DS522 Evaluation of Seismic Safety for Nuclear Installations

	COMMENTS BY REVIEWER Reviewer: NUSSC Members Page.... of.... Country/Organization: All Received Comments Date:				RESOLUTION			
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1.	Canada	General	Include evaluation of Management System Manual in the safety assessment. In many accidents around the world, one of the prominent causes has been pointed out as the managerial interference or unwillingness to implement scientific suggestions. A robust management executive team with professional engineers and scientists on board would reduce the probability of failure.	Despite being noted in several references, the management system continues to be ignored by safety assessment guides. For example, insisting that the design managers should be registered professional engineers would be step forward in this direction. See papers by Shimazaki on the seismic PRA in Japan.			x	We cannot make references to a paper in a Safety Guide. Management system is discussed in Section 8 with due references to the IAEA Safety Requirements and Safety Guides. It is inline with similar sections from other Safety Guides.
2.	Canada	General Technical	1. Treatment of relays (relay chatter) is important part of seismic safety assessment, but it is missing. Relay analysis methods should be discussed referencing EPRI 3002012994, *Seismic Fragility and Seismic Margin Guidance for Seismic Probabilistic Risk Assessments* (2018), and EPRI 3002000709, *Seismic Probabilistic*	1. Incomplete scope. 2. Key concepts presented in the document need to reflect on the latest industry practices and justified as such by referencing the latest IAEA publications. Some references are suggested in the comments.			x	It is implicitly addressed in selection of Seismic Equipment list. A more detailed guidance is provided in Ref [10] Safety

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			Risk Assessment Implementation Guide (2013). Both references provide comprehensive information on the state-of-the-art analysis approaches. 2. Cross reference with the latest IAEA publications to be added for key concepts throughout the document.					Report on Seismic Safety Evaluation Subsection 5.1.2.9. Relay chatter review Also is addresses in Appendix Section Seismic Failure Modes for individual Instruments and Devices in Nuclear Installations
3.	Czech Republic	General	To add: Reference level earthquake - definition or explanation	The term "reference level earthquake" is used throughout the guide but definition or any explanation is missing. IAEA safety glossary does not provide for any definition, too. This seems to be a universal term for any of levels which have been assumed in seismic analyses in past decades (SL-1, Sl-2…) –			X	Paras. 2.24 and 2.25 introduce the reference level earthquake and guidance for its selection.

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				based on codes/standards or regulatory requirements. But this is not mentioned in the guide. As it is not explained this can lead to misinterpretation of some parts in the guide.				
4.	Finland	General	Please check references of the document and update accordingly. reference [7] SSG-9 (Rev.1) published 2022 reference [8] NS-G-1.6 has been superseded by SSG-67 reference [13] DS490 published as SSG-67, also ref. 8	INTERNATIONAL ATOMIC ENERGY AGENCY, «Seismic Design and Qualification for Nuclear Power Plants,» Safety Guide NS-G-1.6, IAEA, Vienna, 2003.	X			
5.	France	General	The current comment does not aim at modifying the text. It is a reminder that France considers of high importance footnote 2 (even if it is just a footnote) "*Some Member States used these methodologies as a complementary technical support and they should not be solely used to comply with Requirements 17 of SSR-2/1 or equivalent requirements from SSR-3 or SSR-4*" This footnote shall be maintained.				x	It is not clear what means complementary support (not used in IAEA terminology used in Safety Standards) It not written any ware that DS522 should be solely used to comply with Requirements 17 of SSR-2/1.
6.	Germany	General	Most guidance is applicable for				x	Guidance for

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			nuclear power plants but not for nuclear installations with a lower hazard potential. It is hard to understand in the text when the graded approach, as described in section 6, is applicable. This is especially the case when explicit demands or expectations are made like in para 5.15. Maybe this would be more clear when pointing out the graded approach in the relevant paragraphs.					application for nuclear i8nstallations other than NPPs is given in section 6.Evaluation of Seismic Safety for Installations Other Than Nuclear Power Plants and ANNEX. It is consistent with SSG67.
7.	Hungary FBG	General	-	Dedicated sub-sections should be added to the document providing recommendations for the specifics of the various potential “secondary” hazards associated with the occurrence of earthquakes, such as: • Fault displacement/ permanent ground deformation • Liquefaction • Slope instability Etc.			x	This level of details is not appropriate for a Safety Guide. Seismic induced permanent ground deformation (including slope stability, liquefaction, etc.) are addressed across the document.

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								More details in Safety Report 103. Fault surface rupture if could be addressed by specific hazard assessment and rulkled out if the frequency of significant displacement is very low. Thsre no fragility or HCLPF associated to fault displacement.
8.	Hungary FBG	General	-	Geological science and earthquake assessment in general operates with a high level of uncertainty even if extensive geological surveys and models have been developed to provide input parameters. These uncertainties may increase to an even higher level in the case of secondary/associated earthquake effects like fault displacement and			x	Considerations of uncertainties in Seismic Hazard Assessment are addressed is SSG-9 Rev 1. DS522 is using the end results of PSHA. There is beyond the

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				liquefaction. Various models and interpretations of the geological survey data can produce widely different results for such phenomena which makes designing against them a major challenge both for operating and new facilities. In order to address this issue dedicated SMA based techniques should be developed and presented (or at least referred to) in the present document. Such methodologies would approach these phenomena from a “purely” technical and practical point of view instead of the theoretical models and differences between the experts, e.g.: A fault displacement margin assessment could provide a HCLPF value for the facility against fault displacement which is directly comparable with the different hazard displacement values calculated with different methods and assumptions, directly rendering the issue				state of practice to estimate HCLPF or fragility curves for the fault displacement.

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				irrelevant (if the HCLPF value is much larger than either hazard assessment result) or provide actual technical solutions to the problematic parts of the design (e.g.: by showing the most “fragile” SSCs and properties which can be modified and upgraded). Such a methodology addressing the issue from a fragility point of view (which operates with actual technical and technological properties and as such with much smaller uncertainties) could provide a low resource-intensive approach and reduce the number of sometimes fruitless discussions between experts with very different assumption and methodologies.				
9.	Hungary FBG	General	X.X The assessment of fault displacement is of interest for many member states. It is challenging both for new and operating facilities and in the case of operating facilities moving the	The proposed text are just examples not actual “proposed new texts”! A section on fault displacement margin			x	Out of scope – see comments above.

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			units are impossible and reinforcing them could be an extremely difficult or simply insurmountable challenge. Furthermore geological surveys under an operating unit is again impossible and even with geophysical modelling the results have a very high uncertainty. This results in a situation where the risk arising from fault displacement hazard cannot be directly and accurately quantified. To overcome this challenge and SMA based Fault Displacement Margin Assessment (FDMA) could be carried out. Such a technique could justify the safety of the nuclear facilities in a low resource-intensive manner if extensive geological surveys and modeling are impossible (e.g.: trenching cannot be carried out under the NPP) or the results are inconclusive/burdened with a very large uncertainty. X.X+1 Similarly to the SMA technique FDMA provides a fault displacement HCLPF value which can be use for: (a) Determination of the seismic	assessment techniques should be developed and added to the current document Chapter 3. I strongly believe that the development of such a methodology would be of great interest and would mean a great deal of help for member countries affected by the phenomena, because the current regulations and recommendations (e.g.: move the unit to somewhere if possible) is simply not applicable in most cases nor does minor fault displacement on the surface present any real threat to the nuclear installations considering the various other factors (e.g.: uneven tilting of the facility during its lifetime) it is already conservatively designed against.				

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<tr><td></td><td></td><td></td><td>safety margin higher than a specified earthquake (e.g. the design basis earthquake) or an actual earthquake that affected the installation;
(b) Demonstration of fault displacement robustness of the installation against cliff edge effects when robustness is characterized by fault displacement safety margin;
(c) Demonstration of sufficient safety margin to restart operation following the occurrence of a fault displacement that may have shut down the nuclear installation;
(d) Comparing an estimate of installation-level HCLPF capacity to regulatory expectations;
(e) Identification of weak links in the credited success paths for the nuclear installation’s response to a fault displacement event;
(f) Identification of possible upgrades for SSCs in the success paths to improve the fault displacement safety margin;
(g) Comparative safety assessment of a group of nuclear installations benchmarked by fault displacement safety margin against either (i) the</td><td></td><td></td><td></td><td></td><td></td></tr>
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			same displacement effects, (ii) the effects of a common scenario, or (iii) displacements that represent the same level of faulting hazard at each site; (i) Effective communication about the robustness of the nuclear installation to stakeholders, including the public. (j) Demonstration that regulatory fault displacement requirements are met for plants which were designed without fault displacement requirements. X.X+2 The main advantages of the FDMA approach are: (a) The HCLPF results are practically independent of the geological inputs and only uses the accurately known design/technological information to calculate the maximum fault displacement value that the facility is able to endure with a very high certainty. This means that the uncertainties of the geological data cannot effect the results of the FDMA but through the HCLPF value it is possible to check and justify the safety of the nuclear					

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			installation even if only very conservative design basis fault displacement values are available. For example: If the HCLPF value calculated through the FDMA technique is higher than the conservatively assumed/calculated maximal fault displacement then the safety of the facility is justified and it can be concluded that the fault displacement is covered in the design basis.					
10.	Israel	General Comment paragraphs 1.11, 1.15 and 5.48, 5.49	This Guide as a whole and its title refer to Nuclear Installations in general, and this is clearly pointed out also in paragraph 1.11 (SCOPE) and in paragraph 1.15 (STRUCTURE). Therefore, we would like to suggest considering change of the title given to Section 6 (*Evaluation of Seismic Safety for **Installations other than Nuclear Power*** **Plants**), since that name may give the wrong impression that the rest of the Guide (with the "same" title – *Evaluation of Seismic Safety for **Nuclear Installations***) refers only to Nuclear Power Plants… Similarly, the last sentence in paragraph 1.15, saying: ***Section 5 is***	Clarity + Editorial			x	The whole guide addressed nuclear installations. It is consistent to other SGs to provide guidance for NPPS and to dedicate a chapter showing guidance for nuclear installations other than NPPs.

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			focused on nuclear power plants, could possibly also be rephrased, since actually this Section (which indeed can be considered as the core of this Safety Guide) is not (at least not explicitly) focused on nuclear power plants. The same as for Section 5, addressing nuclear installations in general (as defined in paragraph 1.11), mentioning, when it is relevant, NPP's (mainly in clarifying footnotes). There are distinct paragraphs (5.48 and 5.49) which are specifically addressed to nuclear power plants. Having "said" these two "phrasing oriented" remarks detailed above, we do think that nuclear power plant aspects related to seismic safety evaluations are definitely properly and comprehensively addressed and covered in the present Safety Guide.					
11.	Israel	General Comments	a) We are aware that IAEA Safety Guides do not include list of Abbreviations and Acronyms. Nevertheless, reading the present Guide, (with acronyms, not necessarily in "everyday	Editorial			x	this is handled by the Safety Standards Editors.

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			use", even by relevant professionals and not mentioned in the Safety Glossary, just for example HCLPF, SPSA, RLE and of course more), we suggest taking an innovative step and consider the possibility of adding a list of Abbreviations and Acronyms (at the beginning or end of the Guide, or possibly as an Annex?). b) The term "*success path*" is used several times in the present Guide. It is an intuitively well understood term, nevertheless we suggest to consider adding a short footnote "defining" it (or alternately including this term in the Safety Glossary?).					
12.	UK	General Comment	Suggest the inclusion of a list to define acronyms used within the guide.	This will assist readers and reduce the potential for misinterpretation of acronyms (which may differ across member states).			X	Acronyms used in the documents are defined within the text of the safety guide or in IAEA Safety Glossary (2018 Edition).
13.	Canada	1.3	At the design stage of a new	Hazard level should include			X	Addition is out

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			nuclear installation, it is required to be checked that the design provides for an adequate margin to protect items important to safety against levels of external hazards <u>(aleatory and epistemic)</u> more severe than those selected for the design basis [3].	predictable and unpredictable hazards.				of context. "Aleatory and epistemic" should describe the sources of variability, not the hazard. The qualifier is too specific for this introductory paragraph.
14.	Canada	1.3	Hence, seismic safety assessments described in this Safety Guide can be either a part of the design process or a completely separate procedure ~~from the design stage~~ <u>upon the design completion</u>.	Meaning of "*separate procedure from the design stage*" is unclear.		X "can be either a part of the design development <u>or a process subsequent and separate from the design basis cases</u>."		
15.	France	1.3	At the design stage of new nuclear installations, it is required to be checked that the design provides for an adequate margin to protect items important to safety against	The beyond design conditions only take into account natural external hazards			X	BDBE is also required for other external hazards, e.g., malevolent

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			levels of natural external hazards more severe than those selected for the design basis					aircraft crash.
16.	Germany	1.3 Line 4	… At the design stage of a ~~new nuclear installation,~~ nuclear power plant, of a research reactor or of a nuclear fuel cycle facility, it is required to be checked that the design provides for an adequate margin to protect items important to safety against levels of external hazards more severe than those selected for the design basis [3] [5] [6]. In addition, in case of a nuclear power plant it is required to be checked that ~~the~~ its design ~~of nuclear power plants~~ provides for an adequate margin to protect items ultimately necessary to prevent an early radioactive release or a large radioactive release in the event of levels of natural hazards exceeding those considered for design [3]. Hence, seismic safety assessments described in this Safety Guide can be either a part of the design process or a procedure, completely separate ~~procedure~~ from the design stage.	Clarification. I.a. please change the text in line with references [3] [5] and [6], as not all new nuclear installations are meant.			X	The types of installations covered by the document and corresponding requirements are listed in Para. 1.2.
17.	Canada	1.4	Suggest to reference the latest IAEA publication related to seismic	SSG-67 supersedes IAEA NS-G-1.6, *Seismic Design*	X			

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			design, SSG-67, *Seismic Design for Nuclear Installations* (2021), especially where new designs are discussed.	*and Qualification for Nuclear Power Plants*				
18.	France	1.4	Guidelines for…The seismic safety evaluation of a new design is intended to explore beyond design basis events for the new designFN2 FN: these methodologies are not intended to be solely used to comply with Requirements 17 of SSR-2/1 or equivalent requirements from SSR-3 or SSR-4	This article is not consistent with French practices without the footnote: France considers design extension seism for which the methods presented in the guidance are not accepted if used solely. Consideration of design extension seism is part of compliance with requirement 17 of SSR-2/1. France has highlighted the high importance of this FN in the previous stage and yet it has been deleted. For France, it is not clear that these methods should not be used solely. The proposed FN is necessary to clarify.		X Added the following sentence "Some member states may have other applicable criteria for seismic safety assessment of new designs for beyond design basis earthquakes."		Note the following in addition to the updated text: - DEC is included in SSG-67, which is referenced in this para. - Para. 1.13 states that the scope of this documents is to provide guidance for three specific assessment methodologies and this does not exclude other methodologies.
19.	Indonesia		This Safety Guide is related to a number of other IAEA Safety Guides dealing with seismic	• SSG-9 has been superseded by SSG-9 (Rev. 1), apply to all	X			

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		1.4/2 1.4/4	hazard and seismic design, including IAEA Safety Standards Series No. SSG-9 (Rev. 1), Seismic Hazards in Site Evaluation for Nuclear Installations [7], SSG-67, Seismic design for Nuclear Installations [8], and NS-G-3.6, Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants [9].	SSG-9, NS-G 1.6 has been superseded by SSG-67, apply to all NS-G 1.6				
20.	Canada	1.5	The seismic safety evaluation of a new design is intended to explore beyond design basis conditions including design extensions conditions for the new design.	Design Extension Conditions are mentioned only in Lines 5.35 and 5.37 for Defence in Depth Level 4. Adding it here would clarify where does it fit.			X	BDBEs are events. DEC is a plant state and not an event. Edited "BDB conditions" to "BDB events" throughout. Note that DEC is also mentioned elsewhere in the document, e.g., 5.20(h).
21.	Canada	1.5	Insert new sentences after "*nuclear*	Inform the reader about the different level of conservatism		X Added the first		The second sentence is too

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			installation as a whole." stating: As such, seismic evaluations aim to be realistic or slightly conservative, but not as conservative as in seismic design. Also, in order to allow for relative ranking of the safety significance of SSCs in evaluations, there should be as uniform as possible level of "conservatism".	in design and evaluation and about the importance of uniform approach to SSCs in evaluations.		sentence with minor editing.		detailed for the background section. Added a footnote para. in 3.9© instead.
22.	Germany	1.5	Guidelines for the seismic safety assessment ~~evaluation~~ of existing nuclear installations — mainly nuclear power plants — have been developed and used in many Member States since the beginning of the 1990s.	According to IAEA Safety Glossary the proper term is "safety assessment" and we suggest using this term instead of "safety evaluation", see also GSR Part 4 (Rev. 1). Further explanation for "safety evaluation" might be provided in footnote for clarity. Please change this over the whole document for consistency.			X	The term "evaluation" is used in broad perspective that include process of data collection, investigations, analysis and assessment etc. for the specific topics covered in this safety guide.
23.	Germany	1.5 Line 3	…. More recently, criteria and methods applied for seismic safety ~~evaluation~~ assessment of existing installations started being used, after some adaptation, for assessing beyond design basis earthquake conditions for new designs, prior to	There are three remarks to this paragraph: 1) "assessment" is a term, used in IAEA Safety Glossary 2) NS-G-1.6 has been superseded by SSG-67,		X		1) See previous comment for response. 2) See responses to previous

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			construction[2]. This assessment is different than the seismic design and qualification of the installation, which is carried out for the design basis earthquake following the guidelines in SSG-67 ~~NS-G-1.6~~ [8]. ~~The seismic safety evaluation of a new design is intended to explore beyond design basis conditions for the new design[2].~~	published in 2021 3) the last sentence repeats the issue stated in a sentence before, please check it is possible to delete it. The suggestion is to remove the footnote respectively.				comments on NS-G-1.6. 3) The last sentence was added in response to requests by MS representatives.
24.	Canada	1.6	On the other hand, in seismic safety evaluation the aim is to establish the actual capacit~~y~~ies of the SSCs in the 'as-is' condition and use it in the evaluation of the seismic capacity of the installation as whole.	Editorial	X			
25.	Canada	1.8	~~The present publication supersedes the Safety Guide on Evaluation of Seismic Safety for Existing Nuclear Installations.~~	Consider deleting this clause if the report number, i.e., NS-G-2.13, is retained.			X	The clause does not reference the publication number. The publication name of NS-G-2.13 will not be retained.
26.	Canada	1.9	For new designs of nuclear installations, the seismic safety evaluation is motivated by the need to demonstrate that safety margins above the design basis earthquake are sufficient to avoid cliff edge	To clarify that the second part related to existing NPPs. Also, suggest that guidance on safety margins above the design basis earthquake that			X	The second part is not exclusive to existing NPPs.

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			effects and, in case of existing nuclear power plants, sufficient to protect items ultimately necessary to prevent radioactive releases in the event of an earthquake with a severity exceeding the one considered for design.	are sufficient to avoid cliff edge effects be included. This mentioned throughout the document.				
27.	Finland	1.9 footnote 5	Add clarification what the cliff edge effect means regarding seismic safety. Ensure consistency within the safety guide see also. 2.15 … (f) The need to address the performance of the installation for beyond design basis earthquake ground motions in order to provide confidence that there is no 'cliff edge effect', that is, to demonstrate that no significant failures would occur in the installation if an earthquake were to occur that was somewhat greater than the design basis earthquake; …	"Cliff edge effect" regarding seismic safety is not generally caused by "a small deviation in a plant parameter" but a small deviation in the seismic demand.		X Added clarification to Footnote 5.		
28.	Finland	1.5, 1.9, 2.15, 3.5, 3.8, 5.16	Term "beyond design basis earthquake" is used in several paragraphs. In order to clarify the meaning of this term in comparison to design extension conditions	Consistency with current terminology (IAEA SSR-2/1, WENRA Guidance on Seismic Events, WENRA-RHWG Guidance on Issue F)			X	The term "beyond design basis earthquake" is almost self-

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			(DEC), the definition for "beyond design basis earthquake" should be given. There may also be need to modify some of the paragraphs to avoid confusion with the term "design extension condition"..					explanatory: it is an earthquake larger than the design basis earthquake. Sometimes the term is used to designate a target margin above the design basis earthquake. Yes, the commenter is right. In the past few years, confusion of terms has been commonplace, since some Member States designate as "design extension events" the beyond design basis external events used to assess the

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								robustness of the design, or to ensure compliance with IAEA SSR-2/1 (Rev. 1) requirements regarding design margin against external events. However, in the IAEA space, “design extension conditions” (DEC) refer to a plant state, not to an external event (see “Definitions” in SSR-2/1 Rev.1, page 66). Hence, within the IAEA space, there is no possible

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								confusion between a "beyond design basis earthquake" and "design extension conditions". In any case, the drafters acknowledge that this terminology issue has been a matter of controversy among Member States. For further clarification, the commenter is referred to the TECDOC under preparation: *Evaluation of the Adequacy of the Design Robustness of Nuclear*

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								Installations against External Hazards, which will be published by the IAEA within a year.
29.	Canada			One of the objectives of the seismic safety evaluation is to demonstrate balanced design of the nuclear installation with respect to seismic response. This is especially important for new installations. The concept of balanced design is new to the industry, definitions and assessment methodologies are currently being developed by international community. This new guide should include expectation of balanced design to reflect on the recent expectations and facilitate further developments in the industry.			X	This consideration is outside the scope and document profile set for this publication.

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				Para. 1.9 of the new Safety Guide and other respective sections (such as Para. 2.13, 2.15, 3.5, 5.34, 5.65) should be updated with expectation to demonstrate that balanced design of the installation is achieved with respect to the installation response to a seismic event, including non-vibratory seismically induced hazards.				
30.	Canada	1.11	This Safety Guide addresses an extended range of new and existing nuclear installations, that is: land-based stationary nuclear power plants, small modular reactors, research reactors and any adjoining radioisotope production facilities…	Should address SMRs as well.		X Deleted “land-based stationary” The text now includes SMRs and other ARs by default to the extent they are included in the safety requirements listed in 1.2 to maintain consistency.		
31.	Indonesia		This Safety Guide addresses an extended range of new and existing nuclear installations, that	Land-based stationary should be deleted to be consistent with SSG- 67 and 2018	X			

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		1.11/2	is: ~~land-based~~ ~~stationary~~ nuclear power plants, research reactors and any adjoining radioisotope production facilities; storage facilities for spent fuel; facilities for the enrichment of uranium; nuclear fuel fabrication facilities; conversion facilities; facilities for the reprocessing of spent fuel; facilities for the predisposal management of radioactive waste arising from nuclear fuel cycle facilities; and nuclear fuel cycle related	IAEA Safety Glossary.				
32.	Germany	1.12 New footnote	For the purposes of this Safety Guide, 'existing' nuclear installations are those installations that are either (a) at the operational stage (including long term operation and extended temporary shutdown periods) FN or (b) at a pre-operational stage … FN At nuclear installations, including NPP, the operational stage ends with the permanent removal of all radioactive material. So, Requirement 12 of GSR Part 4 (Rev. 1) [1] states: "The safety assessment shall cover all the	Please add a new footnote for clarification of 'operational stage', as this term is not defined in IAEA Safety Glossary, and it is not entirely clear in this para where the operational phase of nuclear installations ends. According to Req. 12 of GSR Part 4 (Rev. 1) all stages/phases over the lifetime with possible radiation risks of a facility have to be covered.		X Added footnote: "The operational stage ends with the permanent removal of all radioactive material."		

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			stages in the lifetime of a facility or activity in which there are possible radiation risks."					
33.	Germany	1.12 Line 6	… In existing nuclear installations that are at the operational and pre-operational stages, a change of the original design bases, such as for a new seismic hazard at the site, or a change in the regulatory requirements regarding the consideration of seismic hazard and/or seismic design of the installation, may lead to important ~~physical~~ technical modifications.	Clarification	X			
34.	Indonesia	1.13/2	For the purpose of this Safety Guide, 'new' nuclear installations are those installations for which the design has reached a level of development in which a ~~detailed~~ listed definition of SSCs is available, including the data itemized in paras 4.2– 4.5.	it is not common to use terminology "itemized" in other IAEA guide		X "development in which a detailed definition of SSCs is available, including the data **listed** in"		
35.	Israel	1.4	Following our browsing through the REFERENCES cited in paragraph 1.4, it seems that reference [10], *Methodologies for*	Completeness			X	Ref [10] is mentioned and cited in multiple

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			Seismic Safety Evaluation of Existing Nuclear Installations, Safety Report Series 103, IEAE 2020, although not being a Safety Guide by itself - does constitute (in content and context) a significant step in propagating from NS-G-2.13 to the present revision, DS522. So, we suggest considering mentioning that Safety Series 103 document in the present Guide in a somewhat more "crediting phrasing" than it is done in paragraph 1.4.					locations throughout the document.
36.	Israel	1.12	It might be considered to add a footnote relating/connecting the various operational and preoperational stages mentioned in paragraph 1.12 to the relevant regulatory/licensing stages.	Completeness			X	Good thought but no specific footnote text suggested.
37.	Israel	1.13, 2.30, 4.4 and 5.8	Footnote 6 attached to paragraph 1.13, allows inclusion of new installations with standard design based on g*eneric site parameters for which* ***the site has not been specified*** (yet). We suggest to add in the same footnote that in such	Clarity and Completeness		X Added pointer to Section 5 in the footnote.		

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			cases, when the **actual site is chosen,** it is necessary to compare the actua**l** site geotechnical characteristics with the seismic hazards assessment done earlier (which was based on generic site parameters), and to take in consideration any possible discrepancies. Avoiding such discrepancies can be achieved by including in the early seismic assessment conservative inscribing reference design spectrum.					
38.	Germany	1.15	Section 2 itemizes the safety requirements addressed by this Safety Guide and provides general concepts and general recommendations on the seismic safety evaluation of nuclear installations. Section 3 provides recommendations on the selection of the methodology for performing the seismic safety assessment. Section 4 provides recommendations on data requirements (collection and investigations), both for new and for existing installations. Section 5 is the core of this Safety Guide. It	Please make it clear that core of this Safety Guide – Section 5 – is focused on nuclear power plants and can be applied for other nuclear installations through the use of a graded approach.		X "Specific recommendations for applying .."		

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			provides recommendations on considerations in relation to the assessment of seismic hazards and with the seismic capability necessary for defence-in-depth level 4, then provides recommendations on the implementation of the SMA, PSA-based SMA and SPSA methodologies for seismic safety evaluation focused on nuclear power plants. <u>These recommendations for nuclear power plants are also applicable to other nuclear installations through the use of a graded approach.</u> ~~Section 6 provides~~ <u>Detailed</u> recommendations on applying a graded approach to the evaluation of nuclear installations other than nuclear power plants (with reference to Section 5 where appropriate) are given in Section 6.					
39.	Germany	1.15 Line 15	…. Sections 1–4, 7~~,~~ and 8 apply (in total or in part) to all nuclear installations. Section 5 is focused on nuclear power plants. <u>The recommendations for nuclear power plants are also applicable to other nuclear installations through the use of a graded approach.</u>	Please make it clear that recommendations for NPPs from sections 1-4, 5, 7 and 8 are applicable to other nuclear installations through the use of a graded approach.		X "Section 5 is focused on nuclear power plants and is <u>applicable to other nuclear</u>		

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						installations through the use of a graded approach as discussed in Section 6."		
40.	Indonesia	1.15/1	Section 2 provides ~~itemized~~ general and general recommendations on the seismic safety evaluation of nuclear installations.	To be consistent with another section uses the terminology "provides."		X "Section 2 identifies … "		
41.	Iraq	Para 2.1 Line No.16	Earthquakes in Richter scale in the range from (lower value such as 6) to (upper value such as 6.9) can cause great damage to nuclear installations [Reference].	It is recommended to include numerical values for destructive earthquakes in the draft safety guide to be used by member states as a guideline for evaluating long-term geological stability of the area selected for construction of new nuclear installations.			X	The drafter is not sure that he understands the comment. It seems that the reviewer recommends the inclusion in para. 2.1 of a statement acknowledging that earthquakes of magnitude 6 and above have the potential of

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								causing significant damage to nuclear installations. The drafter agrees with this statement but note that para. 2.1 is a summary of safety requirements currently included in IAEA GSR Part 4. Hence, this para. 2.1 is not the place to make this statement. In fact, seismic site characterization and site safety evaluation is covered by other safety

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								standards (e.g. SSR-1, SSG-9 Rev. 1). It is not the subject of DS522. cl
42.	Iraq	Para 2.1 Line No.16	It is expected that the frequent occurrence of earthquakes (in the range from (lower value such as 3) to (upper value such as 5) in Richter scale) may weaken the durability of the nuclear installations, which may affect its safety in the long- term.	It is suggested that the draft safety guide includes an evaluation of the impact of frequent earthquakes on the long-term durability of the nuclear installations over its lifetime.				The drafter is not sure that he understands the comment. It seems that the reviewer recommends the inclusion in para. 2.1 of a statement acknowledging that frequent earthquakes of magnitude 3 to 5 have the potential of deteriorating nuclear installations in the long term. This statement is controversial

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								and, to the knowledge of the drafter, it has not been confirmed by actual experience.
43.	Israel	2.1 and 3.1-3.2	Requirement 15 of GSR Part 4 (Rev. 1), cited in paragraph 2.1 states: ***Both** deterministic and probabilistic approaches shall be included in the safety analysis* (for seismic design robustness). In the present Safety Guide, three methodologies are discussed: Deterministic (SMA), Probabilistic (SPSA) and a combination of them (PSA-based SMA). Section 3 details the selection (or combination) of the seismic safety assessment methodologies, and "allows" in appropriate cases using only deterministic or only probabilistic approaches. We suggest considering to point out that such choice is not in contradiction with the requirements of GSR Part 4.	Clarity (Consistency?)			X	Very good comment. In the opinion of the reviewer, Req. 15 of GSR Part 4 was written with internal events in mind, even if not explicitly declared. The reason is that current status of technology development does not allow general application of

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								probabilistic safety analysis approaches to all external hazards. In case of the seismic hazard, application of both approaches is possible, but in practical application the deterministic approach uses elements of the probabilistic approach (e.g. to derive the list of SSCs) and it is not truly an independent approach. In other words, the deterministic approach adds little value to the

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								probabilistic assessment when the latter is possible. The trend is now to perform seismic PSA, because reliable seismic hazard curves are becoming available in many sites. If no reliable seismic hazard curves are available, the seismic PSA cannot be carried out and the other methods mentioned by the commenter need to be used.
44.	Israel	2.6	A footnote may be added to paragraph 2.6, suggesting to	Completeness			X	Yes, revising the seismic

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			consider connecting the safety assessment reviews with the major maintenance ("overhauls") done periodically at nuclear installations once every 5 to 10 years. This will also ensure addressing potential safety aspects of possible modifications done during major maintenances.					safety assessment during the periodic safety reviews is an extended practice in many Member States. But, please, note that para. 2.6 is just a summary of the requirements in SSR-2/2, without additional considerations.
45.	Canada	2.7	Add a note 1 after "previous" stating: For some nuclear installations, especially of an older vintage, previous codes/procedures may not always demonstrate a margin (e.g. see US NRC USI A-46).	Provide a word of caution for older/not well designed installations. The reader shall not assume that there is always a margin, but shall establish that early in the process.	X			
46.	Canada	2.8	… ~~It should not be automatically assumed that there is an excess of seismic capacity all over the nuclear installation since this may lead to complacency in the seismic safety evaluation.~~	Delete the last sentence. This guidance is self-evident and doesn't add much to the paragraph.	X			

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47.	Canada	2.9	From this understanding, ~~maximum~~ limiting seismic capacity of the SSCs for which there is high confidence that the safety functions are fulfilled, can be derived.	Seismic capacity associated with the limiting failure mode (the "weakest link") of the SSC is of interest in the seismic assessment, which is a *minimum seismic capacity* resulting in the highest (maximum) seismic fragility of the given SSC (upon an applicable hazard). For the purposes of Paragraph 2.9, a change to "*limiting seismic capacity*" term is appropriate.		*From this understanding, maximum seismic demand for which there is high confidence that the safety functions of SSCs are fulfilled, can be derived. High confidence capacities of the SSCs derived in this way are used to assess the seismic safety margin of the installation as a whole.*		Agree with the reviewer. The text is further modified to improve clarity.
48.	Germany	2.9 Line 4	… From this understanding, ~~maximum~~ seismic capacity of the SSCs for which there is high confidence that the safety functions are fulfilled~~,~~ can be derived.	According to SSG-67, Footnote 19 "Seismic capacity is the highest seismic level for which the necessary adequacy has been verified, expressed in terms of the input or response parameter at which the structure or the component is verified to perform its		*From this understanding, maximum seismic demand for which there is high confidence that the safety functions of SSCs are*		Agree with the reviewer. The text is modified to improve clarity

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				intended safety function", so "maximum seismic capacity" is a tautology. Does it make sense to introduce the same footnote in the current Guide as well?		*fulfilled, can be derived. High confidence capacities of the SSCs derived in this way are used to assess the seismic safety margin of the installation as a whole.*		
49.	Libya	2.9 Line 4	[….] From this understanding, the maximum seismic capacity of the SSCs for which there is high confidence [….]	Improved grammar		*From this understanding, maximum seismic demand for which there is high confidence that the safety functions of SSCs are fulfilled, can be derived. High confidence capacities of the SSCs derived in this way are used to assess the seismic safety margin of*		

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						the installation as a whole.		
50.	Germany	2.10 Line 5	…. The 'as-is' condition typically consists of the original design, design changes during construction and operation, unintended deviations from the design and ageing. The 'as-is' condition of the installation should be the baseline for any seismic safety evaluation.	Deviations which occurred unintentionally should be covered, as experience shows that such deviations occur and affect the seismic safety of facilities	X			
51.	Canada	2.11	… Non-linear analyses of relatively simple structural models or the use of higher damping values and ductility factors — provided that they are ~~used with care~~ technically justified and are consistent with allowable deformations considering the as-is condition of the installation — may be particularly helpful in understanding post-elastic behaviour…	"with care" is not clear. Any simplifications and assumptions intended to credit for ductile performance without full-scope non-linear modelling (such as use of inelastic energy absorption factors) should be made based on the data for the "as-is" condition of the plant SSCs.	X			
52.	Canada	2.12	When a reliable seismic hazard analysis is available for a particular site (see SSG-9 [7]), seismic safety evaluation should use a realistic definition of the ~~hazard dominant~~ earthquake motion for the selected annual frequency of exceedance, in terms of amplitude, duration, directivity and frequency content.	Seismic safety assessment shall address a combined effect of all seismic sources, not only the dominant ones. The term *dominant source* is not an established definition (in contrary to dominant failure mode or dominant natural frequency, for	X			Not fully agree with the commenter. Yes, the seismic safety assessment should consider the effect of all

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			When there are several ~~dominant~~ seismic sources that lead to very different motion characteristics (e.g., far field and near field), the feasibility of using several motion characterizations and, therefore, assessing seismic safety (margins) against each of them, should be considered.	example) and could be associated with a significant degree of subjectivism. The use of the term "*hazard-dominant earthquake motion*" could be misleading in this context.				seismic sources, but not necessarily should it combine the effects of all of them, as if all sources could be triggered at the same time. However, the deletion of the word "dominant", as proposed by the commenter, is acceptable.
53.	Israel	2.12	General remark - paragraph 2.12 might be the place for this remark addressing relative movement between different parts of a given building/structure. Such relative movements can be relevant nuclear installations consisting of large constructional structures with large dimensions (e.g.100 meters in one or both dimensions, or even substantially more). For such constructions, and for relevant	Completeness			X	Agree, but this topic is dealt with in other sections and in the Appendix. Relative movements within the structure are determined from the

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			relative propagation direction of the seismic waves, the difference between the time of arrival of the seismic wave to different parts of the building may cause such relative movements. This may occur also in large constructions with parts of the foundations on different types of soil (e.g. soft soil and rocks) and in cases of even not observed or "negligible" small ramifications of nearby geological faults beneath the construction. Effects of such possible relative movements have to be considered un the seismic safety assessment.					seismic analyses of the structure. Relative movements between adjacent structures are discussed in para. A.3. Incoherence of seismic waves within the structure is mentioned in para. 4.5, when describing data needs.
54.	Canada	2.13	… an evaluation of the seismic safety of new nuclear installations is required to be performed as part of a safety assessment, when the design is completed, to verify that safety margins above the design basis earthquake are sufficient ~~to avoid cliff edge effects~~…	Editorial change (added “part of”). Not only to avoid cliff edge effects. E.g., safety margins need to be quantified for release limits. Furthermore, reference to DS490 throughout this	X			Thank you. The reference to DS490 should be replaced by a reference to SSG-67. The latter had not been published at the time the draft was

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				document should be complemented by or replaced with the reference to the latest IAEA publication SSG-67, *Seismic Design for Nuclear Installations* (2021).				prepared.
55.	France	2.13	Recommendations on the level of seismic margin to be achieved in new installation are provided in IAEA Safety Standard Series NS-G-1.6	DS490 is a draft safety guide and not a definitive guide	X			Thank you. The reference to DS490 should be replaced by a reference to SSG-67. The latter had not been published at the time the draft was prepared.
56.	Germany	2.13 Line 9	…. Recommendations on the level of seismic margin to be achieved in a new installation are provided in IAEA Safety Standards Series No. ~~DS490~~, <u>SSG-67,</u> Seismic Design ~~of~~ <u>for</u> Nuclear Installations ~~[13].~~	DS490 is now SSG-67, Seismic Design for Nuclear Installations, published 2021	X			Thank you. The reference to DS490 should be replaced by a reference to SSG-67. The latter had not been published at the time the draft was prepared.
57.	Russia	2.13	2.13 of the NS-G should be left "as	The problem is in using the			**X**	The drafter

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	Rosatom		is". I.e., this should only be applicable to a power unit of completed construction.	term "SMA", as such. As a matter of fact, this is not an assessment of seismic safety margin; instead, this is an assessment of the absence of threshold effect to a given earthquake level exceeding SSE - up to the RLE, inclusive. The margin is known. This is set relative to ultimate strength and yield point and allows local plastic deformations (for local stresses, the allowable ones increase above the yield point) while maintaining the shape (for membrane stresses, the margin does not decrease).Unfortunately, this margin is not bound to the parameter of impact. The methodologies stated in NS-G-2.13 constitute an attempt to present the seismic margin in terms of a parameter of impact (PGA), and the suggested revision of the document is an attempt to introduce these methodologies in design.				agrees with some of the points raised by the reviewer. (Please, note that the seismic margin comes not only from the difference between allowable and ultimate stresses. Consequently, the margin resulting from the design may not be known in advance… In addition, note that acceptance criteria and capacity formulas when computing seismic margin are not the same as used for design. Hence, the RLE does not

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				It is worth noting that there has already been a similar case. That was about the brittle fracture resistance of reactor vessel. The attempt to bind it to the brittle-ductile temperature turned out to be counterproductive. This works in specific conditions, only. Namely, in the form of determination of permissible temperature at hydraulic tests as depending on the service life (fluence). This temperature rises significantly above 100°C by the end of the service life. At the same time, the ECCS water temperature remains (is assumed) equal to 20°C (in HA, 70°C). In general, the task turned out to be multiparametric, with the simplified approach failing to produce an acceptable result. In the problem under consideration, the multiparametricity lies in active components. This is not just about electrical components (that can only be				automatically substitute the SSE level SL2) Keeping the scope of NS-G-2.13 (only existing installations) would have resulted in a Safety Guide easier to write and easier to apply. However, the scope of the revision was defined by the IAEA Management, based on the IAEA Safety Standards policy, approved by the Nuclear Safety Standards Committee,

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				qualified as per the standards by the testing method), but also about mechanical ones. E.g., the time of fall of CPS control rods may change considerably due to the friction in guide channels of protective tube units and fuel assemblies (even without considering the possibility of their being stuck completely). If we assume the RLE as a level, at which safe shutdown must be ensured, then this level would automatically substitute the SSE level (SL2), with all the design and qualification to be performed for this level. Therefore, an attempt to introduce these methodologies in design threatens with disastrous consequences for the design, as a whole. Therefore NS-G-2.13 should be left "as is". I.e., this should only be applicable to a power unit of completed				representing Member States. This means that the scope of DS522 cannot be changed at this point. Nevertheless, it should be said that the methods defined by NS-G-2.13 started being applied at the design stage to justify the design margins requested by the regulators at some Member States, and to justify compliance with the post-Fukushima IAEA design requirements to have a margin over the design basis external

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				construction. It is up to us (AEP jointly with GP) to outline to the Customer in a reasonable way what measures are taken in the design to obtain the positive result of subsequent assessment as per NS-G-2.13. These measures include calculations of resistance to RLE level impacts, with conservatism lifted, for the primary circuit boundaries (GP) and building structures (AEP). Besides, basic technical specifications for equipment may be supplemented with requirements of performing, as per the IEC/IEEE 60980-344 standard (if technically possible), fragility tests on a sample that has been seismically qualified for the SSE level (SL2).				events (IAEA SSR-2/1, Rev. 1). Hence, if the scope of NS-G-2.13 had been maintained (i.e. only existing plants), then a very similar Safety Guide applicable to new plants would have been needed.
58.	Canada	2.14	… Based on many peer-reviewed seismic safety evaluations, ~~T~~the seismic margin to meet (b) applies to a reduced set of SSCs and normally ~~shows~~ requires larger plant state margins than the seismic	Need to shed light on the rationale for the requirement to having the margin to avoid cliff-edge effects due to seismic hazard less than the margin to protect against		*The seismic margin to meet (b) normally applies to a reduced set of SSCs.*		Even if true for many designs, the last sentence is deleted to prevent

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			margin needed to meet (a).	early radioactive release.				incorrect generalization.
59.	Germany	2.14	In connection with para. 2.13, the design of a new nuclear power plant needs to meet two requirements: (a) Adequate seismic margin for items important to safety to provide protection against seismic hazard~~s~~ levels exceeding those considered for design and to avoid cliff edge effects (see para. 5.21 of SSR-2/1 (Rev. 1) [3]); and (b) Adequate seismic margin to protect items ultimately necessary to prevent an early radioactive release or a large radioactive release in the event of levels of natural hazards exceeding those considered for design (see para. 5.21A of SSR-2/1 (Rev. 1) [3]). The seismic margin to meet (b) applies to a reduced set of SSCs and normally will result in ~~shows~~ larger plant state margins than the seismic margin needed to meet (a).	Clarification 1) we suggest using "seismic hazard levels" instead of "seismic hazard**s** levels" 2) To make it clearer that the difference result from the fact that "The margin to meet (b)" refers to a limited set of SSCs whereas "larger plant state margins" refers to the resulting margins for the whole plant, a slight rewording of the sentence is recommended.		*The seismic margin to meet (b) applies to a reduced set of SSCs and normally will result in ~~shows~~ larger plant state margins than the seismic margin needed to meet (a).*		Point (1) In (a), "hazards" (plural) is used because there is not a single seismic hazard (see para. 2.19 of the draft). Point (2) Accepted
60.	Bangladesh	Para 2.15 (f), Page 18	'The' may require to eliminate from this line.			X Changed "The need" to "A need"		
61.	Canada	2.15	(a) Evidence of a significant increase in the seismic hazard at the	New methods may become available not only for hazard			X	Bullet (a) refers just to seismic

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			site, […], new methods of seismic ~~hazard~~ safety assessment, and/or the occurrence of actual earthquakes that affect the installation;	assessment but other aspects of seismic safety analysis (such as response analysis, capacity evaluation, fragility analysis, risk quantification, etc.).				hazard. Hence, the reference to “new methods of seismic hazard assessment” is correct. The idea put forward by the commenter is included in bullet (b).
62.	Canada	2.15	The need to address the performance of the installation for beyond design basis earthquake ground motions in order to provide confidence that there is no ‘cliff edge effect’, that is, to demonstrate that no significant failures would occur in the installation if an earthquake were to occur that was somewhat greater than (i.e., 1.10 times) the design basis earthquake;	Addressing the issue of cliff-edge effects needs a ratio of the DBE to be applied, i.e., an upper bound to ensure no such effects. The safety guide does not have to specify that ratio but at least a requirement could be added for Member States to follow.			X	The drafter agrees with the commenter. It would be good to provide simple quantitative guidance in the Safety Guide about the appropriate distance to a seismic cliff edge. However, as shown in a

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								separate IAEA TECDOC under preparation (*Evaluation of the Adequacy of the Design Robustness of Nuclear Installations against External Hazards*), rational quantitative guidance would need to be based on the site-specific hazard curves and on the safety goals specified by the regulator. In addition, a quantitative definition of seismic “cliff edge” would be required.

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								Hence, it is not as simple as a ratio with the DBE. Consensus among Member States would have been difficult to achieve in this respect. Consequently, the drafters purposedly avoided to give “simple” guidance in this document regarding this topic. The commenter is referred to the new TECDOC, close to be published.
63.	Germany	2.15 (f)	The need to address the performance of the installation for beyond design basis earthquake ground motions in order to provide	Editorial	X			

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			confidence that there is no 'cliff edge effect', that is, to demonstrate that no significant failures would occur in the installation if an earthquake were to occur that was somewhat ~~greater~~ stronger than the design basis earthquake;					
64.	Germany	2.15 (g)	A programme for long-term operation, extending the lifetime of the plant, for which such an evaluation is required.	Clarification, in line with SSR-2/2 (Rev. 1). The same for para. 7.2	X			
65.	Indonesia	2.15 (f)/4	The need to address the performance of the installation for beyond design basis earthquake ground motions in order to provide confidence that there is no 'cliff edge effect', that is, to demonstrate that no significant failures would occur in the installation if an earthquake were to occur that was somewhat greater than the design basis earthquake.	Rephrase to simplify the sentence.		*The need to address the performance of the installation for beyond design basis earthquake ground motions in order to provide confidence that there is no 'cliff edge effect', that is, to demonstrate that no significant failures would occur in the installation if an earthquake were*		

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						to occur that was somewhat ~~greater~~ stronger than the design basis earthquake;		
66.	Russia NRS	2.15 (a)	Evidence of a significant increase in the seismic hazard at the site, arising from new or additional data (e.g. newly discovered seismogenic structures, beginning of deep tunnel construction or opening of a mining enterprise in the nuclear installation site region; newly installed seismological networks or new paleo-seismological evidence), new methods of seismic hazard assessment, and/or the occurrence of actual earthquakes that affect the installation;	Changes in the anthropogenic environment of the nuclear facility site (construction of new large facilities or intensification of production, for example) can make changes to the assessment of seismic hazard (in the assessment of the danger of human-induced earthquakes).		*(a) Evidence of a significant increase in the seismic hazard at the site, arising from new or additional data (e.g. newly discovered seismogenic structures, assessments of human-induced seismicity, newly installed seismological networks or new paleo-seismological evidence), new methods of seismic hazard assessment, and/or the occurrence of*		

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						actual earthquakes that affect the installation;		
67.	Germany	2.16 (f)	To assess risk metrics (e.g. core and/or fuel damage frequency and large or large early release frequency) against regulatory requirements, if any.	Precision for consistency with PSA-related Guides DS523 (paras 1.4, 2.11 and 8.72, as example) and DS528 (document under development) and its old version SSG-4 (para 6.23, for example) covering all plant operational states/modes and not only early releases, but all large releases	X			
68.	Germany	2.16 (g) Footnote 11	The High Confidence of Low Probability of Failure	Editorial	X			
69.	Hungary FBG	2.16.	(f) To assess risk metrics (e.g. core/fuel damage frequency and large early release frequency) against regulatory requirements, if any.	Since the document specifically talks about "nuclear installations" I believe it is important to mention fuel damage frequency which is a more common PSA metric for the different facilities and release sources (e.g.: SFP or refueling pool in an NPP).		*(f) To assess risk metrics (e.g. core and/or fuel damage frequency and large or large early release frequency) against regulatory requirements, if any.*		Agree. Large (not-early) releases are also included as an example.

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70.	Israel	2.16c	We suggest adding a footnote to paragraph 2.16 (c) explaining the rationale for the need to evaluate and determine the relative seismic capacity and/or risk ranking of all existing nuclear installations in a region or a State.	Completeness			X	Para. 2.16 itemizes potential objectives of a seismic safety evaluation. Those objectives correspond to real experiences in several Member States. The drafter cannot explain the rationale behind these experiences. Para. 2.16(c) corresponds to the experience in the United States of America in the 1990s (Supplement 4 to US-NRC Generic Letter 88-20,

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								NUREG-1407).
71.	Germany	2.17 (b) New footnote	To identify weak links[FN] in the installation and its operations with respect to seismic events. New footnote: In this context, a seismic 'weak link' **refers to** non-redundant SSC or identical redundant SSCs (affected by common cause failure) which has/**have** a smaller capacity than the majority of the other SSCs and, as such, ~~it~~ could be controlling the installation-level seismic capacity.	The explanation of "weak link" is given in footnote 15, which refer to para. 2.24. Please remove this footnote to para 2.16 (f), as "weak link" has been mentioned here for the first time. Please check the wording for this footnote, we suggest using plural due to addition of identical redundant SSCs		Moved footnote: *In this context, a seismic 'weak link' is a non-redundant SSC or identical redundant SSCs (affected by common cause failure) which has a smaller capacity than the majority of the other SSCs and, as such, it could be controlling the installation-level seismic capacity.*		Footnote 15 is moved to this (earlier) position.
72.	Russia Rosatom	2.18	The following item is to be added: "Results of verification for correctness of assignment of seismic resistance categories, with consideration of possible failures of elements of systems and associated initiating events"			*(i) A framework for the revision of the seismic categorization of structures, systems and components.*		
73.	Canada	2.19	(c) Evaluation of other concomitant	Wider scope and improved		X		Corrections to

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			phenomena such as ~~earthquake-induced~~ ~~river~~ flooding due to seismically induced ~~dam~~ failure of dams or water retaining structures, coastal flooding due to tsunami, and ~~landslides~~ seismically induced slope instabilities[14]. [14] Seismically induced slope instabilities include landslides, rockslides, rockfalls, mudflows, slumping, and snow avalanches.	terminology are suggested. Instead of concomitant, terminology should be revised to use 'coincidental hazard, correlated hazard and consequential hazards'. Furthermore, approaches to combining seismic PSA and PSA for other concomitant hazard(s) need to be discussed. Also, landslide is one type of soil failures and need to be addressed in a separate paragraph along with other soil failures (such as liquefaction) or other soil failures need to be listed in item (c) of para. 2.19. Inadequate description of phenomena induced by earthquakes. All seismically induced slope failure scenarios (defined with a footnote) should be evaluated, which also link to comment 102 below.				the text suggested by the commenter are accepted. Please, note that this paragraph refers, exclusively, to the different aspects of assessment of seismic hazards. The need to address all these hazards in the seismic safety evaluation is discussed in paras. 5.10 thru 5.14 of the draft. Approaches to combining seismic PSA and PSA for other concomitant

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								hazard(s) are out of the scope of this Safety Guide. Potential approaches are presented in other IAEA documents (IAEA Safety Report No. 92, *Consideration of External Hazards in Probabilistic Safety Assessment for Single Unit and Multi-unit Nuclear Power Plants*)
74.	France	2.19		The paragraph should be clarified with regard to the criteria and means for conducting the analysis			X	This paragraph is intended as a reminder that the different facets of seismic hazard (ground motion, geological stability,

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								potential concomitant events) is an important input to the seismic safety evaluation. The paragraph refers the reader to other IAEA Safety Guides for guidance on the assessment of those seismic hazards. Paras. 2.20 thru 2.23 already provide criteria for using the guidance given by other safety guides in the context of a seismic safety evaluation. In general, the recommendations on assessing

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								the seismic hazard at the site are dependent on the objectives of the evaluation.
75.	France	2.19 a.i	capable fault” ➔ “capable fault (with a return period to be defined according to the area under consideration)”	Depending on the country of interest the notion of capable fault may differ		The reference to SSG-9 in this paragraph is updated to a reference to SSG-9 Rev. 1.		Agree, but the IAEA has its own definition of capable fault (IAEA SSG-9 Rev. 1, para. 7.4), and this is the one applicable within IAEA documents. The comment is addressed by para. 7.5 of SSG-9 Rev. 1, which states that: “*The period within which evidence of past movement will determine the*

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								capability of a fault, as indicated in para. 7.4(a), should be defined at the beginning of the seismic hazard assessment project through a site specific criterion based on the characteristics of the regional tectonic environment and the conditions in the near region and site vicinity. This criterion for assessing fault capability should be established by or agreed with the regulatory body".

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76.	Germany	2.19 footnote 13	~~In SSR-1 [2] and SSG-9 [7], four scales of investigations are defined: (1) 'regional' radius R about 300 km~~, (~~2) 'near region', R no less than 25 km, (3) 'site vicinity', R no less than 5 km~~, ~~and (4) site area, R about 1 km~~. SSG-9 [7] states that the geological, geophysical and geotechnical investigations for evaluating the seismic hazards at the site should be conducted on four spatial geographical scales — regional, near regional, site vicinity and site area.	SSR-1 and SSG-9 (Rev. 1) are not providing such definition in such a form. SSR-1 introduces 'site area', 'external zone', 'region' and 'site vicinity' for site evaluation. Notice to the radius is given only in para 1.12 for 'site vicinity'. Four scales of investigation are given in SSG-9; however, without notices of corresponding radii and km.		~~*In SSR-1 [2] and SSG-9 [7]*~~, *In SSG-9 Rev. 1 [7] four scales of investigations are defined: (1) 'regional' radius R typically about 300 km, (2) 'near region', R not less than 25 km, (3) 'site vicinity', R not less than 5 km, and (4) site area, R typically about 1 km.*		Agree that those distances are just indicative. Para. 3.22 of SSG-9 Rev. 1 states that "*The near regional studies should include a geographical area typically not less than 25 km in radius from the site boundary, although this dimension should be adjusted to reflect local seismotectonic conditions"* *Para 3.28 of SSG-9 Rev. 1 states: "Site*

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								vicinity studies should cover a geographical area sufficient to encompass all faults and other seismotectonic features requiring detailed geophysical investigation; this area is typically not less than 5 km". Footnote is modified.
77.	Hungary FBG	2.19. (a)	To verify the absence of any capable fault that could produce significant differential ground displacement phenomena underneath or in the close vicinity of buildings and structures important to safety. If there exists evidence that indicates the possibility of a significant capable	The goal of every nuclear standard, regulation and recommendation is to ensure nuclear safety through ensuring the fulfillment of the fundamental safety functions. An external effect that doesn't have the magnitude/amplitude to		*To verify the absence of any capable fault that could produce significant differential ground displacement phenomena*		Agree on the first "significant". However, the term "capable fault" is defined in IAEA SSG-9 Rev. 1, para.

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			fault in the site area or site vicinity, the fault displacement hazard should first be assessed in accordance with the guidance provided in SSG-9	affect the fulfillment of these safety functions (e.g.: fault displacements with a maximum value in the order of a few mm which is well covered by the design for other majoring effects, like uneven tilting) therefore should not be considered relevant to the safety of the site/facility, since by definition cannot affect it. I believe that by adding the term "significant" to the text it could be emphasized that the recommendation refers to fault displacement relevant to safety.		*underneath or in the close vicinity of buildings and structures important to safety. If there exists evidence that indicates the possibility of a capable fault in the site area or site vicinity, the fault displacement hazard should first be assessed in accordance with the guidance provided in SSG-9*		7.4. This is the definition applicable within IAEA documents. Either the fault is capable according to this definition or it is not. In this sense, the meaning of "significant capable fault" is unclear.
78.	Canada	2.22	On the other hand, it should not be considered a prerequisite when the objective of the evaluation is to determine the seismic margin above a ~~predefined~~ reference level earthquake defined in accordance with this Safety Guide and/or to rank the SSCs contributing to the installation-level seismic capacity to withstand that reference level	A predefined RLE does not exist. The RLE is to be defined in the SMA process.			X	"Predefined" means that the reference earthquake is defined as input data for the seismic safety evaluation. For instance,

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			earthquake for identification of seismic weak links.					this was the case of the IPEEE program (US-NRC NUREG-1407), where an RLE was defined as input data for the SMA at each US site East of the Rocky Mountains. (This is a possibility that the drafters did not want to rule out, since a reliable seismic hazard analysis might not be available in some Member States).
79.	Germany	2.22 Line 2	…. A site-specific ground motion seismic hazard assessment is generally preferred.~~, and~~ <u>Th</u>is~~ a~~ prerequisite~~ that~~ should be carried out, as recommended in SSG-9 [7],	Please improve intelligibility.		*A site-specific ground motion seismic hazard assessment is generally*		

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			when the objectives of the evaluation include (a) the assessment of the seismic risk posed by the installation or (b) risk-based metrics for the SSCs. On the other hand, ~~it should not be considered a~~ this prerequisite is not required if the objective of the evaluation is (a) to determine the seismic margin above a predefined reference level earthquake and/or (b) to rank the SSCs contributing to the installation-level seismic capacity and withstanding ~~that~~ the reference level earthquake for identification of seismic weak links.			*preferred~~, and~~ This is a prerequisite that should be carried out, as recommended in SSG-9 [7], when the objectives of the evaluation include the assessment of the seismic risk posed by the installation or risk-based metrics for the SSCs. On the other hand, ~~it~~ a site-specific ground motion seismic hazard assessment should not be considered a prerequisite when the objective of the evaluation is to determine the seismic margin above a*		

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						predefined reference level earthquake and/or to rank the SSCs contributing to the installation-level seismic capacity to withstand that reference level earthquake for identification of seismic weak links		
80.	Germany	2.23 (a)	Calculation of risk metrics (e.g. core and/or fuel damage frequency and large or large early release frequency);	Precision for consistency with PSA-related Guides DS523 and DS528 covering all plant operational states/modes and not only early releases, but all large releases – the same as comment 15.	X			
81.	Hungary FBG	2.23	(a) Calculation of risk metrics (e.g. core/fuel damage frequency and large early release frequency);	Since the document specifically talks about "nuclear installations" I believe it is important to mention fuel damage frequency which is a more common PSA metric for the different facilities and release		*(a) Calculation of risk metrics (e.g. core and/or fuel damage frequency and large or large early release frequency);*		Agree. Large (not-early) releases are also included as an example.

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				sources (e.g.: SFP or refueling pool in an NPP).				
82.	Canada	2.24	It should be understood as a ~~tool~~ fundamental seismic demand to determine the seismic margin of the installation and its seismic 'weak links'.	RLE is a ground motion spectrum, not a *tool* for evaluation of seismic margin.			X	Methodologically, the RLE is a tool, in the sense that it is used to determine the seismic margin of the installation and the weak links. For an existing installation, the margin is a property of the installation, independent of the RLE selected for the assessment. Confusion sometimes arises because in some Member States the RLE is used, at the same time, to

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								specify a target seismic margin.
83.	Canada	2.24	The reference level earthquake should be sufficiently larger than the design basis earthquake to ensure that it challenges the seismic capacity of the SSCs so that an installation-level HCLPF can be determined and the 'weak links' (if any) can be identified.	The statement is unclear. The concept is the RLE is larger than DBE to represent potential beyond design basis conditions for the given installation, and that RLE is used as an input to determine *installation-level HCLPF and associated "weak links" with respect to BDBE.* Installation-level HCLPF and "weak links" can be identified for any ground motion, not only for the reference level earthquake. It is also unclear what is meant "challenges the seismic capacity": any ground motion challenges functionality and integrity of plant SSCs, and it may be below or above the capacity of plant SSCs.			X	A clarification is provided below. In the SMA and PSA-based SMA methodologies, the RLE is set as a screening level, to make the procedure more efficient in practice. The idea is that, for seismic capability engineers, it is easier to decide if the HCLPF capacity is larger or smaller that the RLE, rather than computing the actual HCLPF

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								capacity. Proceeding in this way, many components can be screened out and detailed capacity assessments are reserved for screened-in components. If the RLE is set too high, very few components will be screened out, making the evaluation less efficient. If the RLE is set too low, it might happen that all components are screened out and the margin remains

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								undetermined.
84.	Canada	2.24	… HCLPF can be determined and the 'weak links' (if any) can be identified. The RLE is typicaly specified by the PGA level (peak ground spectral acceleration), although other ground motion parameters (such as velocity, displacement, magnitude, intensity) could be used. The seismic input for a seismic safety evaluation should not be less than a peak ground acceleration…	Prior to defining the minimum PGA level for RLE, the concept of PGA in RLE representation needs to be explained. Furthermore, suggest revising paragraph 2.24 based on the definition of RLE (RE) as a fundamental seismic demand for the purposes of seismic safety assessment as well as the latest state of knowledge in the industry on several fundamental aspects of seismic assessment.		*…HCLPF can be determined and the 'weak links' (if any) can be identified. The RLE is typically specified by means of a spectral shape, anchored at a PGA level, defining the seismic motion at a given control point. The seismic input for a seismic safety evaluation should not be less than a peak ground acceleration of 0.1 g at the foundation level.*		
85.	Canada	2.24	The seismic input for a seismic safety evaluation should not be less than the maximum annual	The requirement of 0.1g is in direct conflict with SSG-67 that requires the DBE to be		*The seismic input for a seismic safety*		The requirement is consistent with

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			probability of exceedance, $1x10^{-4}$ with the ~~a~~ peak ground acceleration ~~of 0.1 g at the foundation level~~ more than the design basis earthquake.	0.1g at free field or foundation level. Also, the guide talks about probabilities everywhere but does not quantify the probability of seismic hazard.		*evaluation should not be less than a peak ground acceleration of 0.1 g at the ground level or foundation level, in the free field.*		SSG-67, since the draft Safety Guide DS522 applies to existing installations, for which the DBE could have been specified at a PGA level smaller than 0.1 g. The idea is that earthquakes with PGA smaller than 0.1g would hardly challenge a well-maintained nuclear installation. Annual frequencies of exceedance associated to seismic hazard

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								are a key ingredient to assess seismic risk, as explained in Section 5 of the draft. In a risk-informed framework target margin depends on annual frequencies of exceedance associated to seismic hazard and the safety goals set by the regulator. (See TECDOC under preparation, *Evaluation of the Adequacy of the Design Robustness of Nuclear Installations against*

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								External Hazards)
86.	Finland	2.24, 6.7	Continue statement: "… not be less than a peak ground acceleration of 0.1 g at the foundation level" for example, with following: "Typical safety case is safe shut down earthquake (SSE). Frequency of PGA should be defined by cut-off-frequency analysis in order to ensure correct amplification in corresponding frequency spectra.	Sentence in these paragraphs "… not be less than a peak ground acceleration of 0.1 g at the foundation level" alone is unclear. Corresponding safety case and frequency of the PGA should be advised. In practice in some cases has been utilized 33 Hz and somewhere else 50 Hz or even 100 Hz. How the corresponding frequency is based on foundation conditions should be clear. This effects to amplification in frequency spectra when PGA is increased to the minimum acceleration of 0.1 g.		*…HCLPF can be determined and the 'weak links' (if any) can be identified. The RLE is typically specified by means of a spectral shape, anchored at a PGA level, defining the seismic motion at a given control point. The seismic input for a seismic safety evaluation should not be less than a peak ground acceleration of 0.1 g at the foundation level.*	X	A sentence is added to clarify the intended meaning. The intended meaning is that there is a minimum earthquake severity below which the analyst should not go. Since, for engineers, the severity of an earthquake is normally expressed in terms of the maximum ground acceleration, the PGA parameter has been selected for the purposes of

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								expressing this lower bound. Peak ground acceleration is a property of a ground motion acceleration time-history. This property is previous to any spectral analysis. In the opinion of the drafter, a general guidance about at which spectral frequency the ground response spectrum reaches the plateau of the peak ground acceleration (PGA), is very difficult to give since it is very

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								site and event dependent. Agree. In modern PSHAs using the conventional Vs-kappa corrections, for hard rock sites, the plateau could be reached for frequencies larger than 100 Hz. Then, it could happen that for spectral frequencies at which the PGA plateau used to be assumed (e.g. 33 Hz), spectral accelerations are larger than the PGA.
87.	France	2.24 Lines N°7,8, 9	The seismic input for a seismic safety evaluation should not be less than a peak ground acceleration of	-ground motion is recorded at the ground surface during earthquakes, **in the free field**	X			Thank you. This addition will make this

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			0.1 g at the ground level **or foundation level, in the free field.**	- foundation level could be variable and dependent on the structure **-according to countries, the reference level is the ground level or foundation level or the both depending of the soil characteristics**				paragraph fully consistent with para. 3.26 of IAEA SSG-67.
88.	Germany	2.24 Footnote 15	In this context, a seismic 'weak link' refers to ~~is a~~ non-redundant SSC or identical redundant SSCs (affected by common cause failure) which has/have a smaller capacity than the majority of the other SSCs and, as such, ~~it~~ could be controlling the installation-level seismic capacity.	Please remove this footnote to para 2.16 (f), as "weak link" has been mentioned there for the first time. Please check the wording for this footnote, we suggest using plural due to addition of identical redundant SSCs	X			Footnote is moved to an earlier location. See resolution of comment 17.
89.	Germany/ BMUV	2.24	For the SMA and PSA-based SMA methodologies, the reference level earthquake13 defines the seismic input that should be used in the seismic safety evaluation. The reference level earthquake (see also para. 5.5) should not be interpreted as a new design basis earthquake, but rather as a tool to determine the seismic margin and seismic weak links14 of the installation. […]	Please move the footnote regarding 'weak links" to 2.16 (b) as the term "weak links" is mentioned there for the first time.	X			

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			Footnote 14: In this context, 'seismic weak links' are non-redundant SSCs or identical redundant SSCs (affected by common cause failure) which have a smaller capacity than the majority of the other SSCs, and, as such, could govern the installation level seismic capacity.					
90.	Hungary P2	2.24 Note 14. (bottom of the page)	Regarding the applicable values of the RLE information are provided by standards and literatures.	Since the review level earthquake RLE is not clearly defined in the literature, the current safety guide shall provide guidance or at least hint regarding the available RLE values and the methods of the selection of them in the case of new and existing NPP's.			X	Some clarification is provided below. Methodologically, the RLE is a tool, in the sense that it is used to determine the seismic margin of the installation and the weak links. For an existing installation, the

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								margin is a property of the installation, independent of the RLE selected for the assessment. In this sense, definition of the RLE is somewhat arbitrary and this is a reason for not giving detailed methods in this draft. In other words, in the SMA and PSA-based SMA methodologies, the RLE is set as a screening level, to make the procedure more efficient in practice.

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								The idea is that, for seismic capability engineers, it is easier to decide if the HCLPF capacity is larger or smaller that the RLE, rather than computing the actual HCLPF capacity. Proceeding in this way, many components can be screened out and detailed capacity assessments are reserved for screened-in components. If the RLE is set too high,

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								very few components will be screened out, making the evaluation less efficient. If the RLE is set too low, it might happen that all components are screened out and the margin remains undetermined. Having said so, the reviewer is right in that confusion sometimes arises because in some Member States the RLE is used not just as a screening tool,

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								but also to specify a target seismic margin. In a risk-informed framework, target seismic margin should be obtained from annual frequencies of exceedance associated to seismic hazard and from the safety goals set by the regulator. (See TECDOC under preparation, *Evaluation of the Adequacy of the Design Robustness of Nuclear Installations against*

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								External Hazards). However, there is still no international consensus on this subject. Hence, no rules can be included yet in a Safety Guide.
91.	Israel	2.24 and 6.7	In these two paragraphs, the value of **0.1 g** is mentioned as **minimal value of *the peak ground acceleration*** *at the foundation level, for the seismic input for a seismic safety evaluation.* We would like to suggest adding (maybe as footnote) the reason (+ relevant reference?) for choosing that specific acceleration value.	Completeness		*2.24* *…HCLPF can be determined and the 'weak links' (if any) can be identified. The RLE is typically specified by means of a spectral shape, anchored at a PGA level, defining the seismic motion at a given control point.*		The requirement is consistent with IAEA SSG-67, which requires a minimum design basis earthquake at the 0.1 g PGA level. It does not make sense to perform a seismic safety evaluation for a reference earthquake less severe than the design basis

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						The seismic input for a seismic safety evaluation should not be less than a peak ground acceleration of 0.1 g at the ground level or foundation level, in the free field.		earthquake. Note that earthquakes with PGA smaller than 0.1g would hardly challenge a well-maintained nuclear installation.
92.	Pakistan	Section 2.24 Section 2.25 Section 5.6	**Reference Level Earthquake** If site specific Peak Ground Acceleration (PGA) is significantly less than the Design SSE value of the plant, guidance may be included to describe the Reference Level Earthquake for such a particular case. (For example, if site specific PGA is 0.2 g and plant SSE is 0.3 g, guidance for Reference Level Earthquake for such type of case be included)		.	X	x	The reviewer refers to a standard plant design made for an SSE (e.g. PGA 0.3 g), placed in a site for which the seismic design basis derived from the applicable regulation give a less severe earthquake (e.g PGA 0.2 g).

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								Some clarification is provided below. Methodologically, the RLE is a tool, in the sense that it is used to determine the seismic margin of the installation and the weak links. For an installation, the margin is a property of the installation, independent of the RLE selected for the assessment. In this sense, definition of the RLE is somewhat arbitrary and this is a reason

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								for not giving detailed methods in this draft. In other words, in the SMA and PSA-based SMA methodologies, the RLE is set as a screening level, to make the procedure more efficient in practice. The idea is that, for seismic capability engineers, it is easier to decide if the HCLPF capacity is larger or smaller that the RLE, rather than computing the actual HCLPF capacity.

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								Proceeding in this way, many components can be screened out and detailed capacity assessments are reserved for screened-in components. If the RLE is set too high, very few components will be screened out, making the evaluation less efficient. If the RLE is set too low, it might happen that all components are screened out and the margin remains undetermined.

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								In the example mentioned by the reviewer, if the RLE is set smaller than PGA 0.4 g, it is very likely that all components are screened out and the margin remains undetermined (it will be above PGA 0.4 g). Having said so, the reviewer is right in that confusion sometimes arises because in some Member States the RLE is used not just as a screening tool, but also to specify a target seismic margin.

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								In a risk-informed framework, target seismic margin should be obtained from annual frequencies of exceedance associated to seismic hazard and from the safety goals set by the regulator. (See TECDOC under preparation, Evaluation of the Adequacy of the Design Robustness of Nuclear Installations against External Hazards). However, there is still no international

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								consensus on this subject. Hence, no rules can be included yet in a Safety Guide. In that sense, if the design basis has been obtained at the PGA 0.2 g, it is very likely that having a design for PGA 0.3 g meets the safety goals of the regulator.
93.	Canada	2.25	In that case, the seismic risk computed for each contribution should be ~~added up~~ combined to obtain the total risk.	Editorial	X			
94.	Germany	2.25 Footnote 16	~~The 'reference level earthquake' concept, as used in the present Safety Guide (see para. 5.5), is not to be confused with the seismic level that is used sometimes in SPSA as a threshold for explicit calculation of fragilities, when below, and for assignment of~~	The footnote is very specific. It will only be understood by specialists, who do not need it. We suggest deleting it.			X	Agree. It will only be understood by specialists. However, this footnote was introduced after

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			~~generic fragilities, when above.~~					a long discussion within the working group supporting the preparation of the draft and it does provide a clarification that might be useful for some readers.
95.	Russia NRS	New lines following Para 2.25	Seismic hazard evaluation Sl-2 shall be based on a Probabilistic seismic hazard assessment (PSHA)/ Typically, the products of a PSHA are hazard curves and UHRS (Uniform Hazard Response Spectra) associated with several hazard exceedance frequencies. The hazard curves and UHRS may be at the ground surface or at some specified depth. SSG-9 provides basic information to characterize the site and to determine the ground motion. When synthesizing accelerograms compatible with the target response spectrum with 5% damping, the	Uncertainty of requirements for initial data. The section should be supplemented with requirements for quantitative parameters of initial seismic impacts. The proposed additions provided in this para.			X	Observations are correct, but the draft already makes reference to IAEA SSG-9 for details about probabilistic seismic hazard assessment. The reviewer provides detailed requirements for synthetic accelerograms.

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			following requirements and quality criteria should be taken into account: 1) The total duration of the generalized synthesized accelerogram (for both horizontal and vertical components) shall not be less than 20 s, and the duration of the interval of maximum amplitudes shall not be less than 6 s. (NRC NUREG-0800 and ASCE/SEI 43-05); 2) The sampling frequency of digital accelerograms shall be 500 Hz (time step of 0.002 s); 3) The peak value (PGA) of the accelerogram shall be equal to or greater than the target PGA value (ASCE 4-98); 4) Spectral accelerations (for 5% damping) shall be calculated for at least 100 values uniformly distributed on a logarithmic scale per frequency decade. This corresponds to a step in the values of adjacent frequencies of not more than 2.353% (ASCE/SEI 43-05); 5) The average ratio of the spectral amplitudes of the synthesized accelerogram components to the corresponding target spectral					However, these detailed requirements are generally out of the scope of IAEA Safety Guides, because they usually correspond to the practice of a group of Member States and there may be other acceptable practices. On top of that, the available space in a Safety Guide is limited and very detailed guidance cannot be given.

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			amplitudes shall not be less than one (ASCE 4-98, ASCE/SEI 43-05); 6) The value of the “zero” period acceleration (ZPA) of the accelerogram spectrum shall be equal to or greater than the (target) acceleration of the PGA and ZPA (ASCE 4-98); 7) The spectrum of the calculated (synthesized) accelerogram shall not deviate down from the target response spectrum by more than 10% in the frequency range of the target spectrum (ASCE 4-98). The spectrum of the calculated (synthesized) accelerogram shall not exceed the target response spectrum by more than 30% in the entire frequency range of the target spectrum (ASCE/SEI 43-05); 8) In the frequency sub-band centered on any of the frequencies of the spectrum and having a width of 10 % of this frequency, only negative deviations of the accelerogram spectrum from the target spectrum shall not take place. When calculating the spectrum based on abovementioned criterion 4, this is equivalent to the fact that					

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			in the frequency sub-band 0.9fi<fi<1.1fi below the corresponding values of the target spectrum, no more than nine values of the accelerogram spectrum are allowed in a row (ASCE/SEI 43-05); 9) Statistical independence of the synthesized components of three-component accelerograms shall be ensured. The cross-correlation coefficient shall not exceed 0.16 in pairs (NRC NUREG-0800 Standard Review Plan 3.7.1); 10) Accelerograms shall be balanced in terms of velocities and displacements (at the time of the end of the accelerograms, there shall be no residual velocities and displacements or they shall be minimized). This criterion is based on the requirements of the General Designer.					
96.	Canada	2.26		The scope of this paragraph needs to include considerations of seismic failure correlation for multiple installations (e.g., multi-unit stations), since			X	Agree with the observations made by the commenter, but the details about these

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				seismic event affects all facilities (units) simultaneously (a common cause impact). Full correlation of seismic failures is typically (and conservatively) assumed as resulting in simultaneous demand on shared systems (including NPP containment), industry guidance on partial correlation is yet to be developed. The subject of seismic response correlation between multiple installations should be covered due to significant effect of highly correlated response on the risk and safety assessment of nuclear installations (multi-unit NPPs).				relatively complex aspects are out of the scope of this Safety Guide. General international practice has not reached a level of consensus that allows inclusion in a Safety Guide, beyond what is already written in para. 2.26. The commenter is referred to other, non-consensus, IAEA documents (IAEA Safety Report No. 92, *Consideration of External Hazards in Probabilistic Safety Assessment for*

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								Single Unit and Multi-unit Nuclear Power Plants)
97.	Canada	2.26	Safety evaluation of multi-facility sites provides risk insights that help minimize the risk of multiunit accidents (e.g. due to shared systems and resources <u>or due to impact of accident phenomena between installations</u>) and to maximize the benefits associated to shared systems and resources among units.	Suggest adding an important factor of interaction between installations when accident progression on one installation may trigger accident on another installation on the site (e.g., releases from the spent fuel pool impact accident mitigation capabilities on reactors).	X			
98.	Germany	Title bevor 2.26	EVALUATION OF SEISMIC SAFETY FOR ~~MULTI-FACILITY SITES~~ <u>sites with multiple nuclear installations</u>	The question is if the term “multi-facility sites” is in line with other IAEA Safety Guides. Typically, the term “multi-unit sites” is used for sites with multiple reactor units, and the term “multi-source sites” is used for nuclear sites with reactor units and other nuclear installation (facilities) representing sources of radioactive releases. Preferably the term “multi-facility sites” should be replaced by “sites with	X			

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				multiple nuclear installations”				
99.	Germany	2.26 Line 4	… Safety evaluation of ~~multi-facility sites~~ **multi-unit sites / sites with multiple nuclear installations** provides risk insights that help minimize the risk of multi-unit accidents (e.g. due to shared systems and resources) and to maximize the benefits associated to shared systems and resources among units. The Multi-unit-PSA is an appropriate methodology for considering potential interactions in a multi-unit context.	Par. 2.26 mixes “multi-facility site” (= multi-source sites, see comment before) with multi-unit aspects only: There are two alternatives to change the text, depending on if the focus should be limited (what from our opinion is not necessary for the example provided in the paragraph) to multiple reactor units only. Then the term” multi-facility sites” needs to be replaced by “multi-unit sites” to be consistent in this paragraph. If, what we assume, the intention is to limit this paragraph to multiple reactors units - because of the last sentence focussing on MUPSA (including at least the spent fuel pools as possible other sources as in the revision DS523 of SSG-3) - the text should be made more consistent with these documents and provide an		*Safety evaluation of ~~multi-facility~~ sites with multiple nuclear installations provides risk insights that help minimize the risk of ~~multiunit~~ simultaneous accidents in several installations (e.g. due to shared systems and resources) and to maximize the benefits associated to shared systems and resources among ~~units~~ installations. The Multiunit-PSA is an appropriate methodology for*		The focus is on sites with multiple nuclear installations.

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				explanation if multiple sources, at least the SFPs, are included (PSA methodology for these is also available and good practice in Member States,. In this case, the term "**sites with multiple nuclear installations"** should be used in line with the comment before. Additionally, please change "multi unit" to "multi-unit" for consistency with other IAEA documents.		*considering potential interactions in a multi-unit context.*		
100.	Germany/ BMUV	2.26	For sites with multiple nuclear installations (generally nuclear power plant~~s~~ units) ~~and/or with nuclear power plants that have a significant number of shared systems and resources or impact of accident phenomena between multiple nuclear installations~~, potential interactions between the installations should be considered in the seismic safety evaluation. The evaluation will provide risk insights to help minimize the risk of	Due to the attempt to incorporate the suggestions made by member states in Step 8, the first sentence of this paragraph has become quite confusing. A possible solution might be the proposed text that stays close to the suggestions made during Step 8.		X Edited to: For sites with multiple nuclear installations (generally multi-unit nuclear power plants), which typically have shared systems and resources,		

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			simultaneous accidents in several installations (e.g. due to shared systems and resources or due to impact of accident phenomena between installations) and maximize the benefits associated with shared systems and resources among installations. […]			potential interactions between the installations should be considered in the seismic safety evaluation[..]		
101.	Canada	2.27	Actual ~~S~~seismic walkdowns cannot be conducted at the design stage.	Virtual seismic walkdown can be done to at least identify interactions.		*Physical seismic walkdowns cannot be conducted at the design stage.*		
102.	Canada	2.27	The probability of the RLE would be one order of magnitude less than the DBE.	If the RLE and the DBE are to be determined at the same time then this guide conflicts with SSG-67 because both define the minimum PGA as 0.1g but without any associated probability.			X	See answer to comment No. 24. The idea is that neither DBE or RLE should be specified under 0.1g, irrespective of probabilities.
103.	Pakistan	2.27/6	All tasks are similar with the one used for existing installations and the differences consists only in the availability of information. Instead of as-built and as-operated information, at the design stage, methodologies should rely on as-designed	In case of SPSA and PSA based SMA for new NPPs only design stage information cannot provide sufficient information to quantify the risk. Therefore, usage of operational experience feedback of		*All tasks are similar to the ones used for existing installations and the difference consists only in the availability of*		

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			information ~~only~~ **and operational experience feedback of similar design**. Seismic walkdowns cannot be conducted at the design stage.	similar designs can play important role and provide more in depth and practical information.		*information. Instead of as-built and as-operated information, at the design stage, methodologies should rely on as-designed information ~~only~~ and operational experience feedback of similar designs. Physical seismic walkdowns cannot be conducted at the design stage.*		
104.	Russia Rosatom	2.28	The following is to be added: "assessment of seismic safety must include verification for correctness of assignment of seismic resistance categories, with consideration of possible failures of elements of systems and associated initiating events"			*…goals, and to optimize the robustness of seismic design and to verify the seismic categorization of structures, systems and components.*		
105.	Canada	2.29	At the licensing stage, the detailed design is completed, and site-specific seismic induced hazards are known.	Not all the detail design will be completed, e.g., equipment vendor information may not be available.		At the licensing stage, the ~~detailed~~ design is completed, and site-specific seismic induced hazards are known.		
106.	Canada	2.27-2.30	1. Add a chapter CONSIDERATION OF SEISMIC SAFETY EVALUATION FOR THE EXISTING	Paragraphs 2.27 to 2.30 identify safety assessment methodologies for new designs and installations in			X	The drafter sees the point of the commenter, but discussion

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<tr><td></td><td></td><td></td><td>INSTALLATIONS.

2. Identify applicability of deterministic SMA methodology for seismic safety assessment (such as, deterministic SMA is typically used for the seismic safety evaluation of existing installations).</td><td>the licensing stage. SPSA and PSA-based SMA are mentioned, but not SMA (deterministic). Existing designs are not explicitly discussed (leaving it open to interpretation). Revisions required for completeness.</td><td></td><td></td><td></td><td>about the selection of the methodology is provided in Section 3 of the draft Safety Guide. Discussion in Section 3 already includes the considerations given by the commenter.

The drafter does not see a need to introduce a new subheading here.

Paras. 2.27 thru 2.30 have an introductory nature and are intended to underscore the larger scope with respect to the previous</td></tr>
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								version of the Safety Guide (NS-G-2.13), where the scope only included existing installations.
107.	Germany	2.29	At the licensing stage, the detailed design is completed, and site-specific seismic induced hazards are known. For nuclear power plants, SPSA methodology is typically used to provide input to the final safety analysis report (see ~~Section~~ <u>Chapter</u> 15 of SSG-61 [12]).	SSG-61 is using „Chapter“, not “Section”; please change for consistency with terminology in [12].			X	The term “Section” has been consistently used throughout the draft. The word “Chapter” has not been used. In any case, the IAEA English editors will fix any deviation from the IAEA style requirements before the Safety Guide is released to press.

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108.	Hungary FBG	2.29.	2.29. At the licensing stage, (depending on the type of licensing activity and national licensing practice) the detailed design is completed, and site-specific seismic induced hazards are known. For nuclear power plants, SPSA methodology and its results shall be used as an iterative tool to improve the design. ~~is typically used to provide input to the final safety analysis report~~ (see Section 15 of SSG-61 [12]). The seismic safety evaluation should provide assurance that the seismic design is adequate for the site-specific seismic conditions. Particularly, the SPSA for new installations provides risk insights, in conjunction with the assumptions made, and contributes to identify and support requirements important to the seismic design of the plant.	I believe this recommendation should be revised. The first issue is that "the licensing stage" can be considered various different licensing stages, e.g.: the GDA in the UK does not require the design to be detailed nor to be site specific, but there are many other countries (e.g.: Hungary) with different requirements on details in the different licensing stages. This should be indicated in the recommendation. The second issue is that the primary goal of the SPSA method is not to provide input for the Final Safety Report, but to justify the fulfillment of related requirements (e.g.: CDF, LERF values) and to be used as an iterative tool to improve the design by eliminating or reducing major risk contributors if possible. The goal to perform		*At the licensing stage, the ~~detailed~~ design is completed, and site-specific seismic induced hazards are known. For nuclear power plants, SPSA methodology is typically used ~~to provide input to the~~ for final seismic safety analysis ~~report~~ (see Section 15 of SSG-61 [12]).*		The paragraph refers to a stage in which the design is complete enough to be submitted to a licensing authority, in contrast with a previous stage in which the design is under development. Wording is changed to address the second issue pointed out by the reviewer.

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				something is never to just put it into the FSR but to fulfill a certain requirement. Of course as a consequence this will be added to the FSR but this is not the goal but the mean to justify the adequacy of the site and the design.				
109.	Hungary P2	2.29.	"At licensing stage when the detailed design is completed and when the site-specific seismic induced hazards are known."	The current text assumes that the detailed design is ready and the seismic induced hazards are known at the licensing stage. However, the licensing could be a long process. These materials become available at some time during the licensing of a new unit. That is the reason why the addition of "when" expressions would increase the clarity.		*At the licensing stage, the ~~detailed~~ design is completed, and site-specific seismic induced hazards are known. For nuclear power plants, SPSA methodology is typically used ~~to provide input to the~~ for final seismic safety analysis ~~report~~ (see Section 15 of SSG-61 [12]).*		The paragraph refers to a stage in which the design (including the seismic design bases) is complete enough to be submitted to a licensing authority, in contrast with a previous stage in which the design is under development.
110.	Germany	2.30	Additionally, a~~A~~fter the plant ~~is~~ has been ~~built~~ constructed and operation starts, the seismic safety evaluation performed at the licensing stage should be updated	Please make more clear that current update belongs to the licensing stage, and not to a licensed/operational one.	X			

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			to reflect as-built and as-operated conditions.					
111.	Hungary FBG	2.30.	2.30. After the plant is built and operation starts, the seismic safety evaluation performed at the licensing stage should be updated to reflect as-built and as-operated conditions.	Again the term "licensing stage" is too vague. It should be specified which licensing stage is meant here or the recommendation should be provided in a way that it expresses the different approaches in the different member states.		*2.30. After the plant is built and operation starts, the seismic safety evaluation performed ~~at the licensing stage~~ before the operating license was granted should be updated to reflect as-built and as-operated conditions.*		Wording is changed.
112.	Canada	3.0		Section 3 and other relevant sections should include reference to SRS-103, *Methodologies for Seismic Safety Evaluation of Existing Nuclear Installations* (2020). Recently published SRS-103 has direct relation to the content of this and other sections which cover existing installations.			X	References to SRS 103 are included in Sections 1, 3, 5, and 7.
113.	Germany	3.1	The selection of the seismic safety assessment methodology is an important decision that should be	Few sentences in (a) and (c) are more wide-ranging and should be removed, with		X Switched the order of the 1st		

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			carefully considered due to its crucial consequences. Requirement 15 of GSR Part 4 (Rev. 1) [1] indicates that both deterministic and probabilistic approaches complement one another and specifies that both approaches should be included in safety analysis using a graded approach. This section discusses the capabilities and limitations of each methodology and provides guidance on the applicability of each methodology (i.e., SMA, PSA-based SMA, and SPSA)[17] to a number of common objectives for existing and new installations. This selection should satisfy the following objectives: (a) The selected assessment methodology should be adequate for achieving the objective of the seismic safety evaluation in the context of the reasons that motivated the evaluation. Paragraphs 2.16 and 2.15 list a number of these objectives and reasons, respectively. This section provides guidance on the applicability of each methodology	slight rewording, at the beginning, to the general part of the para.		and 2nd sentences in the proposed text.		

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			~~(i.e., SMA, PSA-based SMA, and SPSA)[17] to a number of common objectives for existing and new installations~~ (b) The selected methodology and its end products should be able to meet the regulatory requirements applicable to the installation. (c) The selected methodology should be capable of demonstrating that the installation will meet the requirements described in paras. 2.1–2.6, as applicable to the evaluation reasons and installation type. ~~Requirement 15 of GSR Part 4 (Rev. 1) [1] indicates that both deterministic and probabilistic approaches complement one another and specifies that both approaches be included in safety analysis within a graded approach. This section discusses the capabilities and limitations of each methodology~~					
114.	Russia Rosatom	3.1	The following item is to be added: "Deterministic approach to seismic safety methodology must include verification for correctness of assignment of seismic resistance categories, with consideration of possible failures of elements of				X	This statement is not a decision-making objective for selecting the

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			systems and associated initiating events"					assessment methodology.
115.	UK	3.1 (a) & Footnote 17&18	Please include the clarification currently provided by footnotes (17) and (18) within the main body of text, either at the points where the footnotes are currently identified, or as a single (amalgamated) paragraph (for example as a new paragraph 3.3).	Whilst the UK welcomes the clarification provided via the addition of these footnotes during document production, the information would be better communicated if included within the main body of the text. Information presented in footnotes could be missed or interpreted as being less important than the main text. The UK considers this clarification to be equally important in providing context for the guidance and it will be more visible to the reader if presented within the main body of Section 3. This would also align with the IAEA principle of being non-prescriptive.			X	It is clear from the text in 3.1 and 3.2 that the use of the methods presented in the safety guide is not prescriptive or exclusive to perform the safety assessment. The footnotes elaborate on this and provide additional information. Moving the footnote text into the body would clutter the document.

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116.	Germany/ BMUV	3.2	The selection of the seismic safety evaluation methodology is an important decision that should be carefully considered owing to its crucial consequences. This section discusses the capabilities and limitations of SMA, PSA-based SMA, and SPSA17 […]	Clarification. There seems to be a missing word.	X			
117.	Hungary FBG	3.3.	3.3. The SMA methodology is the least resource-intensive of the three methodologies discussed in this Safety Guide and it is used mainly but not excluding for existing installations. It can be executed using as input a seismic hazard characterization developed using either probabilistic or deterministic approaches. The implementation details of this methodology should meet the guidelines presented in Section 5.	It should be highlighted that SMA can be a powerful tool even for new designs in calculating the validity of certain assumptions made in the design.			X	The meaning of the proposed addition is included in the original text.
118.	Germany	3.4	The end product of an SMA is an installation-level HCLPF capacity, which is based on the HCLPF capacity of two (or more) independent success paths, whereby the success path of the HCLPF capacity is the lowest	The explanation/definition of the HCLPF capacity of a success path is missing, we think that providing such an explanation is quite useful.			X	We agree with the comment but this explanation is provided in Section 5 (Para. 5.45)

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			HCLPF capacity of the SSCs in the success path.					
119.	Russia Rosatom	3.4		There is no definition of the concepts of "success" and "success paths"(see i. 2.19 of NS-G-2.13)		X		It is a well understood term and developed further in the document. See 3.5(e) and 5.17(b).
120.	Canada	3.5		Item (h) is missing. Add item (h) or renumber following items.	X			
121.	Germany	3.5 (a)	Determination of the seismic safety margin higher than a specified earthquake (e.g. the design basis earthquake) or an ~~actual~~ earthquake that affected the installation;	Clarification		X Changed „actual“ to recorded“		
122.	Germany	3.5 (e)	Identification of weak links in the credited success paths for the nuclear installation's response to the event of a beyond design basis earthquake ~~event~~;	We suggest using a consistent wording in the whole document and to replace the term “beyond design basis earthquake” by “event”. Please compare with 3.5 (c), which states: “Demonstration of sufficient safety margin to restart operation following the occurrence of a **beyond design basis earthquake**			X	An earthquake is an external event, hence a beyond design basis earthquake is a subset of beyond design basis events.

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				that may have shut down the nuclear installation in addition to other actions defined in Ref. [19]”				
123.	Germany	3.5 (j)	Demonstration that regulatory seismic requirements are met for ~~plants~~ nuclear installations which were designed without seismic requirements.-	The term “plants” implies NPP, therefore the wider term “nuclear installations” – similar to other items in para 3.5 - seems appropriate.		X Changed to “installations”		
124.	Germany/ BMUV	3.5	The end product of SMA is an installation level HCLPF capacity based on the HCLPF capacity of two (or more) independent success paths (c.f. Para. 5.46).	The “HCLPF capacity of the success path” is defined only later in the document, i.e. in Para. 5.46. Therefore, a reference to this explanation should be given here.			X	Good suggestion. However, the HCLPF capacity is defined in Para. 2.18 and its definition is applies to SSC, failure sequence, success path, or installation level. Para. 5.46 describes how to calculate a success path HLCPF and is not a

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								definition.
125.	Pakistan	3.5(a)/2	Determination of the seismic safety margin higher than a specified earthquake (e.g. the design basis earthquake **or SL-2**) or an actual earthquake that affected the installation;	In case of nuclear installation, in IAEA safety standards, most widely used term to define design basis earthquake is SL-2, therefore same may also be used along with design basis earthquake in order to make document coherent.			X	The sentence in question lists one example. The proposed addition is not needed.
126.	Russia Rosatom	3.5 c	Subparagraph 3.5 (c) is to be eliminated	Resuming operation after a beyond design basis earthquake is problematic. According to NS-G-1.6 (p. 2.4), the SL-1 level is associated with operational requirements, as it is considerably lower than the SL-2 level associated with safety. The operability of the NPP units following a beyond design basis earthquake is therefore not assured.			X	This is a realistic objective that has been faced by NPPs that experienced ground motions exceeding their design levels and had to shut down and reopen, e.g., after the Mineral, VA earthquake in the USA.
127.		3.5 e	The following is to be added: "in particular at consideration of deterministic analysis results"				X	The reason for adding this statement is not clear. This

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								paragraph discusses SMA, which is a deterministic analysis.
128.	Germany/ BMUV	3.6 (a)	Determination of the seismic safety margin above a specified ~~level~~ earthquake level (e.g. the design basis earthquake) or a recorded earthquake that affected the installation;	editorial		X Deleted “level”		
129.	Canada	3.7	The end products of the PSA-based SMA should be the installation-level HCLPF capacity and HCLPF capacities for all accident sequences of interest (~~i.e.~~ composed of ~~minimal~~ multiple cut-sets) that can lead to an installation performance unacceptable to safety. An additional end product may be an estimate of the installation-level ~~full~~ probabilistic fragility curve in addition to its HCLPF capacity. The sequence-level HCLPF capacities are typically taken to be the ~~highest SSC~~ lowest HCLPF capacity ~~in each~~ of the constituent cut-set.	Revisions required to the terminology to avoid misinterpretation of accident sequences and cutsets: 1. Accident sequences (depicted by Event Trees) are generally not (minimal) cutsets, these are two different concepts. 2. The cut-set level HCLPF is the maximum HCLPF of the constituent events (i.e. all failures of SSCs and/or human errors shall occur). 3. The sequence-level HCLPF of a sequence composed of multiple cutsets		X Edited to: “The end products of the PSA-based SMA should be the installation-level HCLPF capacity and HCLPF capacities for all accident sequences of interest (and the corresponding cut-sets) that can lead to an installation performance		“Probabilistic fragility curve” suggests that there may be a “deterministic” fragility curves.

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				is the *minimum* (lowest) HCLPF of the cutsets (one cut-set is sufficient to initiate an accident sequence). 4. As such, capacities of the SSCs or Human Errors in the cutsets control an accident sequence-level HCLPF capacity.		unacceptable to safety. An additional end product may be an estimate of the installation-level full fragility curve in addition to its HCLPF capacity. The cut-set-level HCLPF capacities are the highest HCLPF capacity in a cut-set. The sequence-level HCLPF capacity is the lowest HCLPF capacity in the constituent cut-sets." [1] A 'minimal cut-set' is a combination of events (failures) whose sequence		

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						causes the accident to occur. Occurrence of all events in the cut-set is necessary and sufficient for the accident to take place. 1 The installation-level fragility represents the conditional probability of facility unacceptable performance for a given value of the hazard parameter (e.g. peak ground acceleration). It is normally presented as a function of the hazard parameter in the form of a curve. It is commonly		

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						referred to as "plant-level fragility' for nuclear power plants. See Section 5 for more details.		
130.	Canada	3.8	(a) Comparing an estimate of installation-level ~~and accident-class-level~~ HCLPF capacities <u>for significant accident sequences</u> to regulatory expectations;	It is unclear if the term *accident class-level HCLPF capacities* refers to equipment class, seismic design class, accident type, or other. The terms *equipment class and seismic design class* are also used in the document, therefore revision is required to avoid misinterpretation.		X Replaced "class" with "sequence"		
131.	Germany	3.8	(b) Identification of critical accident scenarios that can undermine safety in the installation's response to <u>the event of</u> a beyond design basis earthquake ~~event~~ and the weak link(s) in each sequence;	We suggest using a consistent wording in the whole document.			X	See #30.
132.	Canada	3.9		Add reference to TECDOC-1937, *Probabilistic Safety Assessment for Seismic Events* (2020). Recently published TECDOC-1937 has direct relation to the			X	Generally, safety guides do not refers to TECDOCs (lower-tier IAEA

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				content of Paragraph 3.9 and other paragraphs / sections of the document which cover SPSA methodology.				documents).
133.	France	3.9	More guide on the SPSA methodology can be found in IAEA Safety Standard Series SSG-3	DS523 is a draft safety guide and not a definitive guide			X	See responses to the several other similar comments from France.
134.	Germany	3.9 Line 6	Boolean logic trees <u>are </u>using failure probabilities obtained by quantifying accident sequencies associated to each initiating event.	Editorial, the verb is missing in the sentence.		X Changed to “are solved”		
135.	Hungary FBG	3.9.	3.9. The SPSA methodology can only be executed using as input a site-specific seismic hazard characterization developed using probabilistic approaches. The SPSA methodology discretizes the seismic hazard from PSHA into acceleration levels with corresponding annual ~~occurrence~~ exceedance frequencies and explicitly convolves these frequencies with the installation-level fragility. The installation-level fragility should be constructed by explicitly solving the installation accident sequence. Boolean logic trees using failure probabilities obtained by quantifying accident	Minor corrections.		X		The second correction is accepted. The first one does not require correction.

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			~~sequencies~~ sequences associated to each initiating event. Non-seismic failure rates of SSC and human error probabilities are also taken into consideration in SPSA. This methodology is used for both new and existing installations. The implementation details of this methodology should meet the guidelines presented in Section 5. More guidance on the SPSA methodology can be found in IAEA Safety Standards Series No. DS523, Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants [15].					
136.	Libya	3.9 Line 7	[….] accident ~~sequencies~~ sequences associated to each initiating event. Non-seismic failure rates of SSC and human error probabilities are also taken into consideration in SPSA. [….]	Improved spelling	X			
137.	Canada	3.10	The end products of the SPSA should include the products of the two SMA methodologies, plus the annual frequency of the installation unacceptable performance due to	Incomplete scope of importance analysis, improper use of terminology (importance of accident sequences are evaluated based on relative		X Simplified to "importance metrics" since the suggested drill-down text		

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			seismic hazard, the installation-level fragility curve, the risk importance metrics for initiating events, components, systems and human error events ~~accident sequences and components~~, and the explicit quantification of uncertainties in the computed results.	contribution to risk, not importance metrics). In addition, importance analysis should include evaluation of relative importance of seismic failures vs. importance of random failures of the plant SSCs. The risk importance metrics may also be for human failure events, systems, seismic hazard intervals, etc. It is sufficient to say in this context "risk importance metrics" and discuss details in other sections.		is too detailed for the context of this para.		
138.	WNA CORDEL	§3.10, pg. 28	*Current text:* *The installation level fragility should be constructed by explicitly solving the installation accident sequence. Boolean logic trees are solved using failure probabilities obtained by quantifying accident sequences associated with each initiating event.*	In the context of SPSA, the "logic tree" concept is used to account for epistemic uncertainties in the seismic hazard.		X Changed "trees" to "equations" to avoid the noted reason for the comment.		

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			Proposed text: The installation level fragility should be constructed as further discussed in para 5.64. The starting point is the Boolean expression representing the accident sequences from all seismic-induced initiating events.					
139.	Canada	3.11	(b) Quantification and ranking of relative risk ~~contributions~~ contributors (e.g., ~~of~~ accident sequences, ~~and~~ individual SSCs, seismic hazard intervals, human failure events, etc.) in the installation's as-operated condition;	There may be more important measures than accident sequences and individual SSCs. The proposed wording is more generic.		X Edited to: "Quantification and ranking of relative risk contributions (e.g. of accident sequences, individual SSCs, human actions, etc.) in the installation's as-operated condition"		
140.	Germany	3.11	The SPSA methodology is applicable to the following safety evaluation objectives in addition to	Redundant information, we suggest to delete it.	X			

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			those introduced in paras. 3.5 and 3.8~~, which should be considered in the methodology selection~~: (a) Comparing the risk metrics for unacceptable performance (e.g. core <u>and/or fuel</u> damage frequency and large <u>or large early</u> release frequency) to regulatory <u>requirements</u> ~~expectations~~;…					
141.	Hungary P2	3.11 (e) / 1-2.	-Uncertainty and randomness of the seismic hazard; -Uncertainty and randomness of structures, equipment, components and distribution systems failure rates conditional upon earthquake ground motion;	The consideration would be appropriate to be extended regarding the uncertainty evaluation also the following: (based on 2.2.1 "*Seismic probabilistic safety assessment*" section of the IAEA Methodologies for Seismic Safety Evaluation of Existing Nuclear Installations).		X		Clarified in a footnote that these sources of uncertainty (and others) are included in “uncertainty in seismic safety metrics”.
142.	Germany	Title before 3.12	CONSIDERATIONS ON APPLICATION <u>of seismic safety assessment</u> TO NEW OR EXISTING NUCLEAR INSTALLATIONS	Clarification			X	Does not seem required.
143.	Libya	3.12 Line 7	. [….]the available information for new installations and for existing installations (see para. 4.1). . [….]	Improved Clarity			x	Not needed

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144.	Germany	3.13	The selected methodology should be able to meet the applicable regulatory requirements. Regulatory requirements for existing nuclear installations and for new installations ~~are~~ <u>might be</u> different in several Member States[23].	Clarification		X Added "typically"		
145.	Bangladesh	Para 3.14, Page 30, Line 1	May require some explanation regarding 'Selected Methodology'				X	No specific proposal provided for new text. The subject of Section 3 is the methodology selection guidance, which collectively provides explanation of the process.
146.	Germany	3.15	The anticipated service life of a new nuclear installation may be different and will typically be significantly longer than the remaining service life of a similar existing installation. This <u>would</u> ~~should~~ make the reusability and <u>applicability</u> ~~shelf life~~ of a more rigorous methodology longer for a new installation. Accordingly, the	The European Council Directive 2014/87/EURATOM of 8 July 2014 in Art 8a (2)b asks member states to ensure "the timely implementation of reasonably practicable safety improvements to existing nuclear installations". The flavour of this paragraph is		X Accepte3d some changes. Did not accept the reference to Para. 7.5. This paragraph discusses the cost-benefit trade-off in		

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			'return on investment' from performing the more cost-extensive SPSA methodology for a new nuclear installation typically runs longer than for an existing installation, which may be approaching the end of its service life. <u>Further consideration of the cost-benefit analysis is given in para 7.5.</u>	not in line with this approach that is reasonable from a safety point of view. It should therefore not be: "implement only improvements which are not expensive" but "implement all improvements with a relevant safety benefit which are reasonably practicable (not forbiddingly expensive)". We suggest a changed wording. Reference to the cost-benefit analysis provided in para 7.5 might as well be useful.		selecting the assessment methodology. Para. 7.5 and the related comment address the cost-benefit analysis of implementing an improvement.		
147.	Canada	4.0		1.Incomplete scope of seismic data collection and seismic monitoring. Seismic instrumentation used for earthquake monitoring and development of damage indicating parameters need to be covered. 2. Add references to SSG-67, *Seismic Design for Nuclear Installations* (2021), Section 8, and to TECDOC-1956, *Seismic Instrumentation System and Its Use in Post-earthquake Decision Making*			X	Section 4 corresponds to the collection of data required to perform an evaluation of seismic safety using the methods given Section 3. The inspections and assessments performed as a result of a

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				at Nuclear Power Plants (2021). Recently published SSG-67 (Section 8) and TECDOC-1956 are directly related to the content of Section 4.				seismic event, to decide about continuation of operation (post earthquake actions) are out of the scope of the present draft Safety Guide.
148.	Canada	4.2	(a) The safety analysis report~~, preferably the final safety analysis report~~.	It is understood that the latest and final documentation is always preferred.	X			
149.	Canada	4.2	(d) Level 1 and Level 2 Probabilistic ~~s~~Safety ~~a~~Assessment (PSA) of internal ~~(and external)~~ events, if performed.	Level 1 and Level 2 seismic assessment is required, so that the respective internal events PSAs are necessary. External hazards PSAs have no relevance to Seismic PSA and generally are not required.			X	The idea is that any available PSA study would be helpful. External events PSA could include, for instance, previous versions of a Seismic PSA or external flood PSA which could help in the identification

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								of initiating events.
150.	Canada	4.2	(g) Hazard Assessment (or Hazard Screening) analysis for the installation. (h) Probabilistic Seismic Hazard Assessments (PSHA), if performed.	Hazard Screening and PSHA are critical inputs to the seismic safety assessment regardless of the chosen analysis methodology (SMA, SMA-based PSA, or SPSA).			X	Agree, but those pieces of data are within a different paragraph (see para. 4.4).
151.	Germany	4.2	All available general and specific documentation for new and existing installations relevant for the analysis should be compiled, including the following: ….	Clarification	X			
152.	Pakistan	4.2	**Seismic Hazard Analysis reports (DSHA/PSHA) for both new and existing NPPs site.**	A new bullet may be added to include seismic hazard analysis report which provides basic input for seismic PSA/SMA etc			x	Agree, but this point is already discussed in para. 2.19. See footnote 12.
153.	Canada	4.3		Incomplete information. Add under (a, c, d, e) "design specifications or technical specifications of SSCs"			X	The information of interest is the "as-is" (existing facilities) or the "as-designed" (new facilities) information. This can be different from the "as-

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								specified" information.
154.	Canada	4.3	(b)(ii) Construction of retaining walls, <u>foundations, underground structures,</u> berms or artificial slopes;	Foundations, and underground structures if any, are important aspects of geotechnical design and should be included.	X			
155.	Germany	4.3 (c) (i)	<u>Structural</u> ~~Stress~~ analysis reports (e.g. stress, push-over or fatigue analysis) for all structures of interest;	More accurate wording Structural design covers more than just stress analysis, but e.g. push-over analysis and assumptions of loading and load bearing systems	X			
156.	Germany	4.3 (f)	Service and handling equipment (although some of this is non-safety–related equipment, its evaluation may be needed for analysis and study of interaction effects in operational and storage configurations), <u>i.e.:</u> (i) ~~Main and secondary cranes;~~ <u>Lifting equipment</u> (ii) Fuel handling equipment.	Main and secondary cranes are usually components of fuel handling equipment. Do you mean more general, lifting equipment, here? Please, pay also attention on writing of the wording "non-safety related"		(i) Main and secondary cranes, monorails and hoists; (ii) Fuel handling equipment.		Yes, we mean any lifting devices (cranes, monorails, hoists, etc.) which could be a credible source of seismic interaction, that is, not just fuel handling equipment. IAEA English editors will fix

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								issues, as the one pointed out by the reviewer, according to the IAEA Style Manual, before the draft is released to press.
157.	UK	4.3 c and i	**Structural** ~~Stress~~ analysis report	Structural designs and structural assessments are most often based on sectional forces and moments, rather than stresses.	X			
158.	Bangladesh	Para 4.4 (c), Page 34	Example of 'seismological parameters' may be included in this line as an example.				X	Examples of seismological parameters are listed in 4.4(c). More details can be found in SSG-67 per 4.4(a).
159.	Canada	4.4	(b) Site specific f~~F~~ree field ground motion parameters in terms of elastic ground response spectra, acceleration time histories or other descriptors, such as the power spectral density for each structure located in the facility.	Clarification		*4.4 The characterization of the seismic input used for design should be well understood for conducting*		Free-field ground motion is usually provided at a single control point within the site.

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						the seismic safety evaluation. Any discrepancy between the documentation of the seismic hazard assessment performed during the site evaluation studies and the design basis values finally adopted should be identified. This information is essential for determining the reference level earthquake, which will be used ~~to assess the seismic safety margin of the installation~~ in the evaluation of seismic safety. In this regard, the following		From the motion at the control point, the seismic input to the foundations of the structures is derived in the initial steps of the seismic design process. The last sentence of bullet (c) is deleted.

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						aspects should be covered: (a) Specification of the design earthquake level(s) as used for the design and qualification of SSCs [7]. *(b) Site-specific free field ground motion parameters in terms of elastic ground response spectra, acceleration time histories or other descriptors, such as the power spectral density.* *(c) ~~Dominant earthquake~~ Seismological parameters representative of the earthquakes with the largest contribution to the seismic*		

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						hazard ~~used to define the seismic input motions~~, such as magnitude, distance, ~~definition~~ and duration of the strong motion. ~~Other parameters, such as the focal mechanism or the source spectral shape, might have been used as well.~~		
160.	Canada	4.4	~~Dominant earthquake~~ Seismic source parameters used to define the seismic input motions, such as magnitude, distance, ~~definition~~ and duration of strong motion. Other parameters, such as the focal mechanism, seismic moment, stress drop or other ~~or the source spectral shape,~~ might ~~have been~~ be used as well.	*Dominant parameter* is not an established term, a parameter is rather *main*, *major*, or *important* (or other synonyms). *Definition* is not a parameter (if type of earthquake source is referred to, such as local or regional, the text should be revised as such). *Source spectral shape* is not a parameter (if frequency content is referred to, the text		See resolution of the previous comment		See resolution of the previous comment.

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				should be revised as such).				
161.	Germany	4.4 (d)	If ~~some~~ existing structures were designed in accordance with design codes whose design spectra have implicit reductions for inelastic behaviour, the corresponding elastic ground response spectra should be derived to provide a basis of comparison with the elastic ground response spectra typically used to define the reference level earthquake for the seismic safety evaluation.	For already existing structures a demonstration is needed that energy can be dissipated in the same amount inelastic spectra assumed.			X	The point is valid for both existing and new structures. The point refers to the need to go back to the elastic spectrum, in order to be able to compare with the design basis of other structures for which no ductility reduction was considered in the design basis.
162.	Russia NRS	4.4 c	Dominant earthquake source parameters used to define the seismic input motions, such as magnitude and frequency of maximum earthquake, magnitude, frequency, distance, definition and duration of strong motion. Other parameters, such as the focal mechanism or the source spectral	Additionally, the requirement to account for the magnitude and frequency of the maximum earthquake is included.		(c) Dominant earthquake Seismological parameters representative of the earthquakes with the largest contribution to the seismic		Note that the paragraph refers to the characterization of the seismic input which was selected for seismic design basis.

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			shape, might have been used as well.			hazard used to define the seismic input motions, such as magnitude, distance, definition and duration of the strong motion. Other parameters, such as the focal mechanism or the source spectral shape, might have been used as well.		The "maximum earthquake" will have been used to define the seismic design basis in a previous step.
163.	Canada	4.5		In addition to SSI, this section should cover *GMI (ground motion incoherence)* as part of foundation-structure interaction analysis.			X	Coherency of seismic waves is already mentioned in bullet (a)(iv).
164.	Canada	4.5	(a)(ii) Soil profile properties <u>for each building or structure on ground</u>, including soil stiffness and damping properties used in the site-specific response analysis, information on the water table variation, and consideration of strain dependent properties;	Clarification		(a)(ii) Soil profile properties applicable to each building or structure on ground, including soil		

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						stiffness and damping properties used in the site-specific response analysis, information on the water table variation, and consideration of strain dependent properties;		
165.	Canada	4.5	(a)(iv) Applicability and consideration of seismic wave phenomena in the definition of the input motion. Those should include: definition of seismic input motion as a vertically and horizontally propagating shear wave (typical); coherency; wave passage effect.	Clarification of definition			X	The text refers to the common assumption of vertically propagating seismic waves, and designates this assumption as "typical". Other assumptions are not precluded (e.g. inclined waves).
166.	Germany	4.5 (b) (iii)	~~Allowance~~ Verification for inelastic behaviour, as assumed in the design phase and as implemented during construction.	It is not enough to assume that structures have inelastic behaviour, it must be demonstrated with			X	Agree with the reviewer's observation, but note that

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				verification that these structures have the capability of dissipating energy in the assumed amount.				this is not the point here. The point here is that, when gathering information about the design bases, it is important to find out what was the level of inelastic behaviour allowed for in the design calculations.
167.	Germany	4.5 (c) new issue after (i)	Characterization of the system consisting of the assumed soil, baseplate and foundation, e.g. by impedance or transfer functions	E.g., impedance functions characterize the soil-structure-interaction and allow to review models easier.		(ii) Characterization of the soil-foundation system (e.g. by impedance or transfer functions);		The suggested new bullet could be understood as included in bullet (i). However, a new bullet is introduced, as suggested.
168.	Canada	4.6		First use of the word 'programme'. The current draft is missing the	X			The words "~~programme for~~" can be

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				description of such a programme as it was presented in the current safety guide.				deleted from this paragraph, with no loss of meaning. The drafter does not see harm in keeping these words.
169.	Germany	4.6 last line	… in case of ~~a~~ seismically induced failures.	Editorial (grammar), either "a seismically induced failure~~s~~" or "~~a~~ seismically induced failures"	X			
170.	Germany	4.6 Line 7	…. It should be also emphasized that the as-is condition should properly reflect and include the effects of ageing ~~degradation~~ of the installation throughout its operational lifetime.	Ageing leads not only to degradation but also includes other phenomena depending on the structure/component, e.g. hardening of concrete.	X			
171.	Libya	4.6 Line 1&2	collecting as ~~many~~ much data as is feasible ~~in relation to~~ about the original design basis, [….]	Improved Clarity	X			
172.	Germany	4.8	~~If the nuclear installation has an ageing management programme, a~~Any outputs from ~~it~~ an ageing management programme (e.g. according to SSG-48, SSG-10) of the nuclear installation (e.g. condition assessment, periodic	Clarification to the topic "ageing management programme". Additionally: please check if "Management of modifications" is applicable		4.8. If the nuclear installation has implemented an ageing management programme (e.g.		Thank you. The "Maintenance Rule" is specific of Member States following the US-NRC

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			inspection reports) that identify the as-is condition should be made available for the purposes of the seismic safety evaluation. If ~~some~~ SSCs ~~(e.g. active equipment~~) are not ~~be~~ covered under an ageing management programme, but under some other programme (e.g. ***maintenance rule programme***), the related documentation should also be made available for the purposes of the seismic safety evaluation.	here instead of "maintenance rule programme" (to be in line with para 8.8)		IAEA Safety Standards Series No. SSG-48), any outputs from it (e.g. condition assessment, periodic inspection reports) that identify the as-is condition should be made available for the purposes of the seismic safety evaluation. If some SSCs (e.g. active equipment) are not ~~be~~ covered by the ageing management programme, but ~~under~~ by some other programme (e.g. ~~maintenance rule programme~~ monitoring of the effectiveness maintenance),		regulation (10 CFR 50.65).

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						the related documentation should also be made available for the purposes of the seismic safety evaluation.		
173.	UK	4.8/4	… are not ~~be~~ covered …	Structural designs and structural assessments are most often based on sectional forces and moments, rather than <u>stresses</u>.	X			
174.	Germany	4.9	A critical review of all available as-built and pre-operational documentation (reports, drawings, photographs, film records, reports of non-destructive examinations) should be performed. For this purpose, a preliminary screening walkdown, <u>based on guidance documents such as INSAG-19,</u> should be carried out to confirm the documented data and to acquire new, updated information. During this walkdown, data about any significant modifications and/or upgrading and/or repair measures that were performed over the lifetime of the nuclear installation should be collected and	INSAG-19 is a useful document, which might be used by carrying out a preliminary screening walkdown, therefore we suggest to add it.			X	The drafter does not see a connection of this paragraph with IAEA INSAG-19 (*Maintaining the Design Integrity of Nuclear Installations Throughout their Operating Life*). Is there a typo in the designation of the INSAG report?

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			documented, including any reports on ageing effects. The judgement about how significant a modification would need to be in order to have an impact on the seismic response and capacity of the installation should be made by experts on the evaluation of seismic capacity.					In any case, please, note that this paragraph does not refer to the seismic capability walkdown described in Section 5 of the draft. This paragraph refers to a walkdown to check if the compiled data is enough to perform the evaluation. In the experience of the drafter, this walkdown is justified only for old installations, where an important

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								portion of design information may be missing or difficult to find. In other cases, this walkdown is (implicitly) performed during the seismic capability walkdown.
175.	Canada	4.10	(a) Slopes, foundations, excavation and backfill;	Foundation is an important part of most nuclear installation and should be included here.			X	The foundations do not need the same kind of seismic “special attention” as the slopes, excavations and backfills. Excavations, slopes and backfills are more prone to

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								seismically induced instability.
176.	Bangladesh	Para 4.11 (a), Page 37	Approximate 'Ranges' of the static and dynamic properties for the site specific geotechnical characteristics, may be included in this line				X	Not applicable to the scope of the document. Note that these properties vary widely from site to site.
177.	Canada	4.11	(a) Appropriate ranges of static values and dynamic values for the geodynamic properties, which account for site specific geotechnical characteristics, <u>and uncertainties (βu or r) related to soil parameters</u> should be available for use in the programme for seismic safety evaluation.	Incomplete data. Also: Use a footnote to define the term "geodynamic properties" or revise this bullet for clarity or combine this bullet with bullets (b), (c) and (d). The use of the term "geodynamic properties" appears to be inadequate. It is not clear what the "geodynamic properties" mean/represent and how the "geodynamic properties" in this bullet are different from the properties stated in bullets (b), (c) and (d).		(a) Appropriate ranges of static ~~values~~ and dynamic ~~values for the geodynamic~~ properties, which account for site specific geotechnical characteristics and their variability, should be available for use in the ~~programme for~~ seismic safety evaluation.		
178.	Germany	Title bevor	Recommended investigations: soil	Please complete this title, as		Recommended		Para. 4.14

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		4.11	data and surroundings of the site	para 4.14 is dealing with the surroundings/environment of the site.		investigations: subsoil data and earthquake experience		refers just to earthquake experience (at the site or in the region)
179.	Germany	4.13 Line 4	… To the extent possible, the collection of such data should be carried out in compliance with the recommendations provided in DS531 ~~NS-G-3.6~~ [9].	NS-G-3.6 is currently under revision as DS531, whereby aspects other than geotechnical aspects are out of the scope of the revised Safety Guide and are covered by DS507.			X	DS531 will not be published in the short term. IAEA editors will decide if reference can be made to a Safety Guide under development.
180.	Canada	4.14		This or other paragraph(s) of the document should be updated to outline a necessity of assessing soil failures, specifically liquefaction and slope stability. Further, it should be explained how these effects will be factored into the safety assessment. This should include a methodology of definition of *liquefaction potential* based on the site hazard (e.g., for different annual frequencies			X	Agree, but the scope of Section 4 is data collection. The use of the data to perform the seismic safety evaluation is described in Section 5. This is a

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				of exceedance), the respective *liquefaction fragility analysis* (deterministic or probabilistic), potential for seismically induced land sliding (static or dynamic loading analysis), other fundamentals of soil failures assessment. These effects of soil failures are nonlinear and can significantly affect seismic response of structures and equipment, and, as such, safety assessment of the nuclear installation.				comment for Section 5, in case Section 5, does not include the ideas put forward by the commenter.
181.	Canada	4.14	Special attention should be paid to earthquake-induced phenomena such as river flooding due to seismically induced dam failure, coastal flooding due to tsunami, ~~landslides~~, seismically induced slope instabilities, and liquefaction.	See Comment 19			X	The sentence clearly states that all mentioned phenomena are “earthquake-induced phenomena”.
182.	UK	4.17/3	……. surface damage, the degree of ~~carbonization~~ carbonation, …….	The term carbonation is adopted within a UK context (to reflect the reaction of calcium hydroxide with carbon	X			Thank you. Carbonation is the correct term.

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				dioxide, which can result in corrosion of steel reinforcement). If international practice is to use 'carbonization' (which in the UK context relates to the breakdown of carbonaceous substances via heating), please provide clarification for UK users via a footnote.				
183.	Germany	4.17	Although ageing effects are usually estimated in a separate project, in the seismic safety evaluation, at a minimum, the survey of a concrete building should include visual examination for cracks, effects of erosion/ corrosion and surface damage, the degree of carbonization, the thickness of concrete cover<u>, current prestress of tendons</u> and the degree of degradation of below ground foundations due to, for example, chlorides or other corrosive contaminants present in groundwater.	Prestress has a significant effect on stiffness and degrades over time, please add	X			
184.	Germany	4.20	If design information ~~is inadequate~~ for piping, equipment, and their supporting structural systems <u>is</u>	Clarification		*4.20. If design information ~~is inadequate~~ for*		The idea of "modelling" is included in

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			insufficient /is not available, analysis and/or ~~testing~~ modeling should be performed to establish their dynamic characteristics and behaviour. A representative sample may be sufficient.			*piping, equipment, and their supporting structural systems is insufficient or not available, analysis and/or testing should be performed to establish their dynamic characteristics and behaviour. A representative sample may be sufficient.*		"analysis".
185.	Canada	5.0		Suggested to add reference to DS507, *Seismic Hazards in Site Evaluation for Nuclear Installations (2018)* in the chapters related to seismic hazard assessment. The latest (draft) Guide which will supersede SSG-9.		X		The document working group had instructed the drafters to refer to SSG-9. The IAEA PM will determine whether to update these references to DS507.
186.	Germany	Title and subtitles of	SEISMIC SAFETY ASSESSMENT FOR NUCLEAR ~~INSTALLATIONS~~ power plants	As discussed in para 1.15, Section 5 - the core of this Safety Guide - is focussing		X Changed the title		

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<tr><td></td><td></td><td>Section 5</td><td>ASSESSMENT OF SEISMIC HAZARDS ~~FOR NUCLEAR INSTALLATIONS~~
– Seismic hazard assessment approach
– Development of reference level earthquake
– Characterization of vibratory ground motions
– Characterization of other seismically induced hazards

IMPLEMENTATION GUIDELINES COMMON TO ALL METHODOLOGIES FOR EVALUATION OF SEISMIC SAFETY FOR NUCLEAR ~~INSTALLATIONS~~ power plants
– Scope of the seismic safety assessment
– Development of the selected SSCs list
– Seismic evaluation walkdown

CONSIDERATIONS ON SEISMIC CAPABILITY ~~OF NUCLEAR INSTALLATIONS~~ FOR DEFENCE IN DEPTH</td><td>on nuclear power plants. Section 6 provides recommendations on applying a graded approach to the assessment of nuclear installations other than nuclear power plants (with reference to Section 5 where appropriate). We suggest to change the title of Section 5 in line with this statement.

For consistency in the document, we suggest the same for subtitles in this Section – here is our suggestion.</td><td></td><td>of Section 5 to “SEISMIC SAFETY ASSESSMENT FOR NUCLEAR INSTALLATIONS WITH FOCUS ON NUCLEAR POWER PLANTS”

Changed other sub-titles accordingly.</td><td></td><td></td></tr>
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			LEVEL 4 SEISMIC MARGIN ASSESSMENT ~~FOR NUCLEAR INSTALLATIONS~~ – Determination of seismic responses – Determination of HCLPF capacities for the selected SSCs and the nuclear installation – Considerations for nuclear power plants PSA-BASED SEISMIC MARGIN ASSESSMENT ~~FOR NUCLEAR INSTALLATIONS~~ SEISMIC PROBABILISTIC SAFETY ASSESSMENT ~~FOR NUCLEAR INSTALLATIONS~~					
187.	Canada	5.1	Site specific seismic hazard should preferably be used ~~to characterize the reference level earthquake~~ for the seismic safety evaluation (see para. 2.22). The seismic hazard assessment may be performed using a probabilistic or a deterministic approach. A probabilistic approach should be used to develop the	This paragraph should be moved to the next chapter, "Development of reference level earthquake, prior to Paragraph 5.5. Alternatively, it can be revised as proposed. The current chapter defines overall hazard, not specifically RLE.		X Edited to: "Site specific hazard analysis should preferably be used to characterize the seismic hazard and reference		

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			~~reference level earthquake~~ seismic hazard for an SPSA and PSA-based SMA. A deterministic approach may be used to develop the reference level earthquake for a~~n~~ deterministic SMA as well as for the purposes of design basis derivation ~~and PSA-based SMA~~.	Furthermore, it is not only the RLE but also the entire hazard spectrum is used in the seismic safety evaluation (such as, for seismic risk quantification). Probabilistic safety assessment (that is SPSA and PSA-based SMA) requires site PSHA (i.e., probabilistic hazard). Further suggest removing the highlighted sentence since the deterministic seismic hazard assessment is no longer an acceptable method to obtain seismic hazard at the site for the purpose of SMA or PSA-based SMA in Canadian practice.		level earthquake for the seismic safety evaluation (see para. **Error! Reference source not found.**). The seismic hazard assessment may be performed using a probabilistic or a deterministic approach. A probabilistic approach should be used for an SPSA. A deterministic approach may be for an SMA and PSA-based SMA." While we agree with recommending PSHA, the guide is applicable to all Member		

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						States and some may still use DSHA for PSA-based SMAs.		
188.	Germany/ BMUV	5.1	Site specific hazard analysis should preferably be used to characterize the seismic hazard and reference level earthquake for the seismic safety evaluation (see para. 2.22). The seismic hazard assessment may be performed using a probabilistic or a deterministic approach, or a combination of both. A probabilistic approach should be used for SPSA. A deterministic approach or a combination of deterministic and probabilistic approaches ~~should~~ may be used for SMA and ~~a combination of deterministic and probabilistic approaches for~~ PSA-based SMA.	There is no reason why a deterministic seismic hazard assessment would be more suitable for an SMA (or PSA-based SMA) than a probabilistic one. Therefore, it should not be recommended ("should") to use a deterministic assessment but allowed ("may") to do it.	X			
189.	Russia NRS	5.1	Site specific seismic hazard should preferably be used to characterize the reference level earthquake for the seismic safety evaluation (see para. 2.22). The seismic hazard assessment may be performed using a probabilistic or a	It is recommended that the seismic hazard assessment be carried out on the basis of a deterministic and probabilistic approach. The probabilistic approach is recommended to be used to			X	The suggested text is outside the scope of the paragraph. The DSHA implementatio

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			deterministic approach. A probabilistic approach should be used to develop the reference level earthquake for an SPSA. A deterministic approach may be used to develop the reference level earthquake for an SMA and PSA-based SMA to avoid cliff-edge effect and to **take into account the possibility of the beyond design basis earthquake on the site.**	evaluate realistic (non-conservative) intensity estimates for a given probability of exceeding during the lifetime. A deterministic approach is recommended to assess the extreme seismic impacts of regulatory repeatability for the development of the project on a conservative basis, taking into account the cliff-edge effect and the possibility of manifestation of beyond design basis earthquake on the site.				n details are in Para. 5.3.
190.	Russia NRS	5.2	The PSHA should include a probabilistic characterization of ground motions that can be produced at the installation site by all seismic sources within the regional seismotectonic model, in accordance with SSG-9 [7], **and potential sources of human-induced earthquakes**. The ground motion characterization should be performed for the range of annual frequencies required to meet the regulatory requirements and to achieve the objectives of the safety evaluations. Deaggregation of the PSHA results should be performed at the reference level earthquake to identify the	We believe that potential sources of technogenic earthquakes should already be included in the regional seismotectonic model, since induced earthquakes occur on existing faults. However, the degree of danger of these faults may change taking into account the possibility of technogenic seismicity.			X	The PSHA is an input to the safety assessment. Technical details of what sources of seismicity to include or screen out of the PSHA are outside the scope of this

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			dominant seismic sources, that is, those that have the largest contributions to the hazard.					safety guide and belong in a safety guide on PSHA, e.g., SSG-9.
191.	Canada	5.3	The Deterministic Seismic Hazard Analysis (DSHA) should include determination of ground motions at the installation site using ~~that~~ the dominant seismic sources within the regional seismotectonic model ~~are capable of producing at the installation site~~. The ground motions should be determined in accordance with SSG-9 [7], considering the maximum potential magnitude of each source, the closest associated distance to the site, and an appropriately high confidence level to account for variability due to epistemic uncertainty and aleatory variability in the source model, ground motion prediction model, and site conditions.	Editorial for clarification			X	The distinction of "are capable of producing" is important for DSHA.
192.	Russia NRS	5.3	The Deterministic Seismic Hazard Analysis (DSHA) should include determination of ground motions that the dominant seismic sources within the regional seismotectonic model are	It is recommended to evaluate not only the magnitude, but also the frequency of each source, paying special attention to the possibility of an extreme			X	DSHA considers a scenario that the fault in

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			capable of producing at the installation site. The ground motions should be determined in accordance with SSG-9 [7], considering the maximum potential magnitude **<u>and frequency</u>** of each source, the closest associated distance to the site, and an appropriately high confidence level to account for variability due to epistemic uncertainty and aleatory variability in the source model, ground motion prediction model, and site conditions.	earthquake of rare repeatability near the site, which is not considered in the seismotectonic model of the region.				question ruptures with a probability of 1.0, so the estimated annual frequency of this rupture is not a factor.
193.	Russia NRS	5.3	The Deterministic Seismic Hazard Analysis (DSHA) should include determination of ground motions that the dominant seismic sources within the regional seismotectonic model **<u>and potential sources of human-induced earthquakes</u>** are capable of producing at the installation site. The ground motions should be determined in accordance with SSG-9 [7], considering the maximum potential magnitude of each source, the closest associated distance to the site, and an appropriately high confidence level to account for variability due to epistemic uncertainty and aleatory variability in the source model, ground motion prediction model, and site conditions.	We believe that potential sources of technogenic earthquakes should already be included in the regional seismotectonic model, since induced earthquakes occur on existing faults. However, the degree of danger of these faults may change taking into account the possibility of technogenic seismicity.			X	See comment on 5.2.

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194.	Germany	5.4	~~The dominant seismic sources in a DSHA should be identified by careful review of the seismotectonic model, as recommended in SSG-9 [7], in the absence of deaggregation data from a PSHA.~~ Dominant sources may not be the same for the different ground motion parameters and other seismic hazards (see para. 2.19). In particular, for ~~For~~ sites located in a region of low to moderate seismicity, low-frequency ground motion accelerations can be dominated by distant high-magnitude sources while high-frequency ground accelerations are often dominated by diffuse seismicity, that is, nearby moderate magnitude sources. Geological failures are primarily caused by low-frequency ground motions, while the dominant sources for concomitant phenomena hazards are phenomenon specific.	1) The first sentence belongs to DSHA and thus to 5.3. 2) It is correct that, the difference in the spectral contribution from seismic sources at different distances applies mainly to regions of low to moderate seismicity. Nevertheless, the effect may also be observed in some regions with high seismicity. Therefore, a wording is proposed that does not completely exclude such cases.	X			
195.	Germany	5.4 Line 7	…. ~~Geological~~ Geotechnical failures are primarily caused by low-frequency ground motions, while the …	Editorial. The wording should be the same as in para 5.5.	X			
196.	Germany/	5.4	Dominant sources might not be	It is correct that the		X		This wording

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	BMUV		the same for the different ground motion parameters and other seismic hazards (see para. 2.19). For sites located in a region of low to moderate seismicity <u>and sometimes also for sites in seismically more active regions</u>, low frequency ground motions can be dominated by distant high magnitude sources, while high frequency ground motions are often dominated by diffuse seismicity, that is, by nearby moderate magnitude sources. […]	difference in the spectral contribution from seismic sources at different distances applies mainly to regions of low to moderate seismicity. Nevertheless, the effect may also be observed in some regions with high seismicity. Therefore, a wording is proposed that does not completely exclude such cases.		Changed to: For sites located in a region of low to moderate seismicity, low frequency ground motions are often dominated by distant high magnitude sources, while high frequency ground motions are often dominated by diffuse seismicity, that is, by nearby moderate magnitude sources.		does not exclude high seismicity cites. It gives an example using the more frequent case of low-to-moderate seismicity cites, and does not talk about other sites.
197.	Russia NRS	5.4	The dominant seismic sources in a DSHA should be identified by careful review of the seismotectonic model, as recommended in SSG-9 [7], in the absence of deaggregation data from a PSHA. <u>**When compiling a**</u>	It is recommended to pay special attention to accounting the possibility of manifestation near the site of an extreme earthquake and accounting specific phenomena in the event			X	See comment on 5.2.

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			<u>seismotectonic model, it is necessary to assess the potential for technogenic seismicity.</u> Dominant sources may not be the same for the different ground motion should be identified by careful review of the seismotectonic model, as recommended in SSG-9 [7], in the absence of deaggregation data from a PSHA. **<u>When compiling a seismotectonic model, it is necessary to assess the potential for technogenic seismicity.</u>** Dominant sources may not be the same for the different ground motion parameters and other seismic hazards (see para. 2.19). Low-frequency ground motion accelerations can be dominated by distant high-magnitude sources while high-frequency ground accelerations are often dominated by diffuse seismicity, that is, nearby moderate magnitude sources. Geological failures are primarily caused by low-frequency ground motions, while the dominant sources for concomitant phenomena hazards are phenomenon specific in extreme beyond design earthquakes.	of a possible manifestation near the site of a rare beyond design basis earthquake.				
198.	Russia NRS	5.4	The dominant seismic sources in a DSHA should be identified by careful review of the seismotectonic model, as recommended in SSG-9 [7], in the absence of deaggregation data from a	Caused earthquakes occur on already existing faults (which are most likely included in the regional seismotectonic model). However, the degree of danger			X	See comment on 5.2.

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			PSHA. **<u>When compiling a seismotectonic model, it is necessary to assess the potential for technogenic seismicity.</u>** Dominant sources may not be the same for the different ground motion parameters and other seismic hazards (see para. 2.19). Low-frequency ground motion accelerations can be dominated by distant high-magnitude sources while high-frequency ground accelerations are often dominated by diffuse seismicity, that is, nearby moderate magnitude sources. Geological failures are primarily caused by low-frequency ground motions, while the dominant sources for concomitant phenomena hazards are phenomenon specific.	of these faults may change if we take into account the possibility of human-induced seismicity, which should be paid attention to when compiling a seismotectonic model.				
199.	Bangladesh	Para 5.5 (b), Page 41	May require an example of 'geotechnical material properties' in this line.				X	Please refer to #6.
200.	Pakistan	5.5	Guidance in the draft text represents the current consensus amongst specialists in the field and they are expressed clearly and coherently except with reference to chapter no. 5 section 5.5 of the guide/document. Seismic hazard assessment is carried out to develop reference level earthquake or review level earthquake at a particular site. This reference level earthquake is used for Seismic Margin Assessment (SMA) and Seismic-PSA (s-PSA) studies.	If design level of our nuclear installation is far above the reference level earthquake subsequent consideration to characterize vibratory ground motion etc. may be elaborated.			X	This comment is not actionable. Reference level earthquake level for safety assessment is typically higher than the design basis event level.

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201.	Canada	5.7	For SMA and PSA-based SMA evaluations, the reference level earthquake may be set according to several criteria and should be in accordance with the objectives of the safety assessment (see paras 3.5 and 3.7) and available hazard assessment information (~~see paras 5.1–5.4~~). These criteria include the following: (a) A scaled spectrum of the original design basis earthquake; (b) A scaled spectrum or broadened spectrum of an earthquake that affected the installation; (c) A generic spectrum or suite of spectra (e.g. used in certification of a standard design); (d) A scaled site-specific spectrum for a specified earthquake scenario (~~e.g. para. 5.3~~); (e) A site-specific spectrum for a specified uniform hazard of exceedance (~~e.g. para. 5.2~~); (f) A generic or site-specific spectrum determined by the regulator.	The referenced paragraphs in items (d) & (e) are not matching the scope of these two items.	X			
202.	Germany	5.7	For SMA and PSA-based SMA evaluations, the reference level earthquake ~~may~~ should be set ~~according to several criteria and~~	Clarification			X	The deleted text is not redundant.

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			~~should be~~ in accordance with the objectives of the safety assessment (see paras 3.5 and 3.7) and available hazard assessment information (see paras 5.1– 5.4). These criteria include the following:….					
203.	Canada	5.9	For SPSA evaluations, the reference level earthquake spectrum at each frequency should be set to spectral acceleration levels that contribute most significantly to the resulting seismic risk and have comparable, but not necessarily equal, annual probabilities of exceedance. Therefore, this process implies performing iterative process (via sensitivity studies). The following…	What are the criteria to assess the significance of the contribution to the resulting seismic risk (in defining the spectral acceleration levels) before finalizing the seismic risk? Does this requirement imply iterative process for the SPSA (sensitivity studies mentioned in item (b))? Furthermore, RLE (RE) selection procedure that reflects latest industry practice should be adopted		X Edited to: For SPSA evaluations, the reference level earthquake spectrum at each frequency should be set to spectral acceleration levels that contribute most significantly to the resulting seismic risk and have comparable, but not necessarily equal, annual probabilities of exceedance. This determination		Discussing the criteria for significance is too detailed for the safety guide, especially since multiple criteria have been used. EPRI 3002012994 discusses this topic.

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						may involve an iterative process.		
204.	Bangladesh	Para 5.10, Page 42, Line 1	May require example of 'earthquake parameters' in this line			X Added reference to SSG-9 Rev. 1.		
205.	Canada	5.10-5.14	The concept of *the reference level earthquake parameters for* other (non-vibratory) seismically induced hazards, the options for determination of these parameters (in 5.12, a) to c)), and other concepts described in these paragraphs shall be backed up by *appropriate references* due to the following: 1. The respective IAEA publication, NS-G-3.6 [9], does not contain these concepts but rather describes an assessment of liquefaction potential based on several geotechnical and other parameters (Paragraph 3.17 of NS-G-3.6) which is a standard method for liquefaction analysis, for instance. Similar approach is used in NS-G-3.6 for other non-vibratory hazards. 2. The concept of *reference level earthquake parameters for* liquefaction and other non-	RLE is developed from vibratory ground motion hazard (for SSCs response and fragility tasks). Characterization of (unscreened) non-vibratory hazards is developed using *complete vibratory ground motion hazard spectrum* (not only RLE) as one of many inputs. Liquefaction susceptibility analysis of fine grained soils, for example, considers water content, liquid limit, plasticity index and fines content as other inputs. Characterization of non-vibratory hazards is not described in terms of *reference level earthquake parameters* in NS-G-3.6 or SSG-9.		Added: For non-vibratory seismic hazards that cannot be screened out, the reference parameters for SMA and PSA-based SMA evaluations should be determined on a hazard-specific basis considering the criteria adopted for the reference level earthquake spectrum (see para. **Error! Reference source not found.**) and the hazard assessment	X	The guidance in the cited IAEA publications do not apply to the subject entries. There are two steps in evaluating non-vibratory hazards. Executing ether steps will require using ground properties like water content and fines content. This does not preclude the need to select a seismic input level for performing evaluation and

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			vibratory seismically induced hazards is NOT defined in NS-G-3.6 (the terms "*reference ground motion*" and "*input ground motion*" are used in a general sense and are not defined according to the options in 5.12 a) to c) of DS522). 3. SSG-9 does NOT contain the concept of *the reference level earthquake parameters for* non-vibratory hazards either. 4. Generally, non-vibratory seismically induced hazards are different physical phenomena than vibratory seismic hazard, therefore different physical models are employed in the analysis. The respective geotechnical publications shall be referenced for the methods and practices of impact assessment applicate to non-vibratory seismically induced hazards.	References are required to confirm industry consensus on the concepts described in Paragraphs 5.10 to 5.14 of DS522.		approach (see para. 0). These reference parameters for explicit evaluation have logical correspondence with the reference level earthquake spectrum but do not necessarily correspond to the same annual probabilities of exceedance at the same confidence level as the vibratory ground motion. Options for determining these parameters include the following:		does not need to be mentioned here, just like defining a vibratory ground motion spectrum requires performing a site response analysis and utilizing the soil shear wave velocity and damping profile and modulus-reduction curves: 1. Step 1: Screening. This does not involve selecting an RLE.

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								2. Evaluation: This does required a seismic input level at which the evaluation is performed, either deterministically or probabilistically, and either at a single seismic input level or at multiple levels

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								(i.e. explicitly nonlinear). Selecting This seismic input level to perform the evaluation the RLE for these evaluation. They may be at a different hazard level than the hazard level for the

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								RLE for vibratory ground motion, but are linked. It seems that the reviewer mistakenly understood that the intent is to define one RLE hazard level for all ground motions. This was clarified in the text.
206.	Germany	5.15 Vers.1	An ~~multidisciplinary~~ expert team ~~composed of systems engineers, operations personnel, and seismic capability engineers~~ should collectively determine the scope of the seismic safety assessment. ~~A typical assessment team should have 3–5 members.~~	The demand for a multidisciplinary expert team with specific professional background consisting of 3-5 members – to our knowledge – exceeds by far what has been applied up to now in German evaluations of seismic safety for		X The word “multidisciplinary” is deleted. The intent is that this team be comprised of the utility, consultants, and		The last sentence added about graded approach is covered by Section 7 and the other general references in

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				repositories and other nuclear installations. We propose to omit these specific requirements with respect to qualification and the number of persons involved. In our opinion, it is likely that these specific qualifications in the field of seismic safety are not present in one single organization, especially not in the operating company. Usually, the demonstration (proof) and review of seismic safety is the result of the judgement of the operator, his consultants, the competent authority and its TSO(s). These organizations in total may cover all the required specific qualifications. In other words – it should be stated clearly that the current para should be applied using a graded approach for facilities with a lower hazard potential, than NPPs.		TSOs, not only the utility personnel alone. This has been noted in the footnote.		the text to graded approach.
207.	Czech Republic	5.16	The first step in determining the scope should be identifying the safety functions to be fulfilled in	Guide and the chapter 5 (except for 5.34-5.37) are aimed to (any) earthquake,	X			

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			order to control the progression or mitigate the consequences of an accident to an acceptable end state if the installation experiences ~~a beyond design basis~~ an earthquake	not only beyond design basis earthquake – e.g see para 2.15 for existing installations. Otherwise, it should be defined in para 2 that this guide is focusing on beyond design basis earthquake and, using a graded approach, could be applied to other (lower) levels of seismic loading.				
208.	Germany	5.17 (a)	Establishing the initial conditions of the nuclear ~~installation~~ power plant to be considered at the time of the earthquake. This includes, for example: (i) definition ~~of whether the installation~~ which plant operational modes have to be considered ~~is in normal operating mode or in another mode~~ (e.g., power operation, shutdown, etc.); …	In principle, all relevant operating modes (plant operational states, POS) should be considered. Hence, in a NPP, power operation and shutdown mode with its different phases do not exclude each other, but should both be considered in line with several other Safety Guides.		X Edited to "definition of which installation operational modes are to be considered"		
209.	Germany	5.19 And footnote 30	The final step in determining the scope should be to perform a seismic evaluation walkdown. Paragraphs 5.23–5.33 provide recommendations on this process. For a new nuclear power plant ~~installation~~, the walkdown in the	Clarification for the text of para 5.19 and for footnote 30. Please pay attention, that para 5.21 is dealing with virtual review as well.		X Accepted the edit to the footnote. Para. 5.19 discusses the		

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			design stage may be carried out as a virtual review[30] (to the extent practical), followed by a confirmatory walkdown after construction of the installation is finished. Footnote 30: A virtual review is such that the 3D model of the installations is displayed directly in the VR space	May we ask you kindly to check both paras – 5.19 and 5.21 - to avoid duplications?		seismic evaluation walkdown. Para. 5.21 discusses the systems review walkdown. Both have to be performed virtually for a new design.		
210.	Canada	5.20	… (h) Inclusion of SSCs assigned to perform during identified design extension conditions.	SSCs assigned to design extension conditions need to be included. (per Clause 5.35).		X Inclusion of SSCs required to perform during identified design extension conditions if not included above		These SSCs will likely be included in (a) and others.
211.	Germany/ BMUV	5.20	The list of selected SSCs should be prepared jointly by the multidisciplinary expert team and confirmed by a systems walkdown (see para. 5.21) The following SSCs should be included in the list: […]	editorial	X			
212.	Canada	5.21	… and verify potential assumptions used to justify including or screening elements out of the scope of the	Improper reference in the given context because para. 5.11 refers to screening of non-vibratory ground motion		X A systems walkdown should be		

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			safety assessment ~~(see para. 5.11)~~.	hazards and concomitant phenomena (that is based on engineering analysis of occurrence frequency and consequences), and not to screening of plant SSCs. Paragraph 5.21, however, addresses *Development of the selected SSCs list* in preparation to seismic walkdown, therefore initial SSCs screening should be referred to. Include reference to SRS-103, *Methodologies for Seismic Safety Evaluation of Existing Nuclear Installations* (2020), where a distinction between "systems walkdown" and "seismic capacity walkdown" is made		performed for existing nuclear installations (Ref. [10]). For new installations, a virtual review should be performed of the available design to the extent practical. This walkdown should confirm the completeness and consistency of the selected SSCs list with the as-built systems configuration, familiarize the seismic capability engineers with the as-built configuration, conditions, and apparent seismic robustness or vulnerability of		

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						the SSCs, investigate the surrounding areas to identify potential sources of seismic-induced interactions with the required SSCs, ensure that the credited operator travel paths are compatible with plant operating procedures, and verify potential assumptions used to justify including or screening elements out of the scope of the safety assessment based on credibility and consequence of their failures (see para. **Error!**		

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						Reference source not found. for general discussion of credibility and consequence).		
213.	Canada	5.21		This clause addresses seismic walkdown and is not directly related to the development of the selected lists of SSCs. Clause 5.21 is better included with Clauses 5.23 to 5.33, which cover the seismic evaluation walkdown. Seismic screening of plant SSCs is performed during the development of the SSCs list in preparation to the "seismic capacity walkdown" and further confirmed based on the walkdown observations. SSCs screening is based on the seismic capacity criteria and is an important part of seismic safety assessment, specifically seismic walkdown and fragility assessment. Therefore, para.			X	The suggested reorganization is not deemed required.

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				5.23 should follow para. 5.21, otherwise para. 5.23 could be combined with para. 5.22 and updated to outline the objectives of SSC screening and provide general description of the existing screening procedures referencing TECDOC-1937, *Probabilistic Safety Assessment for Seismic Events* (2020) and SRS-103, *Methodologies for Seismic Safety Evaluation of Existing Nuclear Installations* (2020).				
214.	Canada	5.22	In addition to the two (2) screening categories listed in the statement “Several SSCs on this list may be removed from explicit seismic capability evaluation if qualitative review indicates that they have either: *(i) significantly low seismic capacities and should be assumed to fail in an earthquake, or (ii) significantly high seismic capacities and can be assumed to be rugged in an earthquake*.” there is one more important category: high-capacity components that are screened out according to the	Incomplete scope: capacity-based seismic screening of SSCs is not fully defined. The subject is partially covered in para. 5.23, however presented to the reader as a separate concept from those discussed in para. 5.22, hence merging paragraphs 5.22 and 5.23 is recommended (see Comment 63 above). Complete and clear definition of SSCs screening		X. 5.22 includes screening-level capacity screening. The footnote was edited to clarify.		

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			capacity-based criteria (screening level) developed for each seismic safety assessment. Definition of high-capacity components and screening level should be provided referencing TECDOC-1937, *Probabilistic Safety Assessment for Seismic Events* (2020) and SRS-103, *Methodologies for Seismic Safety Evaluation of Existing Nuclear Installations* (2020).	is necessary to foster correct understanding of item a) in para. 5.30 (refer to the Comment 68 below).				
215.	Germany	5.23	Seismic evaluation walkdowns are one of the most significant components of the seismic safety evaluation in the SMA and SPSA methodologies. They are often referred to as 'seismic capability walkdowns' in the context of SMA approaches and 'seismic fragility walkdowns' in the SPSA approach. ~~For existing nuclear installations, they should be performed after completion of the selected SSCs list.~~ For new installation designs that have not been constructed, walkdowns should be performed after construction is completed to verify consistency between the as-built conditions and the as-designed conditions that were used in the safety assessment based on virtual	We suggest deleting the sentence, as current information is already given in 5.18 (third step) and 5.19 (final step) and confirmed with last sentences of 5.22.	X			

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			review (see para. 5.21) and to observe any installation or site specific features. It is important that all design features used for the seismic assessment be verified in the as-built installation or any deviations addressed in order for the safety assessment to be valid. The final safety analysis report should incorporate any resulting updates to the safety assessment in accordance with regulatory requirements [12].					
216.	Canada	5.24	Each walkdown team should include ~~qualified~~ seismic engineers and support personnel as necessary~~, at least one systems engineer, at least one installation operator, and support personnel as necessary~~ (maintenance, operations, systems, and engineering)…	What is the difference between *installation operator* and *operations support personnel* in this paragraph? Is it an industry consensus to have systems engineer and operations representative during the walkdown? What is the difference between *qualified* seismic engineer and seismic engineer? Wide range of industry practices should be reflected when describing a walkdown crew.		X Edited to and may include support personnel as necessary	X	A qualified seismic engineer is someone who has seismic walkdown qualifications. An operations personnel has knowledge of the operations and is industry practice to include as noted. A support personnel is

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								someone from the plant authorized for access but not necessarily an operator. They are optional to include, and industry practice has shown that they can help make walkdowns more efficient and streamlined by executing ancillary tasks that keep the core walkdown team focused on the walkdown.
217.	Germany	5.24	Each walkdown team should include qualified seismic engineers, at least one systems engineer, at least one installation operator, and support personnel as necessary (maintenance, operations, systems, and engineering). The seismic engineers should have sufficient experience in the seismic analysis,	More clarity is needed that the current para should be applied using a graded approach for nuclear installations with a lower hazard potential than NPPs (the same as to para 5.15).			X	The last sentence added about graded approach is covered by Section 7 and the other general references in

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			design and qualification of SSCs for resisting earthquakes and other loads arising from normal operations, accidents, and external events. One team member should be familiar with the design and operation of the SSC being walked down. It is necessary to underline that current recommendation is "state of the art" for nuclear power plants. In case of other installations, it could be used applying a graded approach.					the text to graded approach.
218.	Hungary P2	5.24/4.	The reviewer (s) focusing on the seismic-fragility work shall have successfully completed the SQUG courses or relevant. During their review can use tools and methods that are provide by the SQUG and GIP practice.	The peer-review team shall have a specific experiences and qualifications and certification to be able to perform the seismic walkdown review. After the qualification word the certification shall be include and with afoot note number [32] the following wording shall added as a note.			X	This wording is too specific to one seismic qualification program to be appropriate for an IAEA Safety Guide.
219.	Japan	5.24	The seismic evaluation walkdown team should include qualified seismic capability engineers, at least one	Inclusion of an operating personnel in the plant walk down team may depends on the		X The seismic		

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			systems engineer and ~~at least one member of~~ preferably an operating personnel; it may also include other support personnel of various areas (e.g. for maintenance, operations, systems or engineering support) as necessary. The seismic capability engineers should have sufficient experience in the seismic analysis, design and qualification of SSCs for resisting earthquakes and other loads arising from normal operations, accidents and external events. One team member should be familiar with the design and operation of the SSC being walked down.	licensee and its effectiveness is unclear. The recommendation on including operating personnel should be weakened.		evaluation walkdown team should include qualified seismic capability engineers, at least one systems engineer, and plant support personnel as necessary (e.g. for maintenance, operations, systems or engineering support).		
220.	Hungary P2	5.26	For SPSA and SMA, the walkdown is clearly used to confirm preliminary screening and to collect additional information for fragility or margin calculations.	This paragraph should provide a brief introductory sentence how the walkdown sequence is implementing. The following wording maybe added in the beginning of the paragraph.			X	This proposed text is captured in Para. 5.25.
221.	Canada	5.28	The preliminary walkthrough should include the ~~senior~~ members of the walkdown team.	What is the meaning of the term "*senior*" in this context? This statement should be removed or revised as necessary		X key members		
222.	Canada	5.29	Identification of the *primary* members on the walkdown team	What is the meaning of the term "*primary*" in this			X	Primary means that they are

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			and confirmation of required access and training credentials	context? This term should be removed from the following statement or revised as applicable. If seismic engineers are referred to, it should be identified as such.				not easily interchangeable.
223.	Canada	5.30	(a) Criteria for capacity screening <u>(see para. 5.22)</u> and ranking;	Refer to Comment 64 above.			X	Not required.
224.	Canada	5.34	in the case that levels of natural hazards greater than those considered for design occur:	What does 'design occur' mean? Also, guidance should be provided in the document on the methods and margin requirements to address cliff edge effects.		X in the case that levels of natural hazards occur that are greater than those considered for design		
225.	Germany	5.35 Ver.1	Defence in Depth Level 4 concerning seismic hazard corresponds to the mitigation of severe accidents and prevention of large releases. The list of selected SSCs to be evaluated for adequate margins should include items needed to perform mitigation functions associated with design extension conditions [3]. For instance, the list should include the items <u>(i)</u> for protection of the containment system, <u>(ii)</u> for <u>protection of</u> installations with such a system, or <u>(iii)</u> for protection of	Please clarify the expression – we suggest two versions		X Edited to: "For instance, the list should include the items for protection of (i) the containment system for installations with such a system or (ii) the last confinement barrier against large releases for		

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			the last confinement barrier against large releases, and of ~~for~~ other installations.			other installations.“		
226.	Germany	5.35 Ver.2	Defence in Depth Level 4 concerning seismic hazard corresponds to the mitigation of severe accidents and prevention of large releases. The list of selected SSCs to be evaluated for adequate margins should include items needed to perform mitigation functions associated with design extension conditions [3]. For instance, the list should include the items for protection (i) of the containment system, (ii) ~~for~~ of installations with such a system, or (iii) for protection of the last confinement barrier against large releases~~, for other installations~~.			X See #204.		
227.	Canada	5.36	(e.g. a large early release frequency of less than 10^{-6} yr^{-1})	Add LERF of E-05/yr as another example. The LERF goal is subject to applicable regulatory requirements of a given utility. E-05/yr is a more widely used safety goal for LERF. E-06/yr should considered for new designs.		X (e.g. a large early release frequency of less than 10^{-6} yr^{-1} for a new nuclear power reactor design)		Adding multiple examples here clutters the text.
228.	Canada	5.37	In seismic safety evaluation of adequate margins for items performing mitigation functions	The main objective of margin assessment is to evaluate seismic response to			X	The comment misreads the sentence. The

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			associated with design extension conditions and beyond design extension earthquake conditions [3], uncertainty in the seismic margin estimates should be properly considered.	BDBE. Design extension conditions would be included in the margin assessment.				sentence identifies SSCs that are required to perform in DEC conditions for special treatment in DiD evaluation compared to other SSCs. Obviously, the whole section about DiD is for BDBE evaluation.
229.	Canada	5.38	[8] Specific considerations for nuclear reactors (e.g., performing safety functions such as cooling and shutting down the reactor);	Item no. [8] is vague. I recommend providing more clarification.		X Specific considerations for nuclear reactors (see paras, 5.48 and 5.49)		
230.	Germany	5.38 Line 6	(5) ~~Systems walkdown (see para 5.21) and~~ seismic evaluation walkdown (see para. 5.23);	The systems walkdown is included in Step 5 but it is part of par. 5.18, included in Step 4. Also, par. 5.39 (d) mentioned in Step 4 uses knowledge from systems walkdown. So, the systems	X			

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				walkdown has to be within Step 4 or earlier.				
231.	Hungary P2	5.38 (7) / 1.	(see para. 5.26)	This part may be referenced to the paragraph 5.26).			X	No need.
232.	Canada	5.39	(c) If multiple success paths are selected, one should be designated primary. The primary path should be the path judged easiest to demonstrate a high seismic safety margin thereto and be consistent with plant design manuals, operational procedures and emergency response procedures ~~training~~.	*Training* is performed per operational procedures, thus the term *training* is redundant in this context. Rather, *design documentation and emergency response procedures* should also be consulted when primary path is identified.	X			
233.	Canada	5.39	(f) The actions required of the operations staff should be reviewed and assessed given the common cause nature of the earthquake. Candidate success paths should avoid relying on operator actions that cannot be executed with high confidence given their timing, durations, installation operational and emergency procedures ~~and training~~, and potential for increased stress level, additional workload ~~confusion~~ or interference with other responsibilities.	*Training* is associated with operational and emergency procedures, thus this term is redundant in this context. "*Confusion*" is not a term to identify excessive stress on operators in accident conditions, refer to SRS-103 and TECDOC-1937 for appropriate terminology.		X and potential for increased stress levels or interference with other responsibilities.		Additional work load and interference with other responsibilities are similar.
234.	Canada	5.39 (b), footnote 36	[36] For water-cooled nuclear reactors, the function "removal of heat from the reactor…" in para.	This guide is intended for existing and new reactors. Some new reactors do not	X			

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			5.16 involves control of the reactor coolant pressure, control of the reactor coolant inventory, and decay heat removal.	require coolant pressure and inventory control for decay heat removal.				
235.	Canada	5.40	These responses may also be required for the seismic capacity evaluation of the structure if its failure modes of interest (see appendix) cannot be qualitatively screened out as ~~relatively~~ seismically rugged in accordance with para. 5.22.	The term "*relative*" adds ambiguity to the concept of rugged SSCs.	X			
236.	Canada	5.41	Probabilistic methods of analysis use best estimate (or median-centred) parameter values and include explicit treatment of uncertainties. Acceptable deterministic analysis methods should include conservative provisions to account for the effect of uncertainties…	Uncommon technical terminology "best estimate-centred parameter values". Suggest using 'best estimate (or median-centred) parameter values' or 'best estimate parameter values'. Furthermore, definitions of seismic response methods in this paragraph need to be backed up with appropriate references to the latest industry publications on the subject, such as TECDOC-1937, *Probabilistic Safety Assessment for Seismic Events* (2020) and SRS-103, *Methodologies for Seismic*			X	A best-estimate model can be mean-centered for some parameter. Though the term "median-centered" is used ubiquitously, it is often used to describe models which are not centered at the median, and is therefore here generalized to use more

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				Safety Evaluation of Existing Nuclear Installations (2020). The methods and approaches described in the document should be justified to reflect on the latest developments in the industry.				technically accurate -even if not familiar-wording.
237.	Canada	5.42	(a) … Scaling is most appropriate for rock sites where the design-basis models of the structures are considered linear and ~~median centred~~ the spectral shapes of the reference level earthquake and the design-basis earthquake are similar. Or: (a) … Scaling ~~is~~ may be ~~most~~ appropriate for rock sites where the design-basis models of the structures are considered linear and median centred, and the spectral shapes of the design-basis earthquake and the reference level earthquake are sufficiently similar within the frequency range of interest.	Technical content imprecise and incomplete, references to the sources should be added. In current industry practice, the scaling method for generating floor response spectra may be justifiable only when the spectral shapes of the input spectra are similar. This requirement may be released in certain extent for structural response in terms of stress, forces, moments, etc. when a rigorous scaling is applied.		X Scaling is considered appropriate for rock sites where the design-basis models of the structures are considered linear and median centred and the spectral shapes of the design-basis and reference level earthquakes are sufficiently similar.		The wording “Scaling of previous response analysis results .. may be justifiable” covers the suggested addition. The second suggested edit was adapted nevertheless.
238.	Canada	5.42	(c) For non-vibratory ground motion input (e.g. response to	Use of uncommon or undefined terminology.			X	Quasi-static analysis is a

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			liquefaction settlement or slope deformation), deterministic or probabilistic analysis should be used depending on significance of soil failures for the plant structures housing components and systems important to safety ~~quasi-static analysis methods should typically be sufficient~~.	"*Quasi-static* analysis methods" are not identified the related literature (otherwise literature sources should be noted in the text).				widely, if not universally understood technical term. The subject of this paragraph is not probabilistic vs. deterministic as the added text seems to have misunderstood. It is about which structural response analysis methods are adequate: e.g. static, response spectrum, time-history analysis, etc.
239.	Israel	5.42(b)	Addressing response spectrum analysis for vibratory ground motion input, use of explicitly nonlinear methods is mentioned in paragraph 5.42(b). In that context, a remark can be added mentioning that nonlinear methods are used for	Completeness		X Added "as appropriate for the expected responses."		

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			cases of large displacements, not symmetric movements and in not elastic ranges.					
240.	Canada	5.43	(c) For non-vibratory ground motion input, ~~quasi-static analysis methods should typically be sufficient~~ deterministic or probabilistic analysis methods should be used depending on significance of soil failures for the plant structures housing components and systems important to safety.	*Quasi-static* analysis methods" are not identified the related literature (otherwise literature sources should be noted in the text).			X	See #217.
241.	Israel	5.43	Following the three recommendations presented in paragraph 5.43, we suggest to consider adding the issue of seismic hazards related to the sloshing effects in liquid reservoirs/pools (e.g. spent fuel cooling pools and tanks with independent foundations).	Completeness			X	This is included in 5.43(b). Is there a reason to single it out?
242.	Canada	5.44	~~The HCLPF capacity of an SSC is expressed function of the hazard parameter (PGA or spectral acceleration) corresponding to the scale factor on the reference level~~	HCLPF definition is not accurate and could be misleading.		The current text reads as follows: The HCLPF capacity of an	X	We believe that the definition is accurate and the differences from the

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			~~earthquake ground motions at which there is at least 95% confidence of a 5% probability of failure. It may alternatively be represented by an earthquake motion level at which the expected (mean) probability of failure is 1% or lower.~~ A HCLPF capacity is defined as the ground motion level at which there is a high (95%) confidence of a low (at most 5%) probability of failure. When the fragility is expressed as a single curve using a composite variability, the HCLPF could be approximated as the ground motion level at which the composite probability of failure is at most 1%.			SSC is expressed as a function of the hazard parameter (PGA or spectral acceleration) corresponding to the scale factor on the reference level earthquake ground motions at which there is at least 95% confidence of a less than 5% probability of failure. It may alternatively be represented by an earthquake hazard parameter at which the expected (mean) probability of failure is 1% or lower. 1 Determining		proposed text are editorial. Please identify the reason it is believed not to be.

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						HCLPF capacities for SMAs can and is often performed using deterministic evaluation methods similar to following design code procedures (e.g., the conservative deterministic failure margin method) in lieu of explicit propagation of uncertainties in the seismic capacity evaluation. Alternately, HCLPF capacities may be determined explicitly using probabilistic fragility analysis methods such as the separation of variables. The		

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						latter is infrequently performed for SMAs compared to SPSAs. [1] The scale factor is to be multiplied by the PGA or Spectral Acceleration of the RLE, in order to get the HCLPF 1 The HCLPF capacity is exactly equal to this quantity when the standard deviation terms for randomness and uncertainty are equal.		
243.	Germany	5.44	The seismic capacities of the selected SSCs should be characterized using HCLPF capacities. The HCLPF capacity[38] of an SSC is ~~expressed~~ a function	Editorial		X "The HCLPF capacity[1] of an SSC is expressed as a		

[1] Determining HCLPF capacities for SMAs can and is often performed using deterministic evaluation methods similar to following design code procedures (e.g., the conservative deterministic failure margin method) in lieu of explicit propagation of uncertainties in the seismic capacity evaluation. Alternately, HCLPF capacities may be determined explicitly using probabilistic fragility analysis methods such as the separation of variables. The latter is infrequently performed for SMAs compared to SPSAs.

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			of the hazard parameter […]			function of the hazard parameter“		
244.	Germany/ BMUV	5.44	The seismic capacities of the selected SSCs should be characterized by determining their HCLPF capacities. The HCLPF capacity39 of an SSC is expressed as a function of the hazard parameter (peak ground acceleration or spectral acceleration) corresponding to the scale factor40 on the reference level earthquake ground motions at which there is at least 95% confidence of a ~~less than 5%~~ probability of failure not higher than 5%. […]	The current wording excludes a failure probability of (exactly) 5%. But typically, such a failure probability would be considered appropriate. Therefore, the wording should be changed in the sense of “less than or equal to”.		X "of 5% (or less) probability of failure“		
245.	Hungary P2	5.44/4-5.	with 95% confidence the probability of failure is less than 5%.	It would be more accurate if the structure of this part of the sentence were restructured by the following:		X		Edited to “at least 95% confidence of a less than 5% probability of failure”
246.	Hungary P2	5.44 / Note 38. (bottom of	The Fragility Analysis method were used for several NPP seismic margin studies. This method	SMA has different types of analysis, mainly divided into two categories the Fragility		X		The comment is appreciated but the

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		the page)	requires the evaluation of parameters such as the median capacity, the randomness variability factor β_R and uncertainty variability factor β_U using considerable judgment. These factors values can be determined and established in different standards guidance. The CDFM method prescribes the parameter values and procedures to be used in calculating the HCLPF capacities and requires less subjective judgment than the FA method, although, some subjective decisions were made in formulating the procedures used in the CDFM method. Also regarding the CDFM procedure the Inelastic Energy Absorption Factors $F\mu$ should be evaluated and selected based on the available Nuclear standard sas ASCE	Analysis(FA) method and Conservative Deterministic Failure Margin (CDFM). Both has it is own advantages and disadvantages. It would be efficient to provide more information in the main text as an individual chapter regarding the applicability of these two directions. Briefly, the following could be added:				proposed text is too long and detailed for the context in which it appears. FA is not commonly used in SMAs, which is the subject of Para 5.44. A clarification has been added to the footnote.
247.	Israel	5.44 s	Regarding characterization of seismic capacities (of selected SSCs) using HCLPF capacities**:** It could be appropriately informative to add a third footnote to paragraph 5.44, explaining how an earthquake motion level at which the expected (mean) probability of failure is 1%	Clarity		X Added footnote.		

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			or lower **- is an alternative** to the expression brought in the first part of this paragraph, which addresses reference level earthquake ground motions at which there is at least 95% confidence of a 5% probability of failure.					
248.	Canada	5.48	Revise to add: Level 2 Internal Events PSA is performed to evaluate containment response to beyond design basis conditions (reference earthquake). Alternatively, containment robustness to the seismic event is assessed if Level 2 Internal Events PSA would not provide any useful results (e.g., if containment failure frequency is dominated by the correlated simultaneous severe accident progression in all units of a multi-unit station).	Incomplete definition		X Added: Alternately, Level 2 Internal Events PSA is performed to evaluate containment response to beyond design basis conditions (reference earthquake).		The rest of the suggested text is already included in the paragraph.
249.	Germany/ BMUV	5.48, line 6	[…] Alternatively, Level 2 probabilistic safety assessment for internal initiating events (see IAEA Safety Standards Series No. SSG-4, Development and Application of Level 2 Probabilistic Safety Assessment	From the current text it is not clear how a Level 2 PSA for INTERNAL initiating events should provide useful information on the containment response under seismic		X Changed to: Development and Application of Level 2		The text refers to SSG-4 for guidance on Level 2 PSA. The suggested text would have implied

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			for Nuclear Power Plants [21] may be performed to evaluate containment response to beyond design basis events (including the reference level earthquake).	(i.e. EXTERNAL) loads. In order not to lose the context of seismic loads, we recommend to mention the reference level earthquake at least in brackets (as proposed in Step 8 by Canada).		Probabilistic Safety Assessment for Nuclear Power Plants [21] may be performed to evaluate containment response to beyond design basis earthquakes.[FN] FN: The reference level earthquake for a Level 2 PSA may be different than the one used for a Level 1 PSA of the same nuclear power plant.		that the RLEs should be the same for Levels 1 and 2 PSA, which is not necessary. A foot note was added to clarify this.
250.	Germany	5.49	A detailed walkdown inside containment to verify that all small lines in a nuclear power plant can withstand the reference level earthquake is resource-intensive and possibly impractical due to (i) the radiation exposure hazard to the walkdown team, and (ii) the challenges of an exhaustive review of potential seismic spatial	Change of contents suggested. The option to exclude a small LOCA by verification of the integrity of small lines on a sample basis should be included. It can be expected that small lines are normally not critical with regard to seismic safety	X			

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			interactions affecting small lines in a crowded space. As a practical alternative, the SMA may be performed by ensuring that any success path is capable of sustaining concurrently the loss of offsite power and a small loss of coolant accident inside the containment. <u>Alternatively, verification of the integrity of small lines on a sample basis could be performed.</u>	if designed and installed appropriately. Experimental results to support this view are available. It is therefore also an option to verify the assumption that no LOCA will occur on a sample basis, rather than assuming a small LOCA.				
251.	Canada	5.50	(c) Determination of HCLPF capacity for the installation (Step 7) is performed differently.	Revision is required to outline how HCLPF analysis is performed (add general definition of the applicable methodology). Further, para. 5.53 states "Determination of the HCLPF capacities for the selected SSCs is typically performed in a similar way to the SMA method." which contradicts the above item (c) in para. 5.50.	X	This applicable guidance for this entry is para. 5.54 (installation-level HCLPF), not 5.53 (individual SSC HCLPFs). Added a pointer to 5.54.	X	This applicable guidance for this entry is para. 5.54 (installation-level HCLPF), not 5.53 (individual SSC HCLPFs). Added a pointer to 5.54.
252.	Canada	5.50	(d) ~~Enhancements of~~ PSA-Based SMA ~~may~~ <u>shall</u> include Human Errors and Non-Seismic Random Failures	Human Errors and Random Failures of SSCs are required for PSA-based SMA.		X Inclusion of Human Errors and Non-Seismic Random Failures.		Inclusion of HEPs and random failures is not required for PSA-based SMA in all MS,

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								and this statement is contradicted by the reviewer comment #86.
253.	Canada	5.52	The selected ~~SSCs list~~ Seismic Equipment List (SEL) should be identified similar to the selected SSCs list for the fragility evaluation in the SPSA methodology (see para. 5.5~~8~~9)	The SSCs list is called Seismic Equipment List (SEL). Revision is required to add definition of SEL referencing TECDOC-1937, *Probabilistic Safety Assessment for Seismic Events* (2020) and SRS-103, *Methodologies for Seismic Safety Evaluation of Existing Nuclear Installations* (2020).			X	This is addressed earlier in the document. Please refer to the footnote in 5.18.
254.	Germany	5.53 (a)	(a) Development of conservatively biased seismic fragility estimates for the SSCs. ~~This can be performed by assigning a generic or estimated value of the variability to define a lognormal function anchored to the HCLPF capacity at 1% mean probability of failure40.~~	This recommendation is too specific for the general applicability of the Safety Guide. It can only be understood by experts in PSA-based seismic margin assessment, who however will not need this recommendation.		X Edited to make it less specific.		
255.	Canada	5.54	The installation-level HCLPF capacity should be determined by incorporating all minimal cut-sets that can lead to ~~an~~ unacceptable end states. It may be computed using ~~following~~ one of the	Editorial for clarity. Furthermore, the two approaches (a) and (b) are not interchangeable. Approach (a) provides	X			Accepted the editorial. No action required on the rest.

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			following two approaches:	seismic *capacity* and is only used in PSA-Based SMA. Approach (b) provides seismic *fragility curves* and can only be executed in full SPSA in order to include seismic and random (non-seismic) failures of SSCs. Note that Type 2 (mixed) cutsets (that contain seismic failure events and random failures of SSCs) are not accounted for in the PSA-based SMA because specific approach for evaluation of Type 2 cutsets is not available (due to limitations of the PSA-based SMA methodology). If the approach (b) implies development of the installation-level fragility curve within a PSA-based SMA, then it is only based on Type 1 (seismic) cutsets and needs to be stated as such. Revisions are required.				
256.	Canada	5.57	… For example, the most popular	Fault trees in SPSA model a		X		

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			approach in the Member States is to use seismic event trees to model accident sequences and fault trees to model basic seismic events, random failures of SSCs and human failure events.	combination of seismic and non-seismic failures; not only seismic basic events.		"basic failure events"		
257.	Canada	5.57		Incomplete scope. Items (a), (c), (d) and (e) are also applicable to SMA and PSA-based SMA, however were not listed for the latter two methodologies in the respective sections. Revisions are required. Item (a) needs to elaborate on the existing approaches to quantification of seismic failure correlation referencing.			X	These items are examples of why the internal events PSA model needs to be modified, not requirements. They need not be listed under the discussion of each methodology and would clutter the document if they were. Note that the SMA methodology does not use a PSA model.
258.	Canada	5.57	(e) Earthquakes might result in seismic interaction failures (e.g. seismic-induced fire, seismic-induced flood).				X	An example need not be exhaustive, and is kept short for

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								concision. Note that Item 5.57 is already longer than half a page.
259.	Germany	5.57 (b)	The ~~range of~~ seismic ground motions represented by the seismic hazard curve range<u>s</u> from moderate to very large earthquakes. The resulting probabilistic distributions of seismic demands at the plant level ~~led~~ l<u>ead</u> to <u>a</u> distribution of the core damage frequency <u>and/or fuel damage frequency</u>, large or early release frequency or <u>an</u>other risk metrics of interest <u>as a</u> function of the hazard parameter.	1) Limitation to core damage frequency in Level 1 PSA is no longer state-of the art and does not cover power and shutdown states with a risk of fuel damage 2) Editorial		Edited to: "The seismic ground motions represented by the seismic hazard curve range from moderate to very large earthquakes. The resulting probabilistic distributions of seismic demands at the plant level lead to distribution of the core and/or fuel damage frequency, large or early release frequency, or other risk metrics of interest as a function of the		

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						hazard parameter.“		
260.	Canada	5.58	Common-cause failures and seismic fragility correlations between basic events should be modelled.	Incorrect terminology: common-cause failures and failure correlation are not interchangeable terms.	X			
261.	Canada	5.59	The selected SSCs list for the seismic evaluation ~~walkdown~~ should include…	Improper reference to the walkdown list which is only a subset of the full SSCs list (SEL) discussed in this paragraph (see Comment 85 related to SEL definition).	X			“walkdown” deleted to avoid confusion.
262.	Germany	5.59	The selected SSCs list for the seismic evaluation walkdown should include all the SSCs whose seismic-induced failures contribute to the basic events in the accident sequence logic model. This list typically includes significantly more SSCs than are needed for the SMA methodology, which only involves ~~including~~ SSCs sufficient to achieve a limited number of success paths…..	Clarification		X Edited to: “which only requires including ..”		
263.	Canada	5.62		Best industry developments should be referenced, otherwise this paragraph remains generic and ambiguous.			X	No text change proposal provided.
264.	Canada	5.63	Assessment of human failure event	Uncommon terminology.		X		

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			probabilities should be performed considering the unique challenges of earthquakes and the level of damage, confusion, concurrent genuine and spurious failure alarms, and potential loss of indicator signals on shaping human performance.	The term "*confusion*" to be replaced by appropriate terminology (see Comment 72).		"Increased stress levels"		
265.	France	5.63	More guidance on human reliability modelling can be found in in IAEA Safety Standard Series SSG-3	DS523 is a draft safety guide and not a definitive guide			X	See responses to the several other similar comments from France.
266.	Canada	5.64	The installation-level fragility curve should be computed explicitly at each intensity level from the SSC fragilities, non-seismic failure rates, and human failure probabilities in accordance with para. 5.54(b).	Additional information should be included for completeness. Within an SPSA framework, plant-level fragility curve is obtained from fragilities of individual SSCs using analytical procedures such as second moment procedures and simulation techniques. Furthermore, reference to para. 5.54(b) is not appropriate since this paragraph is part of PSA-based SMA related section and requires revisions as			X	The suggested level of detail is too specific for the safety guide. The reference to para. 5.54(b) is appropriate and avoids repeating the same process in para. 5.64. Added "(except using the full fragility curve)"

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				identified in Comment 86. Revision is required.				
267.	WNA CORDEL	§5.64	*Current text:* *Risk quantification should be performed by combining the SSC fragilities, minimal cutset Boolean equations, and seismic hazard curves over an earthquake intensity parameter range of interest.* *The installation level fragility curve should be computed explicitly at each intensity level from the SSC fragilities, non-seismic failure rates and human failure probabilities, in accordance with the approach described in para. 5.54(b) (except using the full fragility curve instead of the min-max approach or estimated curves). This fragility curve should be integrated with the earthquake severity occurrence rates according to the hazard curve to compute the annual frequency of unacceptable performance.* Proposed text:	Min-max approach is in para. 5.54(a), not 5.54(b). It is common practice to include the seismic initiating event frequency in the initiating event of the event trees, therefore the minimal cutsets include a frequency event and the convolution is implicitly included in the quantification.		X Edited the sentence that had "min-max" to."… in accordance with the approach described in para. **Error! Reference source not found.**(b) and using the full fragility curves instead of estimated curves"		

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			Risk quantification should be performed by generating the minimal cutsets that are representative of the Boolean expression of the seismic accident sequences (recall para. 3.10). The minimal cutsets include SSC fragilities, non-seismic failure rates and human failure probabilities. The quantification is performed at discrete levels of the earthquake intensity parameter, using the corresponding values of the seismic fragility curves and of the hazard curve, respectively. The summation of the risk (core damage frequency or large / early release frequency) for the distinct levels is an approximation of the convolution between the installation level fragility and the hazard curve. The set of earthquake intensities is supposed to cover the range of intensities with non-negligible					

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			contribution to the overall risk. The installation level fragility curve should be quantified, in terms of the conditional probability of core damage or large / early release, where the conditioning parameter is the earthquake intensity level. This is the SPSA equivalent to the installation level fragility curve of the PSA-based SMA, as defined in para. 5.54(b).					
268.	Canada	5.65		All items in this paragraph are also applicable, fully or partially, to SMA and PSA-based SMA, however were not listed for the latter two methodologies in the respective sections. Revisions are required.			X	The suggested level of detail is too specific for the safety guide. The reference to para. 5.54(b) is appropriate and avoids repeating the same process in para. 5.64. Added "(except using the full fragility curve)"

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269.	Germany	Title of Section 6	~~EVALUATION OF~~ SEISMIC SAFETY <u>ASSESSMENT</u> FOR INSTALLATIONS OTHER THAN NUCLEAR POWER PLANTS	Section 6 provides recommendations on applying a graded approach to the assessment of nuclear installations other than nuclear power plants (with reference to Section 5 where appropriate). We suggest to put the title of section 5 in line with this statement: see also para 1.15. Please also pay attention that “assessment” is a term used in the IAEA Safety Glossary.			X	See response to Comment No. 244
270.	Germany	6.2	Seismic safety <u>assessment</u> ~~evaluation~~ of nuclear installations other than nuclear power plants should be based on graded approach, as recommended in the following paragraphs. The intent is that the <u>assessment</u> ~~evaluation~~ verifies that the performance of the SSCs important to safety <u>even in the event of the earthquake are still able to fullfill their safety functions</u> ~~within the installation is acceptable.~~	Clarification		X Seismic safety evaluation of nuclear installations other than nuclear power plants should be based on graded approach, as recommended in the following paragraphs. The intent is that the evaluation verifies that the performance of		

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						the SSCs important to safety even in the event of the earthquake are still able to fulfil their safety functions.		
271.	Germany	6.3	The methodology to be followed in evaluating nuclear installations other than power plants is essentially identical to that for nuclear power plants; however, the end state will be unique for each installation. In the case of a nuclear power plant typically the end state ~~most common~~ is to prevent core damage (i.e. safely shut down the plant and remove residual heat from irradiated fuel) and to prevent a large early release. For nuclear installations other than nuclear power plants, the end state may be to prevent leakage of aerosolized contaminants, for instance, in the case of a fuel processing facility. Once the desired end state is ~~established~~ defined, the methodology for assessing the installation's ability to achieve this end state should be evaluated using	Clarification	X			

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			the SPSA, PSA based SMA, or SMA approaches presented in Sections 3 and 5 of this Safety Guide.					
272.	France	6.4 & 6.5	section 9 of IAEA Safety Standard Series NS-G-1.6	DS490 is a draft safety guide and not a definitive guide		X, Section 3 of SSG-67		
273.	France	6.4	In Table 2 of IAEA Safety Standard Series NS-G-1.6	DS490 is a draft safety guide and not a definitive guide		X, in Table 3 of SSG-67		
274.	Germany	6.4	For the purpose of seismic safety evaluation, each SSC that is required to perform a seismic risk mitigating function should be assigned to a seismic design class (SDC), which is a hierarchical category that denotes its importance in mitigating seismic hazard (see Section ~~9~~ 3 of ~~DS490~~ SSG-67 [13]). The seismic design class assigned to the SSC is a function of the severity of adverse radiological and toxicological effects - on workers, the public, or the environment - of the hazards that might result from the seismic failure of the SSC[45]. ~~Table A–1 in the annex to this Safety Guide provides an example of criteria for use in determining the seismic design class.~~ A framework like the	Clarification Additionally, to point out that annexes and footnotes are not integral parts of the main text, we suggest moving the reference to the annex behind the reference to Safety Guide SSG-67.	X			

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			one given in the annex of this Safety Guide or in Table ~~2~~ 3 of ~~DS490~~ SSG-67 [13] should be used in establishing the seismic design class for the SSCs of the nuclear installation. Additionally, Table A–1 in the annex to this Safety Guide provides an example of criteria for use in determining the seismic design class.					
275.	Germany	6.4 Footnote 45	For example, in the United States of America, nuclear installations are assigned to seismic design classes (see ~~appendix~~ annex). SSCs that perform a safety function are placed into a design category based on the unmitigated consequences that may result from the failure of the SSC by itself or in combination with other SSCs. Consideration is given to consequences to the worker, the public, or the environment.	In this Safety Guide this is an annex, not an appendix	X			
276.	Libya	6.6 Line 1	A conservative screening process should be used ~~prior to~~ before categorizing a nuclear installation. [….]	Improved grammar	X			
277.	France	6.7 Lines 20, 21	The seismic input for the safety evaluations should not be less than a peak ground acceleration of 0.1 g	-ground motion is recorded at the ground surface during earthquakes, **in the free field**		X At the free field or foundation		

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			at the ground level **or foundation level, in the free field.**	- foundation level could be variable and dependent on the structure **-according to countries, the reference level is the ground level or foundation level or the both depending of the soil characteristics**		level		
278.	France	6.11	section 7 of IAEA Safety Standard Series NS-G-1.6	DS490 is a draft safety guide and not a definitive guide		X SSG-67		
279.	Germany	6.11	~~There is a correlation between the hazard level used for design, the seismic margin achieved by the design and the installation level performance goal, as described in Section 7 of DS490 [13]. In this context, the minimum required seismic margin is related to the seismic design basis and the target performance goal of the installation. Seismic margin in this context can be regarded as a surrogate for the installation level performance goal. The basis for the graded approach is described in paras 6.12 and 6.13.~~ According to para 7.4 of SSG-67 [13] "There is a correlation between the hazard level used to define SL-2, the seismic margin (HCLPF capacity) and the seismic	We suggest using wording direct from SSG-67, otherwise the intent of the current para is not clear.		X According to para 7.4 of SSG-67 [13], there is a correlation between the hazard level used for design, the seismic margin achieved by the design and the seismic performance goal. In this context, the minimum required seismic margin		

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			performance goal (expressed in terms of core damage frequency, large release frequency or large early release frequency, as applicable). In this context, the minimum seismic margin of the nuclear installation to ensure that the seismic performance goal is achieved, and that cliff edge effects are avoided, should be determined”. Paras. paras 6.12 and 6.13. describes how to use a graded approach in this case.			of the nuclear installation is related to the seismic design basis and the target seismic performance goal of the installation. With regard to this the seismic margin can be considered as a surrogate for the seismic performance goal. The basis for the graded approach is described in paras 6.12 and 6.13.		
280.	Canada	6.12	(b) … Either the SMA or SPSA approach may be used.	Could PSA-based SMA be used? Revision is required.		X … Either the SMA, SPSA or PSA-based SMA approach may be used depending on the objective		

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						and scope of seismic safety assessment.		
281.	Canada	6.12	(c) For selected SSCs of installations in the higher hazard category, methodologies for seismic safety evaluation as described in Section 5 should be used (i.e. no application of a graded approach).	Only SPSA should be used for high hazard category (not SMA or PSA-based SMA). Revision is required.			X	All NPPs are considered in list of a high hazard category and SMA and PSA-based SMA should not be excluded if they are suitable for objective and scope agreed with the safety authority.
282.	Germany	6.12	(a) For low hazard installations, the seismic capacity evaluation methods for the selected SSCs may be based on simplified but conservative static or equivalent static procedures, similar to those used for industrial hazardous facilities, in accordance with national practice and standards. Similarly, the seismic hazard to be used in these evaluations may be taken from national building codes and <u>seismic hazard</u> maps and does not need to be taken from a site-	Addition for clarification. Otherwise, the term "map" is unclear in this context.	X			

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			specific PSHA. If a PSHA exists, however, the seismic hazard from that study may be used.					
283.	Germany	7.2	The programme for seismic safety evaluation of an existing nuclear installation may result in a subset of the selected SSCs that do not meet the established acceptance criteria. If that is the case, then consideration should be given to ~~physical~~ technical upgrades or strengthening programmes. The decision about implementing this kind of programme should consider the potential seismic risk reduction versus the implementation costs, and the time needed for implementing technical measures with consideration of ~~at risk concept, considering~~ the remaining life of the installation.	One lesson from the Fukushima Daiichi accident was (see IAEA report 2014): "When faced with a revised estimate of a hazard that exceeds previous predictions, it is important to ensure the safety of the installation by implementing interim corrective actions against the new hazard estimate while the accuracy of the revised value is being evaluated. If the accuracy of a new hazard estimate is confirmed, the operating organization and regulatory authority need to agree on a schedule and comprehensive action plan to promptly address the method of coping with such higher hazards to ensure plant safety." This is a strong argument against a time-at-risk concept. Therefore, this expression should be omitted. Suggestion for other	X			

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				expression to consider the timing issue.				
284.	Indonesia	7.2	The programme for seismic safety evaluation of an existing nuclear installation may result in a subset of the selected SSCs that do not meet the established acceptance criteria. If that is the case, then consideration should be given to physical upgrades or strengthening programmes. The decision about implementing this kind of programme should consider optimization of the potential seismic risk reduction versus the implementation costs, and the time-at- risk concept, prioritizing safety and considering the remaining life of the installation	Safety must be prioritized physical upgrades or strengthening programmes		X "should consider the <ins>priority of potential</ins> seismic risk reduction versus the implementation costs and"		
285.	Germany	7.3	In many instances there are alternate solutions for reducing the risk to an appropriate level. These may include, for instance, the following: (a) Reducing the <ins>risk from</ins> ~~material~~ <ins>hazardous materials</ins> ~~at risk~~ to moderate or low inventory levels,	Clarification, the wording "material at risk" is not understandable. The same for 7.3(c)			X	"Hazardous materials" includes flammable and chemical materials whose release has no

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			such that less demanding performance targets can be met;					radiological consequences.
286.	Germany/ BMUV	7.3 (a)	Reducing the inventory of <u>radioactive</u> material at risk to moderate or low levels so that less demanding performance targets can be met;	Clarification. Without the addition, it is not clear what kind of material is meant.	X			
287.	Germany/ BMUV	7.3 (c)	Hardening the primary containment so that the inventory of <u>radioactive</u> material at risk — for which the unmitigated radioactive release amount was calculated — is reduced.	Clarification. Without the addition, it is not clear what kind of material is meant.	X			
288.	Germany	7.5	The risk-informed decision should look at the alternate solutions and consider both cost and the risk reduction. Options that are easy to implement and for which <u>the cost is appropriate</u> ~~there is very little cost involved~~ should be implemented. For options that are very costly and for which there is very little risk reduction, the operating organization of the nuclear installation should work with the regulatory body to determine if the costs exceed the benefits from the small amount of risk reduction.	The European Council Directive 2014/87/EURATOM of 8 July 2014 in Art 8a (2)b asks member states to ensure “the timely implementation of reasonably practicable safety improvements to existing nuclear installations”. The flavour of this paragraph is not in line with this approach that is reasonable from a safety point of view It should not be: "implement only improvements which are not expensive" but "implement	X			

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				all improvements with a relevant safety benefit which are reasonably practicable (not forbiddingly expensive)". The change in the wording is suggested.				
289.	Libya	7.5 Line 2	[….] alternate solutions and consider both cost and ~~the~~ risk reduction. [….]	Improved Clarity	X			
290.	Canada	7.6		Additional recommendations for scope completeness: suggest to add that plant modifications should be evaluated to ensure no new potential seismic interactions are introduced.		X "Potential new seismic interactions being introduced by new or modified SSCs should be assessed, and eliminated to the extent practical"		
291.	Czech Republic	7.6	Modifications to nuclear installations are required to be designed in accordance with recognized codes and standards ~~and, at a minimum, to the original design standards~~.	Original codes and standards, used during the design stage for older NPPs mostly did not include sufficiently detailed requirements for seismic assessment.			X	While we agree with the rationale, the requirement is introduced as a minimum

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				Moreover, requirements for seismic evaluation have changed during the past decades and new methods (as parts of codes and standards) were developed and accepted.				requirement and would be applicable where national regulations permit it (para. 7.7)
292.	Indonesia	7.8	The type of upgrading of existing structures or substructures depends on the additional seismic capacity that is needed. As a consequence, the effects of the upgrades on interconnected systems and components (e.g. distribution systems) should be evaluated. The upgrading of structures or substructures should not degrade the seismic capacity of the interconnected systems and components. Once the design of the final upgrade is completed, the need for a dynamic analysis to generate new in- structure response spectra and displacements should be evaluated.	It must be ensured tthat any modification to structures or substructures may not degrade the level of installation seismic safety		X “As a consequence, the effects of the upgrades on interconnected systems and components (e.g. distribution systems) should be evaluated, such that the upgrade should enhance and not degrade the overall seismic safety of the facility.”		The requirement includes an evaluation of this effect and a re-assessment of updated demands vs. capacity if necessary

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293.	Germany	7.9	The type of upgrading of existing systems and components also depends on the additional seismic capacity that is needed. Generally, the following types of upgrading of SSCs should be considered: … (c) Upgrading of electromechanical relays, ~~to~~ for models with larger seismic capacity. (d) Upgrading of critical components, ~~to~~ for models with larger seismic capacity	Clarification		X ".. to models with"		
294.	Germany	7.10	~~An important consideration is to prioritize the upgrades based on contribution to the risk reduction of the installation on a cost-benefit basis.~~	The cost-benefit analysis is already covered by paragraph 7.5. With the repetition, which by the way does not fit under the heading "Design of modifications …", the cost aspect gets a wrong emphasis in the context of a Safety Guide. Therefore, the paragraph should be deleted.		X "is to prioritize the selection between upgrade design solutions based on the relative risk reduction to the installation in addition to cost."		The scope of Paragraphs 7.5 and 7.10 are different. Edited 7.5 to clarify.
295.	Canada	7.11		Additional recommendations for scope completeness: maintenance procedures should also be considered in		X "Existing procedures for		

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				this context (in addition to inspection procedures).		the inspection and maintenance of SSCs..”		
296.	Germany	8.1	The management systems for nuclear installation ~~*each of the organizations involved in the seismic safety evaluation*~~ should be established and implemented before the start of the seismic safety assessment ~~evaluation~~ programme [22], [23]. The management system is required to cover all processes and activities of the seismic safety assessment ~~evaluation~~, in particular, those relating to data collection and data processing, field and laboratory investigations, and analyses and evaluations that are related to ~~within~~ the scope of this Safety Guide. It is also required to cover ~~those~~ processes and activities corresponding to the upgrading phase of the assessment programme.	Clarification. Inter alia references [22] and [23] cope with management systems for nuclear facilities and activities.		X The management systems for nuclear installation should be established and implemented before the start of the seismic safety evaluation programme [22], [23]. The management system is required to cover all processes and activities of the seismic safety evaluation, in particular, those relating to data collection and data processing, field and laboratory		

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						investigations, and analyses and evaluations that are related to the scope of this Safety Guide. It is also required to cover processes and activities corresponding to the upgrading phase of the assessment programme.		
297.	Germany	8.2	Owing to the variety of investigations and analyses to be performed and the need for engineering judgement by the team implementing the seismic safety assessment ~~evaluation~~, technical procedures that are specific to the project should be developed to facilitate the execution and verification of these tasks and they should be covered by the management system as well.	Clarification.		X Owing to the variety of investigations and analyses to be performed and the need for engineering judgement by the team implementing the seismic safety evaluation, technical procedures that		

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						are specific to the project should be developed to facilitate the execution and verification of these tasks <u>and they should be covered by the management system as well.</u>		
298.	Germany	8.3	A peer review of the implementation of the seismic safety ~~evaluation~~ <u>assessment</u> methodology should be performed <u>and documented</u> <u>in the management system.</u> In particular, <u>for facilities</u> <u>with a high hazard potential</u> the peer review should assess the elements of the implementation of the SMA, SPSA or PSA-based SMA methodologies against the recommendations of this Safety Guide and current international good practices used for these evaluations. <u>For facilities with a lower hazard potential</u> <u>the peer review can be carried out</u> <u>using a graded approach.</u>	The requirements in para 8.3 are tailored for nuclear power plants, but too detailed and too strict for nuclear installations with a lower hazard potential. This should be clearly formulated in the current para. The same is for para 8.4.		X A peer review of the implementation of the seismic safety evaluation methodology should be performed and documented in the management system. In particular, [….] 1.1. A new		The requirements related to management system are applicable to all nuclear facilities and activities and cannot be restricted to high hazard installations. Application of requirements can be graded.

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						para 8.5 is added related to application of graded approach "A graded approach should be used for the application of management system for nuclear installations other than nuclear power plants to cover process and activities of the		

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						seismic safety assessment, development of technical procedures for the specific tasks to facilitate and verify these tasks and peer review of the implementation on seismic safety assessment etc. In general, application of management system		

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						requirements should be most stringent for nuclear installations with high hazard category and for the nuclear installations with a lower hazard category, application of management system requirements may be the least stringent		

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						[24]".		
299.	Germany	8.4	For facilities with a high hazard potential t~~T~~he peer review should be conducted by experts in the areas of systems engineering, operations (including fire prevention and protection specialists), earthquake engineering and other specialists depending on the focus of the seismic evaluation. Peer review should be performed at different stages in the evaluation process, as follows: (a) The review of systems and operations should be performed first, coinciding with the selection of the success paths for SMA or the tailoring of the internal event system models for the SPSA or the PSA-based SMA. (b) Seismic capability peer reviews should be performed (i) during and after the walkdown, and (ii) after a majority of the HCLPF values (for SMA or PSA-based SMA) or fragility functions (for SPSA) for the SSCs have been calculated. The seismic capability	As in para 8.3, the requirements in para 8.4 are tailored for nuclear power plants and are too detailed and too strict for nuclear installations with a lower hazard potential. This should be clearly formulated in the current para.		X [….] The findings of the peer reviews should be documented in the management system. Resolution is similar with above mention question for para 8.3.		

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			peer review should include a limited plant walkdown, which may coincide with a part of the plant walkdown or may be performed separately. For facilities with a lower hazard potential a graded approach can be used. The findings of the peer reviews should be documented in the management system.					
300.	Libya	8.4 Line 2	[….] earthquake engineering , and other specialists depending on the focus of the seismic evaluation. [….]	Improved grammar	x			This terminology is ised in technical; language
301.	Libya	8.4 Line 8	. [….](i) during and after the ~~walkdown~~, walk down,. [….]				x	The term walkdown is used in different IAEA standards.
302.	Canada	8.6	(i) Summary of seismic failure functions for ~~front-line~~ accident mitigation and support systems modelled, including identification of critical components, if any, for the SPSA; (j) Walkdown report summarizing findings and ~~system wide~~ observations, if any;	Uncommon terminology used.		X (i) [….] for prevention and mitigation including the front-line system and support systems modelled in SPSA,		

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						including identification of critical components, if any, for the SPSA;		
303.	Germany	8.6	(g) A table of selected SSC items with the results of screening process (if any), failure modes, seismic demand, HCLPF values (for the SMA and PSA-based SMA) and fragility functions (for the SPSA) tabulated;	In order to make the text more reader-friendly it recommended to clarify what exactly is meant by "screening" in this case: - capacity screening (para 5.30), - screening-based capacity evaluations (para 5.45), or - screening process, which is used prior to categorizing a nuclear installation (para 6.6). The same for para 8.7	X			
304.	Germany	8.7	(c) Detailed documentation of all walkdowns performed, including SSC identification and characteristics, results of screening process (if appropriate), spatial interaction observations for the seismic system, and area walkdowns usually performed for systems such as cable trays and small bore piping, and to evaluate	As for para 8.6: in order to make the text more reader-friendly it is recommended to clarify what exactly is meant by "screening" in this case: - capacity screening (para 5.30, - screening-based capacity evaluations (para 5.45), or	X			

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			seismic induced fire or flood issues;	- screening process, which is used prior to categorizing a nuclear installation (para 6.6).				
305.	Germany	8.8 And Title bevor	Management of modifications ~~CONFIGURATION MANAGEMENT FOR SEISMIC SAFETY EVALUATION FOR NUCLEAR INSTALLATIONS~~ 8.8. The operator should implement management of modifications ~~a configuration management programme~~ to ensure that, in the future, the design and construction of modifications to SSCs, the replacement of SSCs, maintenance programmes and procedures, and operating procedures do not invalidate the results of the seismic safety evaluation.	If configuration management programme means "Management of modifications", please change this respectively in the title and in the text of para 8.8 as well, in order to stay in line with IAEA Terminology. Additionally, in the Title the part "… FOR SEISMIC SAFETY EVALUATION FOR NUCLEAR INSTALLATIONS" should be deleted, as it is not appropriate in this case. Additionally, in para 4.8 the term "maintenance rule programme" is used, as we understand for the same purposes. Please make the terminology consistent.	X			
306.	Germany	REFEREN-CES		There is a duplication of the list of references. One set of references should be deleted			X	No duplication found

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				after checking which one is the more actual and correct one.				
307.	Germany	Ref. [7]	SSG-9 Rev. 1, IAEA, Vienna, 20~~10~~ 22	Please update/replace	X			
308.	Germany	Ref. [12]	~~In preparation.~~ 2021.	Please update/replace	X			
309.	Germany	Ref. [13]	… «Seismic Design of Nuclear Installations,» IAEA Draft Safety Standard SSG-67 ~~DS490~~, Vienna, 2021	Please update/replace	X			
310.	Germany	Ref. [24]	[24] INTERNATIONAL ATOMIC ENERGY AGENCY, ...	Reference [24] - NS-G-1.5 - included in A.27 (b) is missing in the list of references. Please add as the revision of NS-G-1.5 which has been published as SSG-68 in 2021	X			
311.	Israel	References [12], [15] [16], [21]	Four references ([12], [15[, [16] and [21]) in the present Guide are marked as "***In Preparation***". The technical officers and/or contributors working on DS522 and on preparation of those four references, will have to pay attention to possible effects of those revision on DS534 itself (checking for consistency).	Completeness	X			
312.	Israel	References	a) The list of REFERENCES appears twice in the present Draft. b) Reference [7], SSG-9, Seismic	a) Typo	X			Thank you. The reference to SSG-9 should

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			Hazards in Site Evaluation for Nuclear Installations is quoted numerously in the present Guide. Since it was revised in 2022, its publication date has to be changed in the references list (from 2010 to 2022).	b) Editorial				be replaced by a reference to SSG-9 (Rev. 1). The latter had not been published at the time the draft was prepared.
313.	Russia Gidopress	**REFERENCES/** 15-16	[8] INTERNATIONAL ATOMIC ENERGY AGENCY, Seismic Design and Qualification for Nuclear Power Plants, Safety Guide **NS-G-1.6**, IAEA, Vienna, 2003. shall be replaced with **SSG-67**	According to the information on IAEA site www.iaea.ore document **NS-G-1.6** has been replaced with **SSG-67**	X			Thank you. The references to NS-G-1.6 and DS490 should be replaced by a reference to SSG-67. The latter had not been published at the time the draft was prepared.
314.	Russia Gidopress	5.17/7	-	It is necessary to define the term **“abnormal condition”** and add this definition to Safety Glossary [11]			X	Abnormal conditions is used in Safety Glossary already also Associated to abnormal operation or in the definition

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								of cliif edge effect. The TO cannot make changes to the Safety Glossary.
315.	Canada	Appendix	SEISMIC FAILURE MODE CONSIDERATIONS FOR ~~DIFFERENT~~ STRUCTURES, SYSTEMS AND COMPONENTS IN NUCLEAR INSTALLATIONS	All sections require language corrections, review by technical writer recommended. Emergency Mitigation Equipment (EME), also called flexible mitigation strategies (FLEX) for US applications, should be covered in this Appendix.	X			
316.	Germany	Appendix A.5	Mechanical equipment in nuclear installations typically includes process equipment, pumps, tanks and heat exchangers, fans and air handlers, and valves. The review of their seismic capacity should include the quality of anchorage, support structure, mounting configuration, equipment construction, and the ability of the equipment to function. Some damage to the equipment is tolerable if it does not compromise its ability to perform its credited	Usually, for pressure retaining mechanical components a differentiation is made between - integrity, - leak tightness, and - function (with distinction between function during or after the seismic event). This should be reflected in this Appendix of the Safety Guide.		X Edited to Some damage to the equipment is tolerable if it does not compromise its ability to perform its credited function (e.g. active function, leak-tightness, or structural		

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			function. The functional assessment includes time considerations (e.g. whether the component is needed to operate during or after the earthquake shaking and the duration of that operation without outside support) and also the type of function required (integrity, leak tightness and/or active function). It should also include an assessment of potential seismic interactions and the flexibility of attached distribution system lines.			integrity)."		
317.	Israel	Appendix I A.14 and also 5.30 (b)	The need to restrain batteries is mentioned in paragraphs A.14 and 5.30 (b). We suggest to considering the addition of a remark (footnote?) mentioning the hazards of possible spill/splash of acid from batteries damaged due to seismic hazards, possible damage to nearby (safety related) electric systems and ways to prevent spilled acids from reaching and damaging such systems.	Completeness		X Added sentence to A.14.	X	Yes, this is a potential seismic spatial interaction effect, but note that the main reason to restrain the batteries is to preserve the electrical connections between individual units. In addition,

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								safety-related battery rooms in nuclear plants do not usually house other safety-related equipment, and floors and walls of the room are protected by ceramic tiles (or equivalent) against accidental acid spillages.
318.	Germany	Appendix A.21 Line 8 (last line)	… to spray-sensitive SSCs. Consideration should also be given to overhead rainwater drainage lines, whose failure might affect safety relevant electric equipment by ingress of rainwater.	Operating experience shows that in existing plants rainwater drainage lines could be installed in a manner that a leakage could affect items important to safety.		X Edited to "The review of seismic-flood and seismic-spray interactions should consider the seismic vulnerabilities of the fire protection systems, overhead		

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						rainwater drainage lines, and other non-ductile piping"		
319.	Canada	A.26	(a) Settlement of structure foundations due to liquefaction, groundwater drawdown, or dry sand ~~settlement~~ compaction may result in failure of buried distribution systems at the interface with the structure;	Groundwater drawdown is one of the main causes for foundation settlement and should be included.	X			
320.	Canada	A.27	~~The seismic slope stability and displacement capacity to trigger a landslide~~ Seismically induced slope instabilities that could affect the nuclear installation site should be explicitly evaluated. ~~The~~ Their consequences ~~of this landslide~~ on the safety-related functions should be assessed considering the slope discharge along the ~~landslide~~ slope failure path and the distance to the installation.	All seismically induced slope failure scenarios should be evaluated (see comment 19). It is recommended to use seismically induced slope instabilities rather than a landslide here.		X Clarified to: The seismic stability of adjacent geographic features e.g. slopes that can trigger a landslide or rockfall event that could affect the nuclear installation site should be explicitly evaluated. Their consequences on the safety-related functions	X	Slope instabilities within the installation are addressed in A.26. A.27 addresses failures that happen outside the installation but may have consequences far-reaching enough to affect the installation safety

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						should be assessed considering the discharge along the failure path and the distance to the installation.		
321.	Canada	Reference [A.2]		Suggest using the latest version (ASCE 43-19 has been published).	X			
322.	Germany	Annex, Table A-1	*Please check the Note "a" as well as subscripts in seismic design classes 1[a] and 2[a]*	We suggest deleting the current (a) in order to be in line with table A-2.			X	Table A-1 is taken directly from reference [A-1]. We cannot make any change in this table.
323.	Germany	Annex, Table A-1	*Please check the Note "a" as well as subscripts in seismic design classes 1[a] and 2[a]*	We suggest deleting the current (a) in order to be in line with table A-2.			X	Table A-1 is taken directly from reference [A-1]. We cannot make any change in this table.

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