **faults**~~, shear zones)~~	A shear zone is by definition a brittle fault.			x	See comment response above about deleting what is considered 'duplication'

Sweden	15	3.18	such factors as distance from the site or installation, orientation, slope angle, height, groundwater level**,** **climate induced changes** and geology.	Considering climate change (such as changing precipitation patterns) and its influence on slope stability. Climate change in the coming decades is very important when assessing suitable sites.		x changes in general would be better		
Sweden	16	5.11	along with protocols for data dissemination and **performed maintenance measures**	Any measures taken due to the monitor program needs to be documented and reported. Please consider adding "performed maintenance measures".			x	Comment is not clear. As we understand it, maintenance of software and hardware should be specified within the specifications and qualifications of hardware and software, which is already listed in the sentence.
UK	1	Document Title	Geotechnical Aspects in Siting, Design, Construction and Operation of Nuclear Installations	Change proposed to reflect the full scope of the safety guide within the title.			x	The current title addresses the main focus of this guide, which are siting (site evaluation + hazards) and design of nuclear installations. The stages of site evaluation are as follows: 1. selection stage 2.characterization stage 3. pre-operational stage and 4. operational stage. Therefore the scope and applicability of the guide are for the entire lifetime of the installation (except decommissioning). We provide limited guidance related to construction and operation these topics are not the main focus of the document. Additional note for clarity: please consider that siting and design in the title are to be interpreted as verbs rather than nouns.

UK	2	2.4(d)/2	Please add the highlighted text - Operational stage. Selected investigations and monitoring are pursued over the lifetime of the installation to provide reassurance of conditions, to demonstrate the continued validity of the safety assessment and potentially to support future recharacterization if required.	Whilst more detail is provided in para. 2.26, the supplementary text contextualises the expectation?	x			
UK	3	2.6/3	Please add the highlighted text - The detail of this documentation should be sufficient to support the safety justification, evaluations, and analyses and to support independent peer reviews and review and assessment by the regulatory body.	In the UK the owner of and primary customer for the safety case/safety justification is the end user, with regulators' requirements being secondary. The proposed change just reflects that relative importance.	x			

UK	4	2.10/5	Please add the highlighted text - In the verification stage, the investigation programme should cover the site as a whole, but should also be conducted on a smaller scale appropriate for the layout of the nuclear installation. The investigation programme should take into account site characteristics (e.g. compositional and structural heterogeneity within the subsurface materials) and their variability, available from the earlier stages of investigation, and the overall planned layout. The ground investigation phase should be carefully planned to ensure that it is structured, complete and sufficient to satisfy all stakeholders' requirements and to address any uncertainties. Where practicable, core samples should be retained to support future investigation. The following site investigation techniques and related points should be considered:	In UK experience, failure to adequately plan the ground investigation can result in an incoherent/incomplete/imperfect justification. The provision of a specification setting out the requirements of all stakeholders/end-users (e.g. designers, safety case, seismic hazard specialists etc.) should help deliver a cogent justification. This can also improve efficiency by avoiding duplication of effort. This is an important point that is worth emphasising.The retention of core samples is later mentioned in section 7, but it would be helpful to introduce the requirement in section 2. Long term retention of core samples has proved valuable for future site characterization and other infrastructure projects. The UK expectation would be for the core retention strategy to be included in the campaign specification.	x	The first proposed sentence was added, the second proposed sentence is already covered in 2.10 (b).		

UK	5	2.12/5	Please add the highlighted text - The content of the site characterization, in situ testing and laboratory testing programmes conducted in the confirmation stage should be planned on the basis of both the preliminary characteristics of the nuclear installation and the geotechnical characteristics of the site as identified in the previous stage. The plan should reflect all end user requirements, including information required to support the detailed design. Data validation/verification should be undertaken in a timely manner to enable additional or repeat testing where issues are identified. The results of these investigations should be used in evaluating the suitability of the preliminary layout and modifying it, as necessary. If planned layouts are changed, it is important to consider whether additional testing is required in new, untested locations.	UK has experienced situations where test data was rejected (because it was not considered reliable or robust) after the ground investigation work had been concluded. No new data was then collected because it was deemed too expensive to remobilise the investigation work. This has resulted in incomplete data being available to support the detailed design phase. The timeliness of validation/verification and interpretation of datasets between investigation phases if therefore important.	x			

UK	6	2.9(g)	Please add the highlighted text - Dewatering requirements. Groundwater monitoring should be undertaken early in the geotechnical investigation to inform the hydrological and hydrogeological models. This should be specified and scoped to meet all stakeholder needs including any requirement for de-watering;	The verification and confirmation stages are silent regarding the requirement for groundwater monitoring. The proposed addition is in the verification section, but it could also be added in the confirmation section. It takes time to gather sufficient data to inform the hydrological and hydrogeological models and therefore it is important to instrument relevant boreholes early on in the Geotechnical Investigation. The monitoring should be specified to provide sufficient data to meet all end-user requirements. This information is also needed to inform dewatering needs – important for operator safety – and potentially long-term suitability of the site.			x	Monitoring is addressed in Section 5, we do not mention monitoring of any of the other bulleted items, therefore, adding it here would cause an incosistency. See para 5.5.

UK	7	2.23/10	Please add the highlighted text- Geotechnical investigations should be continued after the start of construction of the nuclear installation until the start of operation of the installation to complete and refine the assessment of site characteristics by incorporating geological and geotechnical data that are newly obtained during the excavation and construction of the foundations. As subsurface material is exposed during and after foundation excavations, it should be carefully observed and mapped for comparison with the assumed design conditions and confirmed with the design itself. Deformation features (e.g. faults, potential soft zones or soft interbeds in rocks, lateral compositional changes, materials susceptible to volume change, other features of engineering significance) discovered during construction should be carefully assessed to ensure the safety objectives are not compromised2. If necessary, in situ tests may also be performed in the base of the excavation. The existing ground model should be validated and verified or should be revised to reflect any new information.	UK agrees with this section. The additional text is proposed to highlight the importance of verifying or changing the ground model to reflect new information. Any unexpected conditions should be investigated and analysed to ensure it does not undermine the design	x			

UK	8	2.24	Please add the highlighted text- Where there is a particular concern about settlement, the requirement for re-assurance monitoring should be defined within the specification and programme for testing. The data obtained on actual performance in settlements and deformations due to structural loads should be used to verify the predicted behaviour of the foundations. Since the construction sequence is generally long, these monitoring data should be used to revise the settlement models and the soil properties on the basis of actual performance, if needed.	If there is a particular concern regarding actual settling on a construction site, it should be captured in the plan/specification/ end-user requirements (mentioned previously) with appropriate testing being undertaken as soon as practicable within the GI.			x	Monitoring is addressed in Section 5. See paras. 5.3, 5.4 and 5.16.
UK	9	2.33/7	Please add the highlighted text- ……….. The tests should include some or all of the different techniques shown in Table 1, in accordance with best practices taking into account the subsurface conditions. Geophysical tests can be verified/complimented by the subsequent in-situ tests. Complimentary data sets may be combined to provide a robust characterisation and understanding of ground conditions.	To provide a link to in-situ testing to improve the analysis.	x			

UK	10	2.39	Please add the highlighted text- The results of the geotechnical investigations and the resulting site characterization should be documented in a detailed geotechnical report. This report should be compiled at the end of the confirmation stage and updated during the pre-operational and operational stages. In some circumstances, such as a large ground investigation, it may be beneficial to have separate reports with constrained scopes. For example a factual account of the geotechnical investigation and resultant data, an interpretative report analysing the data, and a geotechnical (design) report. The ~~This~~ report(s) should include the following items:	In some circumstances it may be beneficial to have separate reports covering each of the key stages, rather than trying to put it all in a single report – See Eurocode 7. These would consist of; reporting the geotechnical investigation and presenting data arising from it, interpreting the accumulated GI data and a geotechnical (design) report.		x Added the first suggested statement. Did not add the second, as examples of this level of detail add complexity to the readibility of the recommendations.		
UK	11	Table 2	Please include:· CPTU - Cone Penetration Test with pore water pressure measurement· Menard pressuremeter test (possibly covered by the pressure meter test)· Flexible dilatometer test· Flat dilatometer test· Weight sounding test· Borehole breakouts is not mentioned, but can be used to determine in-situ stress direction within boreholes	UK considers that these additional tests should be included in Table 2.			x	Cone penetration tests are included. Dilatometer tests are included. Please note that this table is not an exhaustive list of tests, as the intent is just to give the audience an overview of the types of testing. This is indicated in para. 2.34, which has been updated to state: '...A list of some techniques for geotechnical investigations...'

UK	12	Table 3	Please include: additional tests from Annex 1 of EC7-2 that are not included (e.g. CBR, laboratory vane test etc.)	UK considers that these additional tests should be included in Table 3.			x	Para. 2.37 has been updated to state: "The laboratory tests should be conducted in conditions adequately representing the conditions of the site. A list of some techniques and their purposes is shown in Table 3. " The reason for the update is that the table is not meant to contain an exhaustive list, but just to provide a small sample of types of tests that may be applicable. Mostly directed to embarking countries that may need some additional guidance on the topic.
UK	13	5.13/5	Please add the highlighted text- Specifications for the selection of geotechnical monitoring devices — including preferences in terms of sensors, data acquisition systems and related components and accessories — should be defined based on an assessment of long term exposure to environmental conditions, including atmospheric conditions, temperature, hydrogeological conditions, hydrochemical conditions, electromagnetic interference and sources of background noise. On site seismic monitoring should be invoked as soon as practicable, preferably being available during construction as well as during operations.	UK considers that on-site or near-site seismic monitoring provides further geotechnical information that is valuable as part of the characterization of the site.			x	Seismic monitoring is covered in SSR-1, SSG-9 Rev. 1 and in SSG-67. It is out of scope of this guide, here we are only concerned with geotechnical monitoring.

Ukraine	1	4.109	Long, buried piping systems are primarily subjected to relative displacement induced strains rather than inertial effects. These strains are induced primarily by the passage of seismic waves and by differential displacement between a building attachment point (i.e. an anchor point) and the ground surrounding the buried system. The following seismically induced loadings should be considered for long buried piping, conduits and tunnels: (a) Strains induced by the passage of seismic waves; (b) Differential displacements in zones of different materials; (c) Deformation and shaking of the ground or anchor points relative to the ground; (d) Ground failures such as liquefaction, landslides, settlements and discontinuous displacements. Seismic oscillation internal liquid in long buried pipes also should be considered.	Internal liquid can influence the frequencies of natural oscillations and form of oscillations and make an additional dynamic impact on long buried pipes.		x Added a statement related to sloshing of internal liquids due to seismic waves		

Ukraine	2	7.10	Studies, evaluations and analyses should be reviewed by qualified individuals who have not participated in their specification or in their development, with the purpose of ensuring that the intended scope has been met, the technical approach and method of analysis are valid, and the results are correct. Evidence of the review work should be produced and kept as a quality management record in the project archives. The qualifications of the reviewers should be such that they could have competently performed the study, evaluation or analyses that they are reviewing.Details of the findings from the study and analysis shall provide the possibility for their comprehensive review.	Information detailing with the scope is essential for the qualified independed evaluation and review. This aspect is relevant for large nuclear power plants and for applying a graded approach to geotechnical siting investigations and activities for other types of nuclear installations.			x	The first sentence of this paragraph targets specifically the comprehensive review that the additional sentence proposes. Therefore, this comment has not been accepted because it would result in a redundancy. The reviews are already covered by the existing text.
Ukraine	3	General		According to the References, the first document in this list is indicated as: IAEA, Seismic Hazards in Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSG-9 (Rev. 1), IAEA, Vienna (2022), and the second document is indicated as: IAEA, Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSR-1, IAEA, Vienna (2019). In new Section 6 para. 6.12, the reference to SSR-1 [1] is not correct. In addition, it should be noted that such incorrect references are also found in other sections of the draft document. For example, paras. 1.1, 1.3, 2.1, 2.7 etc.	x			

USA	1	Para 2.34	Geotechnical tests address the near field area (to a depth of at least twice the shorter dimension of the structure's base, or to a depth where stress increase due to estimated foundation load is less than 10 % of the effective overburden stress). The tests can be performed by many different techniques, such as using boreholes or working directly from ground level. Techniques for geotechnical investigations of soil and rock samples are shown in Table 2. The appropriate tests should be selected, taking into account the subsurface conditions, and conducted. In some cases (e.g. when developing seismic site response characteristics), geotechnical testing of samples taken deeper in the soil profile is needed.	Common engineering practice suggests that geotechnical exploration points should extend below the depth where the stress increase from foundation load is significant. Normally it should be two times the width of foundation or less than 10 % of the stress increase from foundation load.	x			
USA	2	Para 2.39(l)	Descriptions of the groundwater regime ~~and~~, the physicochemical properties of the groundwater, and the groundwater chemicals such as sulphate, chloride and pH.	The presence of certain chemicals (e.g. sulfates, chlorides) and pH levels in groundwater above permissible limits can cause damage to concrete foundations.		x Added 'physical and chemical' after physiochemical for clarity.		
USA	3	Para 2.5 (e)	Hydrogeological and hydrological information (e.g. groundwater regime, hydrostratigraphical and hydrogeological model, quality of the groundwater, groundwater table, groundwater chemicals such as sulphate, chloride and pH, connections between groundwater and surface water).	The position of groundwater has a significant effect on the bearing capacity of the soil, slope stability, and liquefaction potential. The presence of certain chemicals (e.g. sulfates, chlorides) and pH levels in groundwater above permissible limits can cause damage to concrete foundations.	x			

USA	4	Scope	This Safety Guide, the word ‘geotechnical’ is used as a broader term, which covers some geophysical, geological, geomorphological, geochemical, and geo-mechanical aspects relevant to siting of nuclear installations (as specified within the text).	Geochemical aspects were discussed in the guidance specifically addressing presence of sulphates and other geochemical properties of soil that may cause swelling or liquefaction.			x	Para. 1.6 was deleted on the basis of another comment. Geochemical aspects have been mentioned in paragraphs that list different disciplines throughout the document
USA	5	Page 6; Section 2	Technical information that is provided in Sections 3 and 4 should be referenced more frequently in Section 2, especially the “PROGRAMME” subsection.	A reviewer of the subsection “Geotechnical Investigation Programme for Siting of Nuclear Installations” could attain and use the information quicker if the technical information from Sections 3 and 4 were referenced more frequently within that subsection.		x Will be considered during the addressing Member States comments phase.		
USA	6	Page 7; 2.5 (b)	Change “Characterization of soil and rock (in terms of physical and chemical properties)” to “Characterization of soil and rock (in terms of physical, chemical, and geomechanical properties)”	Geomechanical properties of rock and soil are important for siting and safety.	x			

USA	7	Page 7; Selection Stage	Unclear as to the level of effort required in the selection stage.	2.7 states, "…by means of field reconnaissance, including … surveys (see para. 2.32) …" while 2.8 states that, "…inferences can be made about seismic amplification effects, bearing capacity, potential settlement and swelling, and soil–structure interactions…" Unclear as to how much information should be obtained from current and historical documents and how much from field surveys.			x	SSG-35 Appendix A provides the following details on this topic: Site survey stageA.5. Use should be made of existing data available from national and localarchives such as the following:(a) Regional geological maps, including those containing data on stratigraphy,i.e. with appropriate cross-sections;(b) Tectonic maps;(c) Hydrogeological maps;(d) Regional geophysical maps, indicating gravity and magnetic anomalies;(e) Satellite imagery.Site selection stageA.6. At this stage, the data, as already indicated, should be augmented withmore detailed information. This may require more detailed and site specificinformation such as existing borehole logs and geophysical surveys to be obtainedand studies of the site to be undertaken, for example by means of geologicalfieldwork, to confirm its geological and hydrogeological characteristics.No change to the text has been made as a result of this comment.
USA	8	Para 2.7b, page 8	This Para includes ambiguous terms such as: hard rock, rock, or soft rock and other terms such as stiff soil or soft soil. We recommend that in describing the classification of rock foundation to use the terms: sedimentary, metamorphic, or igneous, and then to identify the rock as fractures, altered, weathered, or degraded. Further subclassification may include qualitative description of common soil-rock types like: healthy/slightly weathered/ segmented rock formations, very stiff to soft clays, very dense to loose sands etc. This qualitative description is also related to the proposed range of values of the mean shear wave velocities.	Better terminology and qualitative soil classification based on range of values of mean shear wave velocities.			x	At this stage (site selection) many embarking Member States still do not have a lot of information about their sites. The classification (as stated in the text) if applicable can be used in ranking criteria for site selection. No change to the text has been made as a result of this comment.

USA	9	Page 8; 2.8	Change "…sites with unacceptable subsurface conditions should be excluded…" to "..sites with unacceptable subsurface conditions and that cannot be corrected by means of geotechnical treatment or compensated for by construction or design measures should be excluded…"	4.17 makes clear that unacceptable subsurface conditions are acceptable if treatable.	x	Changed statement to: "…sites with unacceptable subsurface conditions for which there are no generally pracitcable engineering solutions should be excluded..."		
USA	10	Page 8 through 12; Characterization stage: Verification vs. Confirmation	The distinction between the Verification vs. Confirmation characterization stages is often unclear.	There seems to be repetitive text between the two stages. Many of the list items in 2.9 and 2.13 are similar and it's not clear how the investigations should be done differently. E.g., drilling is discussed in both stages, but the differences in the objections should be discussed in more detail.			x	Per IAEA SSG-35 - the difference in the phases is: 'The site characterization stage is further subdivided into: site verification, in which the suitability of the site to host a nuclear installation is verified mainly according to predefined site exclusion criteria, and site confirmation, in which the characteristics of the site necessary for the purposes of analysis and detailed design are determined'. To ensure consistency between the Safety Guides, both parts of the confirmation stages are presented here and the main difference is that the investigations require a different level of detail related to their specific objective.No changes have been made to the text as a result of this comment.

USA	11	Page 12; 2.25	This information should be presented earlier in the section.	The reader should be made aware of the long-term impact of investigative drilling on the geological environment and aquifers before a drilling program is discussed in detail.	x	The paragraph was moved to the beginning of the section. After paragraph 2.3.		
USA	12	Page 13; 2.27 (a)	Remove 2.27(a)(iv) and (ix).	2.27(a)(iv) Gas pockets and (ix) Natural bridges seem improbable candidates for undesirable subsurface conditions.			x	The list presented was compiled by the drafting group and has been supplemented by feedback from an IAEA Technical Meeting on Geotechnical Aspects related to nuclear installations. The opening paragraph to this list states 'should be considered' in order to indicate that this list is provided for consideration purposes. This allows the users to consider them acceptable or otherwise address the potential undesireability. No changes have been made as a result of this comment.
USA	13	Page 17; 2.41(d)	Include the following information in 2.41(d): Determine if the upstream drainage areas can be controlled to minimize the amount of runoff which could erode or inundate the site; determine sufficient depth to the groundwater; characterize springs or groundwater discharge within or near the site.	These hydrogeological characteristics have the potential to affect the performance and safety of a nuclear installation.	x	Partially included as examples of 'other conditions'.		

USA	14	Para 3.12,	In site evaluation Para 3.12 we recommend its modification to read: The greatest risk in site evaluation and to the foundation safety of a nuclear installation is from the existence of large piping system carrying inflammable materials such as oil or gas through the property. Other risks include: presence of fill materials, open cavities, solution filled features at shallow depths (relative to the size) and mechanical discontinuities below the foundation of the structure.	In siting evaluation and design serious attention should be paid to avoid existing large piping system carrying oil or natural gas through the nuclear installation property or contiguous to its border line.			x	Added a clarification about this paragraph, which is strictly concerned with geotechnical aspects.
USA	15	Page 33; 4.2	Define “permeability of the site.”	Unclear if “permeability” means hydraulic conductivity of the saturated, or unsaturated, soil/rock of the site or some other parameter.		x Added 'soil/rock' infront of permeability for clarity.		
USA	16	Page 49; 4.98	The term “embedded” needs further clarification.	The definition in 4.98 hinges on the term “significant;” however, it is not clear how this is quantified.			x	Significant' interaction would become clearbased on the structural response. No changes have been made to the text as a result of this comment.

USA	17	Para 5.11 Page 53	It was stated in the standard the following: The monitoring program and monitoring records should include the entire monitoring history beginning from site selection, through to construction, commissioning, operation and decommissioning of the nuclear installation. <u>Comment:</u> The safety guide is unclear regarding protocols or processes of monitoring aspects during the decommissioning phase particularly during dismantlement and investigation of subsurface contamination since structures and components as well as infrastructure and decommissioning cranes could be impacted by earthquakes or other physical, environmental, and climate conditions. Therefore, the safety standard could benefit by adding additional paras regarding safety features and monitoring during the decommissioning phase. In addition, the draft standard would benefit from using advanced remote technologies for monitoring and subsurface characterization to locate buried infra structure items during the decommissioning process.	The guide would benefit by adding extra safety features and monitoring during decommissioning as indicated in the comments.			x	Decommissioning is currently not within the scope of this guide. However, this statement will be noted and can be considered for inclusion in future revisions of the document.
USA	18	Last Para, page 69	Wang, W. Nuclear Regulatory Committee, United States of America, modify to: Wang, W. Nuclear Regulatory Commission, United States of America	NRC is a “Commission” not a “Committee.”	x			

USA	19	2.10(d), page 10	For cohesive and granular soil samples obtained during the drilling/coring operation, appropriate consolidation and shear strength testing should be conducted on the undisturbed samples (see para. 2.35) to allow the estimation of soil strength, stiffness, stress-strain responses and ~~phi~~ consolidation property values.	1. "phi" is soil internal friction angle here and one of the parameters in stress-strain response relationship; 2. Consolidation tests will determine cohesive soil consolidation property that is needed for long term settlement evaluation.	x			
USA	20	2.13, page 11	(c) A determination of the settlement of structures;(d)Evaluation of the site amplification of seismic waves; (d) Establishment of soil and soil–structure interaction parameters (dynamic and static); (e) Engineering assessments of the liquefaction triggering (e.g., earthquake) and consequences (e.g., settlement, slope failure, lateral spreading); (f) Evaluation of a site specific design response spectrum (if needed).	Determination of settlements of structures and the site amplification of waves are such different evaluations that they should be listed separately. Evaluating liquefaction potential is vague. Suggest being specific in assessing liquefaction triggering and consequences. Liquefaction triggering is common terminology for liquefaction occurrence/initiation and consequences are the possible effects of liquefaction such as slope failure, lateral spreading, settlement, etc.	x	Included text as proposed without the parentheses		
USA	21	2.14, page 11	Where heterogeneity and discontinuities are present, the usual investigation process should be supplemented with investigation holes at adequate spacings and depths ~~small enough (and depths large enough)~~ to permit detection of the geological and geotechnical features and their proper evaluation.	We require adequate spacing and depth of drillings for supplemental site investigation, and details will be determined based on site specific conditions.	x			

USA	22	2.22, page 12	At least one investigation hole should be drilled at the planned location of every safety related structure[2].	Note that RG 1.132 Appendix D states that at least 3 borings should be within the footprint of every safety-related structure. Recommend that a footnote be added stating that some states require at least 3 investigation holes be drilled for every safety related structure.	x			
USA	23	2.31, page 15	Other possible sources of information should also be considered, such as observations, reports, publications, theses, and models available from individual observers,	Grammar issue, a comma was added.	x			
USA	24	2.34, page 15	Geotechnical tests address the near field area (to a depth of at least two times the shorter dimension of the structure's base or to a depth where the change in the vertical stress during or after construction due to applied loads are less than 10% of the effective in situ overburden stress). If competent rock is encountered at lesser depths, boring should penetrate to the greatest depth where discontinuities or zones of weakness or alteration can affect foundations and should penetrate at least 6 m into sound rock.	Investigations to a depth of two times the shorter foundation dimension or where the stress increase is less than 10% is required to perform a proper assessment of foundation settlement in soils unless competent rock is encountered at shallower depths.	x			
USA	25	2.39(l), page 16	Descriptions of the groundwater regime ~~and~~, the physicochemical properties of the groundwater, and the groundwater chemicals such as sulphate, chloride and pH.	The presence of certain chemicals (e.g. sulfates, chlorides) and pH levels in groundwater above permissible limits can cause damage to concrete foundations.		x Added 'physical and chemical' after physiochemical for clarity.		

USA	26	2.41 (c), page 17	S and P wave velocities, stress–strain relationships, static and dynamic strength properties, strain-dependent modulus degradation and damping relationships, consolidation, permeability and other mechanical properties obtained by in situ tests and/or laboratory tests;	The strain-dependent modulus degradation and damping relationships are particularly important for their use in site seismic ground response spectra determination and performance of SSI analysis.	x		
USA	27	2.46, page 18	Seismic site response assessments under free field conditions should be performed for Type 2 sites and Type 3 sites (see para. 2.43) or when site specific conditions (such as crustal shear wave velocity, zero-distance spectral decay factor, k_o, and strain levels) differ from the ground motion model reference conditions. Site response assessments provide input parameters for the assessment of cyclically induced displacements and deformations (including those for soil liquefaction engineering) as well as for soil–structure interaction analyses. Additionally, the site response assessments should provide site-specific response spectra. At a minimum, data on the following should be gathered:	More considerations than just a Vs30 should be considered when determining if a site-specific site response analysis should be performed. As noted in RIL2021-15 "Documentation Report for SSHAC Level 2: Site Response," ground motions predicted by a ground motion model are associated with a reference site condition that represents a crustal shear wave velocity, Vs, and site attenuation parameter, ko. The reference condition generally represents a stiff condition with linear site amplification. So, an important consideration on determining if site specific site response is needed is whether the ground motion model reference condition is consistent with the site-specific reference condition in terms of the deeper Vs, ko, and strain level.	x	The parantheses content was not included, as it is too detailed for this guide.		

USA	28	3.7, page 24	Geophysical methods that can be used as ~~high~~ preferred resolution survey techniques in determining the depth, size and geometry of subsurface cavities include cross-hole seismic survey, cross-hole radar methods, electrical resistivity survey, acoustic resonance with a subsurface source, microgravimetry, high resolution seismic refraction, high resolution seismic reflection, surface wave method, ground penetrating radar methods and suspension P-S logging. Several of these should be applied in conjunction with tomographic techniques, for cross validation.	Current available technologies do not have the ability to provide high resolution information of the depth, size and geometry of subsurface cavities. Also, most of the listed non-invasive methods have effective depth limitation. The surface wave method is another method can be used to detect underground cavities if using proper sensor matrix and data analysis.	x			
USA	29	3.13, page 25	A site that is underlain by a potentially large and complex cavity system should be excluded, since a realistic evaluation of the hazard posed by the cavity system might be very difficult.	"underlain" should be used instead of "underlaid". Underlain is the past participle of underlie. The definition of underlie is: lie or be situated under.	x			
USA	30	3.15, page 25	If it has been found necessary to make improvements in the subsurface conditions due to the risk of slope failure or other unfavourable soil or ground conditions, the improvements (e.g. jet grouting~~grounding~~, ground cementation) should be designed and conducted during the ongoing stage of site characterization and/or site construction, and their effectiveness should be verified by in situ testing (see also paras 3.48–3.50 and 4.16–4.19).	It should be "grouting", not "grounding".	x			

USA	31	3.20, page 26	For pseudo-static slope stability calculations, the safety factor is based on the consideration of seismic effects as equivalent static inertial forces by means of seismic coefficients. To determine the equivalent static inertial forces, the seismic amplification in the slope should be ~~modelled~~ determined based on seismic loading distribution along the vertical direction of the slope. Peak ground acceleration ~~should~~ can be used in ~~the~~ initial estimate of the inertial forces; however, a lower value may be acceptable ~~and~~ but needs to be justified by additional calculations and studies. In slope stability calculations, the safety factor calculated based on the pseudo-static equilibrium should be at least 1.1.	The equivalent static inertial forces should be determined based on the seismic loading distribution along the vertical direction of the slope, and PGA can be used as the initial estimate because the PGA is normally determine at the ground elevation and slopes are usually above ground and seismic loading may be amplified from the ground elevation, then the equivalent force and acting point should be determined accordingly.	x			
USA	32	3.23, page 26	If a slope is deemed to be potentially unstable, a stability analysis should be performed. The stability analysis should consider factors such as slope angle, height, water content, groundwater level, reduced soil strength under seismic loadings, other geotechnical conditions of the material of the slope, as well as the potential uncertainties associated with these factors due to the variability of the slope material (e.g. primary stratification of the sediments; see Section 2).	Groundwater level greatly affects the stability of slopes, and strength of some soil can decrease under dynamic/seismic loading conditions.	x			

USA	33	3.24, page 26	3.24. A conventional sliding surface analysis is usually performed to evaluate a safety factor against sliding failure. This method is based on a simple equilibrium of force and is valid for an external load like gravity. However, for loads such as those generated by an earthquake, an additional evaluation should be conducted to determine the exact location of the expected sliding surface if it is different from the sliding surface determined using the minimum safety factor that considers only gravity and the residual strength of the slope. A 3-D slope stability analysis may be needed to more realistically evaluate the stability of the slope and the impact of the failed slope portion.	The conventional sliding surface (a line, in 2-D model) slope stability analysis sometimes can either over or under estimate the stability of slope. A 3-D model can estimate sliding surface in 3-D and can estimate the volume of the possible failed slope materials, thus provide information for evaluation of the consequence of the slope failure.	x	Replace may with might per technical editor guidance.		
USA	34	3.26, page 27	If a natural slope is not assessed as sufficiently safe (i.e. by a safety factor and/or any other criteria (e.g. residual displacements)) measures for prevention and mitigation of slope failure should be considered, such as the removal of the whole or a part of the natural slope. If removal is deemed unreasonable, strengthening measures should be considered, such as lowering the slope angle, lowering groundwater level, soil nailing, rock bolting, grouting, anchors, piles, build berm or ~~and/or~~ retaining walls.	Lowering groundwater level is an effective method to increase the stability of slopes, if applicable. Build berm at the base of slope can also increase the stability of slopes if feasible.	x			

USA	35	3.31(d), page 28	Index properties. For coarse grained soil mixtures, sieve and sedimentation/laser diffraction or hydrometer tests should be performed on soil samples to assess grain size characteristics. Samples should be collected to accurately represent the spatial variability of the site soil conditions. In addition to the percentage of fines and their consistency limits, mean grain size, uniformity coefficient, relative density~~minimum and maximum void ratio~~ and specific gravity are additional important properties that are useful for liquefaction engineering assessments.	Relative density is an important parameter in soil liquefaction assessment and it requires soil natural void ratio, min. and max. void ratios.	x			
USA	36	3.31(l), page 29	Seismic design parameters. A minimum of moment magnitude and ground motion parameter (e.g. peak ground acceleration) data pair in deterministic seismic hazard assessments. Alternatively, the ground motion parameter levels deaggregated for moment magnitude bins, or ground motion parameter levels corrected to a reference magnitude (duration) event as part of probabilistic seismic hazard assessments, is needed.	Recommend only using peak ground acceleration as an example ground motion parameter required for a liquefaction analysis. As new models are developed, alternative ground motion parameters will likely be used and may result in better estimates of predicting soil behavior.			x	This sentence relates specifically to deterministic seismic hazard assessments, which are only based on magnitudes and PGA (current known and proven practices). Changing the language here, may allow for deterministic assessments to be confused with probabilistic. Therefore, no changes have been made to the text as a result of this comment.

USA	37	3.37, page 30	For probabilistic assessments, the frequency of liquefaction triggering should be ~~less than 10-6 per year~~ established to satisfy applicable structural performance goals or risk metrics.	We should not specify a recurrence rate. The recurrence rate provided may only be applicable to situations consistent with ASCE 45-19 SDC 5. Newer facility designs may be able to demonstrate that they can meet applicable regulations for lower seismic design categories that have higher allowable recurrence rates. Higher recurrence rates for liquefaction triggering or consequences may be appropriate. Higher triggering rates may also be appropriate for nuclear facilities that are not nuclear reactors.	x	Text was changed to …should be established sufficiently low to satisfy performance targets.		
USA	38	4.26, page 37	If the subsurface materials are soils or soft rock, information on the stress history of the subsurface materials should be obtained to predict settlement and heaves, and to assess the hazard of gross foundation (shear) failure. Additionally, for soft rocks (e.g. gypsum, chalk) and clay soil in saturated conditions, their creep under static loading should be assessed. For computing this stress history, the following should be obtained at a minimum:	Clay soil has creep and stress relaxation characteristics.	x			

USA	39	4.31 (b)	In general soil–structure interaction analysis should be performed for sites with conditions of Type 2 or Type 3 foundation material (see para. 2.43). A fixed base support may be assumed in modelling of structures for seismic response analysis for Type 1 sites where the combination of earthquake input motions, rock conditions, and structure characteristics is demonstrated to behave as a fixed-base system.	According to ASCE 4-16, "Seismic Analysis of Safety-Related Nuclear Structures," there should be some requirements in addition to Vs in order to consider the structure as fixed-base. The added text makes the Safety Guide consistent with ASCE 4-16.Alternatively, a footnote could be added noting that some states have additional requirements to consider a structure as fixed-base.	x			
USA	40	4.55	The assessment of foundation stability should be performed under static (i.e. permanent) loads and under a combination of static loads and dynamic loads induced by earthquake input. The vertical component of the seismic acceleration should be considered acting upwards or downwards. The assessment should include the consideration of bearing capacity, overturning and sliding.	A period is added between the two sentences	x			
USA	41	4.58, page 44 and 4.64, page 45	In 4.58: "If the sliding resistance is the sum of shear friction along the foundation and the soil lateral pressure (i.e. up to the full passive pressures pressure capacity induced by embedment effects)," and in 4.64: "If sliding resistance is estimated as the sum of the shear friction along the basemat and the soil lateral pressure up to the full passive pressure capacity induced by embedment effects," are duplication.	4.58 and 4.64 have some overlaps, may consider combining these two items together.	x	Deleted 4.64, and split 4.58 into two paragraphs.		

USA	42	6.11 (a), page 60	The ~~geotechnical~~ geological structure of subsurface materials, with a description of the stratigraphic sequence of soil or rock strata, and the nature and dimensions in plan and depth of the different formations;	The definition of “geotechnical structure of subsurface materials” is not clear: we know geotechnical structures such as the foundations, dams, etc. but not sure what the “geotechnical structure of subsurface materials” means here. It looks more like geology structure of subsurface materials here. Suggest make it clear.	x			
USA	43	6.11 (b), page 61	The static and dynamic geotechnical properties of subsurface materials, as necessary to assess the stability and bearing capacity, evaluate seismic and other hazards, and to define design basis parameters;	Seismic hazard evaluations may be a controlling factor in the graded site investigation approach used to determine shear wave velocities at the site.	x			
USA	44	6.11, page 61	The application of a graded approach may include the level of detail (e.g. number and layout of boreholes, types and number of laboratory and field tests) used in the investigation of these items, but the scope of the geotechnical site investigation should always include these items. Variability and uncertainty in subsurface materials should always be addressed.	The borehole drilling plan includes not only the number of the boreholes but locations and depth. As for the lab and field test plan, not only the numbers but more importantly, the type of tests are need.	x			
USA	45	6.12, page 61	6.12. Geotechnical characterization is required to provide ~~enough~~ sufficient information to perform a reliable and defendable site evaluation with respect to geotechnical hazards,	Suggest replace the “enough” with “sufficient” because “enough” emphasizes more on quantity.	x			

USA	46	7.10, page 65	7.10 Studies, evaluations and analyses should be peer-reviewed by qualified individuals who have not participated in their specification or in their development, with the purpose of ensuring that the intended scope has been met, the technical approach and method of analysis are valid, and the results are correct.	It is not clear "their" really means here: the qualified individuals or the geotechnical evaluation of site? Does it really means the qualified individuals should not be involved in the site investigation/evaluation project?	x			

DS531 “Geotechnical Aspects in Siting and Design of Nuclear Installations”
(Draft dated 04 August 2023)
Status: STEP 7

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

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)** (with comments of GRS and BASE) Page 1 of 1 Country/Organization: **Germany** Date: 2023-09-25				RESOLUTION			
Rele-vance	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modi-fied as follows	Rejected	Reason for modi-fication/rejection
2	1	Chapter 2.7. (b) line 5 and 6	If applicable, the rock at a rock site should be further classified as hard rock, medium hard rock or soft rock. Or If applicable, the hardness (soft, medium or hard) of the rock at a rock site should be further classified ~~as hard rock, rock or soft rock~~.	Clarification	x			
2	2	Chapter 2.7. (b) line 6 and 7	If applicable, the soil at a soil site should be further classified as stiff soil, medium stiff soil or soft soil. Or If applicable, the stiffness (soft, medium or stiff) of the soil at a soil site should be further classified ~~as stiff soil or soft soil~~.	Clarification	x			
1	3	Chapter 4.103. to 4.116	Add Paragraph on the influence of frost heaves on buried pipes, conduits and tunnels	Frost heaves can cause stress in bur-ied pipes, conduits and tunnels	x	Added to paragraph 4.103.		

Relevance: 1 – Essentials 2 – Clarification 3 – Wording/Editorial

Title: DS 531; Site Geotechnical Aspects for Design Basis of Nuclear Installations

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: M Ashfaq		Pages: 02					
Country/Organization: Pakistan/PNRA		Date: 03-10-2023					
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	1.7	It covers the programme of site investigation that should be performed to obtain appropriate understanding of the subsurface conditions, which is necessary for **foundation design** and determining whether the………	The considerations for the foundation design are normally made as per topography of the area and the sub soil characteristics.	x	Foundation is added after 'conditions are suitable for'		
2.	3.26	If a natural slope is ~~not~~ assessed as **not** sufficiently safe (i.e. by a safety factor and/or any other criteria (e.g. residual displacements)) measures for prevention and mitigation of slope failure	Please rephrase as to create a meaning of safety factor is not above the criteria to be declared as safe.	x			
3.	4.6	Surveillance (periodic inspection and monitoring of dams and dykes) and maintenance work should be performed continually during construction and operation of the nuclear installation **by third party or shared by dam safety organization/operator of dam**…	Responsibility for conduct of surveillance and monitoring of dams and coordination may be added also.	x			
4.	4.21(a)	The forces due to the structures should be transmitted to the **subgrade** soil ~~with no~~ **without any** unacceptable deformation;	Please rephrase.	x			
5.	2.35/4th line	....sampling should be done in accordance with established procedures and practices with respect to quality requirements **by qualified perosnels.**	Qualified and experienced Personnel should be responsible for handling samples.			x	Quality requirements already indicate that personnel should be qualified. The addition of suggested text would be redundant.
6.	2.32	Two types of test — geophysical tests	Please mention soil &	x			

Relevanz: 1 – Essentials 2 – Clarification 3 – Wording/Editorial

COMMENTS BY REVIEWER Reviewer: M Ashfaq Pages: 02 Country/Organization: Pakistan/PNRA Date: 03-10-2023				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		and geotechnical tests — are available **for soils & rocks.**	rock simultaneously.				
7.	2.14	Please add a heading of **Laboratory Testing Programme** and relevant commendations such as laboratories, testing equipment's, testing procedures, calibration, QA requirements etc. may be enlisted accordingly.	This will provide guidance for subcontracted laboratories to fulfilled the requirements.			x	Sub-contractors are not target audiences of this document. Furthermore, the guidance provided related to the quality of the laboratories and tests is specified - see para. 7.14.
8.	3.2	The geological factors include the potential for buried channels, the stratigraphic sequence, the characteristics of the rock type and the properties of the rock mass **of sufficient lateral and vertical extent.**	The vertical and lateral extent of the rock mass considered potentially suitable to determine whether the selected site area or volume is large enough to accommodate the facility;			x	vertical and lateral extent of rock mass are important, but they are not geological factors, as this statement is focused on the properties of the rock mass, as opposed to the extent or layout
9.	3.3	The mechanical stability of the bedrock is governed by the stress state, the properties of the rock mass and the discontinuities transecting the rock mass **at all depths of interest.**	The characteristics and mechanical properties of discontinuities and of the rock mass at all depths of interest are done.	x			
10.	3.3	**The mechanical properties of the rocks and soils that could influence the design and construction of the facility and provide rock quality ratings such as Q, RMR, GSI;**	Please add this para along with, Table 2 may be enriched with other tests also such as RMR, GSI;			x	The proposed paragraph does not contain a recommendation, so it is not added

Relevanz: 1 – Essentials 2 – Clarification 3 – Wording/Editorial

COMMENTS BY REVIEWER Reviewer: M Ashfaq Pages: 02 Country/Organization: Pakistan/PNRA Date: 03-10-2023				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
							or accepted. RMR and GSI are not geotechnical in-situ tests or techniques, they are classification systems and do not belong in Table 2.
11.	General	**The characteristics of the construction/borrow materials that could be used for construction purposes.**	Please add this para for construction material quality check.	x	The proposed paragraph does not contain a recommendation is not accepted. Wording related to the quality of the construction materials has been added to para 4.16		
12.	2.22	Where conditions are found to be variable, the number and spacing of drillings should be chosen to obtain a clear definition of changes in soil and rock properties. **The details are mentioned in Annexure....**	General guidance may be provided for number and spacing of boring may be provided as annexure.			x	

Relevanz: 1 – Essentials 2 – Clarification 3 – Wording/Editorial

TITLE
DS531 Geotechnical Aspects in Siting and Design of Nuclear Installations

COMMENTS BY REVIEWER Reviewer: WASSC member Page 1 of 1 Country/Organization: Republic of Korea/Korea Institute of Nuclear Safety Date: October 04, 2023				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	p.23/ 3	o The following is suggested. (before) 3.1 Requirement 22 of SSR-1 [1] states: (after) 3.1 Requirement 22 of SSR-1 [2] states:	o I think that it is a typo. o Reference 1 in the draft safety (DS531) is SSG-9 (Rev.1) (2022)	x			
2	p.23 / 7	o The following is suggested. (before) Undesirable soil conditions at nuclear installation sites (after) Undesirable soil and rock conditions at nuclear installation sites	o According to the requirement 21 and 22 of SSR-1 (2019), the geotechnical hazards should be evaluated based on the soil and rock conditions for the site. So, it is recommended that the phrase of and rock be added.	x	Title changed to 'Undesirable subsurface conditions at nuclear installation sites'		