DS490 Seismic Design of Nuclear installations, Draft 17th September 2018, STEP 7

COMMENTS BY REVIEWER Reviewer: M. A GAHEEN Page.... of.... Country/Organization: Egyptian Atomic Energy Authority (EAEA) Date:26th October 2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
	Pages (2, 7, 14, 22, and 28)	It is proposed to use design extension conditions instead of **beyond design basis** in DS490 (beyond design basis earthquake conditions, Beyond Design Basis Earthquake, ...)	The term **beyond design basis accidents** was replaced by **design extension conditions.** Using the term of Beyond Design Basis in DS490 well not be consistent with Ref 1 and other IAEA NSS and may be confusing.	Y	Beyond Design Basis Earthquake is not counted as an accident condition of the plant, thus it is not a synonym to DEC. It designates the severity of the seismic hazard to be used for seismic margin assessment or seismic safety evaluation. To avoid confusion "Beyond Design Basis earthquake Conditions" was replaced with "Beyond Design Basis Earthquake BDBE".		

	2.1	It is proposed to add **Requirement 59: Provision of instrumentation** to main overarching and supporting safety requirements should be applied for design of nuclear installations to cope with the effects generated by earthquakes: ……. **Requirement 59: Provision of instrumentation** **Instrumentation shall be provided for: determining the values of all the main variables that can affect the fission process, the integrity of the reactor core, the reactor coolant systems and the containment at the nuclear power plant; for obtaining essential information on the plant that is necessary for its safe and reliable operation; for determining the status of the plant in accident conditions; and for making decisions for the purposes of accident management.** **6.31.** Instrumentation and recording equipment shall be provided to ensure that essential information is available for monitoring the status of essential equipment and the course of accidents, for predicting the locations of releases and the amounts of radioactive material that could be released from the locations that are so intended in the design, and for post-accident analysis.	1. Seismic instrumentation should be installed at any nuclear installation. 2. Safety-related process instrumentation (temperature instrumentation, pressure transmitters, ….) should be designed and seismically qualified per standards to demonstrate that they can withstand a seismic event, and continue to provide reliable service under post accident conditions.			X	External hazards are covered by Requirement 17, paragraphs 5.15A and 5.17 to 5.21A of SSR-2/1 (Rev.1). We listed those requirements that explicitly talk about considerations of external hazards, including seismic design.

	4.40 Page 26	It is proposed to add new title/header to section 4 headers, namely INSTRUMENTATION AND CONTROL DEVICES to include 4.40 (change to 4.43) The design should ensure functionality of the instrumentation and control devices to avoid spurious signals during the seismic shaking (belong to ELECTRICAL EQUIPMENT) and new text 4.44 Safety-related process instrumentation should be designed and pass tests to demonstrate that they can withstand a seismic event, and continue to provide reliable service under post earthquake conditions.	1. More relevant than to be belong to ELECTRICAL EQUIPMENT (as it is in **DS490)**. 2. Safety-related process instrumentation should withstand a seismic event, and continue to provide reliable service under post earthquake conditions.	Y	The Heading was changed to "ELECTRICAL EQUIPMENT, CONTROL AND INSTRUMENTATION". Seismic qualification of safety related C&I is covered by 4.36 f), 4.39, 4.40 and Section 6. Seismic category (where qualification requirements are derived are defined in Section 3 SEISMIC CATEGORIZATION FOR STRUCTURES, SYSTEMS AND COMPONENTS		

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COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: M-L Järvinen			Page.... of....				
Country/Organization: STUK			Date:24th October 2018				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
	2.3	2.3. It should be kept in mind that the design of a nuclear installation against ~~the effects of an earthquake~~ seismic hazards is a measure to comply with the fundamental safety principle of prevention of accidents and to mitigate the effects of nuclear and radiation accidents. An earthquake generates effects which may lead to serious challenges to the multiple layers of defence in depth.	In the draft text there is confusion on prevention and mitigation accidents. In the last sentence of the draft paragraph there is a grammatical inconsistency. In addition, it would be better to use the term "seismic hazards" in the sense of SSG-9, and not for the effects generated by an earthquake.	Y	We changed Earthquake or Seismic hazards to Seismic events. Seismic hazards designate the likelihood of occurrence of an earthquake exceeding given severity typically characterized by frequency of exceedance. Seismic Event designed potential impact of the seismic hazard that can be translated in loads, displacements, strains, etc.		
	3.13 a)	… horizontal layers ..	instead of … horizontally layers …	Y			
	3.27	… main control room …?	… main room …	Y	Uncertainties always exist in		

		The text "within the uncertainty of the determined DBE values" should be omitted.	BDBE is related to the exceedance of the DBE. If the DBE is determined on the basis of PSHA and a given exceedance frequency, the DBE can be exceeded even though there were no uncertainty. In addition, the one standard deviation uncertainty of DBE may be very high in some areas and the requirement might be very strict. If the topic is treated in the Guide its should be done clearly in connection with the determination of BDBE in paragraph 3.31, not in a subordinate clause, In Para 3.27 the use of early or large releases is confusing. Also "shall" should not be used in safety guides. the acceptance criteria should be those defined for cliff edge effects. For such earthquake level, noted as Beyond Design		Seismic Hazard Assessments and are considered in the definition of SL-2 or DBE. They reflect the incomplete knowledge related to earthquake sources parameters and ground motion prediction equations. "Large release or an early release" in this paragraph are necessary because this paragraph links this safety guide to the Paragraph 5.21A of the safety requirements SSR-2/1 (Rev.1), published in 2016. The term is defined in IAEA Safety Glossary. "Shall" was replaced with "should"		

			Basis Earthquake (BDBE), the design shall provide for an adequate safety margin for those SSCs ultimately required for preventing an early radioactive release or a large radioactive release, complying with mitigation measures required to fulfil SSCs involved in Level 4 of the defence in depth concept and the main room of the installation, as well as to avoid the cliff edge effects within the uncertainty of the determined DBE values.				
	3.28		Please ensure that the text will be consistent with modified 3.27.	Y			
	3.33	All SSCs … as part of the design process …	"All" instead of "The whole sets" Instead of "at the beginning of the seismic design process". The formulation in the current guide is more appropriate, considering possible refinement of the categorization and	Y			

		The text " .. to assign them specific levels of vibratory ground motion… " should be reformulated.	interaction with the general design process. Seismic categorization is about identifying the items for which seismically induced vibrations shall be taken into consideration in the design, not about assigning items specific levels of vibrations.				
	3.40	… whose structural failure or failure to perform the intended functions …	Structural failure should be mentioned in addition to functional failure.			X	Structural failure is covered by "whose failure to perform the intended functions"
	6.24.	Seismic tests <u>performed by a competent testing organization</u> may be performed on the item itself or on a full-scale model or, where appropriate, on reduced scale models. For qualification purposes, the component itself or a full-scale model should be tested without any simplification. However, if there is no other practical alternative, a properly justified use of a reduced scale model may be permitted for qualification purposes.	Please add. performed by a competent testing organization The competence of the testing organization should be included.	Y	paragraph deleted (is redundant to other paragraphs)		

Draft Safety Guide DS490, "Seismic Design of Nuclear Installations",
Status: STEP 7, Version dated 17 September 2018

COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 10 Country/Organization: **Germany** Date: 26.10.2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	2.3, line 4	It should be kept in mind that the design of a nuclear installation against the effects of an earthquake is, precisely, a measure to comply with the fundamental safety principle of prevention of accidents, through providing all practical efforts to prevent and mitigate nuclear or radiation accidents. ~~An~~ e<u>E</u>arthquake<u>s</u> ~~effects~~ generate seismic hazards which may lead to serious challenges to the multiple layers of defence in depth.	Clarification	Y	2.3. It should be kept in mind that the implementation of the relevant safety requirements in the design of a nuclear installation against the effects of an earthquake is aimed to comply with the fundamental safety principle of prevention of accidents. Seismic events can lead to a serious challenge to multiple layers of defence in depth, through common cause effects.		

2	3.19, line 7	[…] in order to fulfil the different needs of ensuring the safety of the installation in case of a severe ~~extreme~~ rare earthquake and of ensuring the possibility of continued operation for a less severe but more probable earthquake event. […]	To improve consistency severity AND occurrence frequency should be mentioned in both cases.	Y			
3	3.26, line 3	[…] In that regard, considering (i) the advances on the developments of new design of nuclear installations, (ii) the uncertainties in the seismic hazard assessment ~~and the constant increase of such seismic hazard values~~, […]	The second part of (ii) could be read as if the seismic hazard was in fact increasing, whereas it is (probably) meant that the thorough consideration of uncertainties leads to higher hazard estimates. To avoid such a misunderstanding, it is proposed to delete the second part of (ii).	Y			
4	3.26, line 2	[…] In that regard, considering (i) […], (ii) […], (iii) the effectiveness in terms of cost and technical provisions of providing a high level of assurance against the seismic hazards from the conception phase of the installation, ~~and (iv)~~ the minimum level for seismic design should correspond to a peak ground acceleration of 0.10g, and not less than values established by the national seismic codes for conventional facilities, to be	The current item (iv) is not an additional aspect to be considered but the consequence from the considerations in (i) to (iii).	Y			

		considered at the free field ground surface.					
5	3.27, line 3	[…] For such earthquake level, noted as Beyond Design Basis Earthquake (BDBE), the design shall provide for an adequate safety margin for those SSCs ultimately required for preventing an early radioactive release or a large radioactive release, complying with mitigation measures required to fulfil ~~SSCs involved in~~ requirements for Level 4 of the defence in depth concept and the main control room of the installation, as well as to avoid the cliff edge effects within the uncertainty of the determined DBE values.	The general intention of this paragraph seems clear. But in particular the second part is difficult to understand and would benefit from reformula-tion – we made a suggestion.	Y	Wording changed to accommodate comments done by another member state.		
6	3.30, line 3	[…] In this regard, the evaluation performance criteria recommended in Ref. [3] for RLE level affecting an existing nuclear installation may be applied, as indicated in the objectives of such Safety Guide. Similar ~~and using the recommended~~ methodologies to evaluate performance against BDBE event shall be used ~~and that may be~~ based on best estimate parameters for calculating the seismic demand and the seismic capacity, i.e., relaxed from those used in design methods and acceptance criteria.	The general intention of this paragraph is clear. However, the second part is difficult to understand and would benefit from reformulation.	Y	We cannot use "Shall "statement in a Safety Guide. Text related to existing nuclear installations was deleted (out of scope)		

7	3.38	~~The p~~ Physical barriers designed to protect the installation against the effects of external events other than seismic events (e.g. fires or floods) ~~should remain functional and maintain their integrity during an SL-2 earthquake level, thus they should be included in the list of Seismic Category 2~~.	As physical barriers belong to the SSCs that should be included in Seismic Category I (as stated in the current para. 3.28), they should be listed as item f) in para. 3.27.	Y	Flood and fire barriers should not be disabled by earthquake since earthquake induced flood and /or fire can happen.		
8	4.8 e)	It is recommended that detailing of structures should favor ductile failure modes in opposition to brittle failure modes. In this regard, the following should be considered: …. e) Structural joints, particularly in reinforced concrete structures, should be designed ~~to provide~~ to accommodate large displacements and rotations; […]	Clarification	Y			
9	4.15	The seismic design of engineered (human made) earth structures and buried structures ~~that are relevant to the safety of the nuclear installation~~ should be consistent with the seismic design category~~. These recommendations should be also consistent with~~ and guidance provided in Ref. [6].	The seismic design of SSCs should always be consistent with the seismic design category. Thus, “that are relevant to the safety of the nuclear installation” should be deleted. Then the paragraph can be simplified by connecting	Y			

			the second sentence to the first.				
10	4.18 line 4	[…] As a basic rule, the horizontal stiffness of the isolators should be chosen so that the fundamental vibration ~~period~~ frequency of the isolated structural system is significantly lower than that of the original, non-isolated, structure.	The effect of a base isolation is to lower the natural frequency of the structure by reducing its stiffness.	Y			
11	4.22 New item	The design of the isolation system should have the following goals: ….. (g) Avoiding negatives effects on the protection against other external hazards.	Seismic base isolation systems may have negative effects on the control of other external hazards (e.g. horizontal loads due to aircraft crashes or tsunamis). Therefore, it is recommended to include a corresponding item (g) in the bullet list.	Y			
12	4.46, line 1	In accordance with accepted engineering practice, seismic design ~~of seismic design~~ of HVAC ducts in nuclear installations is usually done by analysis, […]	Clarification	Y			
13	5.4 b)	The analysis model should adequately represent the behaviour of the structure under the seismic action, ~~taking~~ considering properly the inertial and stiffness distribution of the structure;	Clarification	Y			

14	6.12 c)	The seismic demand on SSCs may be computed using linear equivalent static analysis, linear dynamic analysis, complex frequency response methods or non-linear analysis, depending on the relevance of the particular component and on the national practice. Regardless of the method: ….. c) The important natural frequencies of the SSC should be estimated, or the peak of the design response spectrum multiplied by an appropriate factor <u>> 1</u> should be considered as input. Multimode effects should be considered too; …..	From the text it is not clear whether the "appropriate factor" could also be < 1. (Probably a factor > 1 is intended.) The allowable range of factors should be clearly stated.	Y			
15	6.31, line 9	~~The combined analysis and testing methods should be used to justify extrapolation of test results on connected cabinets to qualify a multi-cabinet assembly.~~ <u>e)</u> Development of an analytical model with modal frequencies, damping, etc., verified by testing of a typical component, enables the effects of component configuration variations to be analytically simulated. ~~It might be impractical to test a multi-cabinet assembly of similar cabinets due to~~	The first sentence is already covered by para. 6.31 a) and the last sentence gives the reason why this might be necessary. Thus, both sentences can be deleted. The remaining (more general) sentence could then become item e) in the bullet list.	Y			

		~~limitations in the size of testing facilities.~~					
16	7.1	Seismic robustness is expressed by seismic margin capacity which defines the capability of a nuclear installation to achieve certain performance for seismic loading exceeding the site-specific seismic hazard. ~~those corresponding to SL-2~~. Seismic margin should be provided by conservatism associated to definition of SL2, application of the nuclear safety requirements and applicable nuclear design codes.	The first sentence defines margins via the seismic capacity beyond SL-2, whereas the second sentence recommends (amongst others) a conservative definition of SL-2 to achieve this. This leads to a contradiction as doing as recommended in sentence two reduces the margins as defined in sentence one. Therefore, reference to SL-2 should be avoided in sentence one. If SL-2 would be used as a baseline for defining robustness and seismic margins, a hypothetic plant "A" with an SL-2 corresponding to seismic loads with an exceedance frequency of 10-3/a and a certain seismic margin with respect to this baseline would have to be considered safer or more in line with the			x	There is no contradiction because of the following reasons: - Seismic margins are calculated against seismic design level (SL-2) using different criteria those used in the design. - The source of seismic margins is (a) in conservatism associated to DBE/SL2 and (b) in conservatism associated with design acceptance criteria (nuclear design codes and standards).

			requirements of this safety guide than a plant "B" with an SL-2 corresponding to seismic loads with an exceedance frequency of 10-5/a and a somewhat smaller seismic margin (compared to plant "A") with respect to this baseline. To avoid punishing a conservative definition of SL-2, margins should always refer to the site-specific hazard as a baseline not the SL-2.				
17	7.6, footnote 25	~~In many Member States the adequate seismic margin (at facility level) is defined by HCLPF > 1.5x SL-2.~~	There are two problems with the footnote: 1) As explained in Comment 16 referring to para. 7.1, relating margins to SL-2 is not recommendable. 2) To my knowledge, at least in Europe, there are not many countries that specify quantitatively in their regulations what "adequate seismic margins" are. Considering both problems deleting the			x	SL-2 represent the design level incorporating design conservatism. Seismic Margins is calculated having as reference seismic design. RLE (BDBE) used in seismic margins does not represent simply scaling of the SL-2. Part of design conservatism associated to SL2

			footnote would be appreciated.				must be removed (see NS-G-2.13). IAEA recommend defining adequate seismic margin to be linked to seismic performance that satisfy requirements 5.21 and 5.21A of SSR 2/1. The footnote represents the practice at international level, including many EU countries.
18	7.10	The facility level seismic margin (HCLPF) should be compared with the adequate seismic margin defined ~~in~~ <u>according to</u> paragraph 7.6 or established by the national regulatory body.	Para. 7.6 does not specify an adequate margin but describes how an adequate margin should be defined. The text of para. 7.10 should be reformulated to reflect this.			x	The understanding of adequate margin is related to seismic performance goals, which requires reference to probabilistic understanding and the seismic PSA method. Since there is a strong correlation between severity of the seismic hazard selected for seismic design basis (SL2),

							seismic margin and seismic performance expressed in CDF and LERF para 7.6 clear specify what means adequate seismic margin. The footnote said that if HCLPF > 1.5 SL2 the seismic performance target is achieved (based on past S-PRA experience)
19	8.1, line 4	[...] The site specific seismic instrumental data are required for various purposes, ranging from helping in the assessment of the seismic hazard at the site to recording the actual seismic ~~response of~~ loads on SSCs, in the event of a felt earthquake, [...]	The seismic instrument-tation does typically not record the *response* of *systems and components* to earthquake induced vibrations. Another alternative would be: "[...] recording the actual seismic response of ~~SSCs~~ structures and the free-field ground motion, in the event of a felt earthquake, [...]"	Y	The whole sentence starting with Site specific was deleted – based on comments made by another MS.		
20	8.1 c)	To provide triggering mechanisms for the automatic shutdown of the nuclear installation in case that the earthquake exceeds a defined threshold level, if applicable.	Whether an automatic shutdown triggered by the seismic instrumentation is advisable depends on site- and plant-specific conditions. To avoid that this bullet point is read as	Y			

			an implicit recommend-dation to have such an automatism, it should be slightly modified.				
21	new para. after 8.9	Besides providing cumulative damage indicators, the seismic instrumentation should allow an easy comparison of the response spectra of the actual seismic event with the design basis response spectra.	Notwithstanding the importance of cumulative damage indicators, also an exceedance of the design spectra in certain frequency ranges might be important from a safety point of view (cf. para. 8.14). Therefore, also such exceedances should be easy to identify.	Y			
22	8.12	In addition, the Post-Earthquake Action Programme should be comprehensive enough to minimize the likelihood of prolonged plant shutdowns following seismic ground motions that do not damage SSCs important to safety. ~~In all cases~~ For earthquakes well below the design basis levels SL-2 and SL-1, primary emphasis is on the physical and functional conditions of the installation, as opposed to analytical evaluations. In some cases, confirmatory analytical evaluations may be performed while the installation is in operation after restart.	Safety should always be the primary focus. As a component or system that is seemingly okay (i.e. functioning and showing no external signs of damage) after being exposed to an exceptional load (such as an earthquake) may nevertheless be significantly damaged and fail after some further operation / load cycles (a well-known phenomenon in other industries, e.g. aviation) analytical	Y			

			evaluation might be necessary to ensure safe operation. Therefore, the statements in para. 8.12 should be clearly limited to weak earthquakes.				
23	9.3	**Remarks to bullet list**	Currently the bullet list of para. 9.3 is not consistent with the corresponding list (para. 9.5) in DS 507. It should be ensured that both lists are consistent in the final versions of the corresponding documents.	Y	Para 9.3 covers the ones from DS507 except consideration of the site characteristics which are included in "Potential of on-site and off-site radiological contamination"		
24	10.5, line 7	Previously proven designs <u>need</u> ~~should~~ not be subject to verification unless they are intended for different applications or the performance criteria are different.	Safety should always be the primary focus. As an additional verification does not impair safety, it should not be excluded.	Y			

COMMENTS BY REVIEWER **Reviewer:** AERB **Country/Organisation** : India			**Page ….of ….** **Date**: 26/10/2018	**RESOLUTION**			
Comment No.	**Page/ Para/Line No.**	**Proposed text**	**Comments/Reason**	**Accepted**	**Accepted, but modified as follows**	**Rejected**	**Reason for modification / Rejection**
1	Chapter-3 Page-8	*Add following in Chapter 3, in General Concepts of Seismic Design:* *For plant structure, systems and components sensitive to low frequency motions (Eg. SSCs on isolators), time histories/ response spectra should be examined and, if necessary, modified to take related effects into account.*	The latest draft discusses seismically isolated structures which are very sensitive to low frequency motions In view of this it is felt that, Chapter-3 which discusses input for seismic design need to incorporate special requirements on ground motion characteristics to be considered for structures on isolators	Y	The text was added to the former Paragraph 3.26 (in the revised version, paragraph 3.27), under subsection Determination of the Design Basis Earthquake (DBE).		
2	4.16.	c) Site contour: retaining walls, ~~*natural slopes,*~~ cuts and fills.	The section discusses ‘engineered earth structures’. The natural slopes mentioned in item (c) may be dropped as it	Y			

			is not an engineered earth structure.				
3	3.15	*Modify as follows:* • Type 1 sites: *Vs* > 1100 m/s; • Type 2 sites: *Vs* < 1100 m/s; • ~~Type 3 sites: 300m/s > *Vs*;~~	Three categories of sites are specified in the draft.. However, detailed guidance is provided only for two types of sites, one with sites having Vs>1100m/s and second where sites have Vs <1100 m/s. No specific guidance is included for type 3 sites (Vs<300m/s). Hence it is suggested that classification can be reduced to just two groups as suggested, or guidance, as appropriate for sites with Vs<300m/s can be added.	Y	The following text was added: Type 3 sites (soft soil conditions) require detailed studies and site response analysis as described in Ref. [5].		

4	3.16	*Add following after section 3.16:* *Heterogeneity of the soil should be captured appropriately by using at least 60 randomized shear wave velocity profiles paired with 60 sets of randomized shear modulus and damping curves (i.e., one shear velocity profile with one set of modulus reduction and damping curves).*	The proposed approach for development of free-field motion from site response analysis requires convolution of bedrock hazard curves using compatible time histories to free field. These simulations need to capture inherent variability in subsurface strata and associated parameters. Hence a minimum number of simulations would be required, which as per international regulations is of the order of 60 profiles/simulations.			x	This level of details is not appropriate for the Safety Guide.
5	3.16	*Add following after section 3.16:* *Maximum material damping value of soil shall be limited to 15 percent.*	The material damping of soil shall be limited to be in line with values that is generally observed and adopted internationally.			x	This level of details is not appropriate for the Safety Guide.

	3.16	*Add following after sections 3.16:* *While adopting analysis using nonlinear time domain method, the input time history should have sufficiently small time increment and material models should be compatible with strain dependent shear modulus and damping curves. The spatial discretization of domain should be selected based on the maximum frequency of interest.* *The spectra of these time histories should be compared with fundamental frequency of soil to ensure that the spectra has sufficient energy content at the natural frequency of the site.*	The convolution approach for SRA requires many number of simulation using multiple real THs. The requirement of time histories with respect energy content in the fundamental frequency shall also be included. (A separate section for specification of THs can be added. This should reflect THs requirements for both time domain and frequency domain)			x	This level of details is not appropriate for the Safety Guide.

6	3.16	*Add following after section 3.16:* *In the case of site response analysis adopting equivalent linear frequency domain method, strain level up to which the method is valid should be established.*	The equivalent linear frequency domain analysis for site response analysis is not adequate/accurate when soil is subjected to high strain conditions. Hence in site response analysis, applicability of these methods should be limited to lower strains.			x	This level of details is not appropriate for the Safety Guide.

Japan NUSSC Comments on DS490, "Seismic Design of Nuclear Installations"

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	General	This draft seems to be mainly focusing on low-to-medium seismicity countries, and some of the parts may not applicable for higher seismicity countries. Note that the most of the following comments are based on this observations.		Y	Paragraph 5.21 of SSR-2/1 (Rev.1) requires to provide an adequate margin to avoid cliff edge effects (regardless of low/medium or high seismicity). On the other hand, Seismic Margin Assessment is not sufficient to demonstrate seismic robustness of the design in case of high seismic sites. Therefore, a new paragraph was added: 7.8. Seismic Margin Assessment is typically		

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					performed for low/moderate seismicity and Seismic - Probabilistic Safety Assessment S-PSA is recommended for sites with high seismicity. S-PSA will provide in addition to facility seismic margin, more insights about seismic robustness of the design, seismic performance expressed in S-CDF and S-LRF or S-LERF and the significant contributors to seismic risk that may include human errors associated to recovery actions.		

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
2.	General (Section 1 ,2-4, 7)	There are three types of margins in this draft safety guide. "Seismic safety margin" is used in Section 1. "Safety margin" is used in Section 2 to Section 4. "Seismic margin" is mainly used in Section 7.	Clarify the distinction among three types of margins and provide clear definitions for each of them	Y	Modified to ensure consistency.		
3.	3.2.& 3.3.	3.2. As defined by the IAEA Safety Glossary "Terminology Used in Nuclear Safety and Radiation Protection [4], design is the process and the result of developing a concept, detailed plans, supporting calculations and specifications for a facility and its parts. Also, qualification refers to the ~~qualification of~~ equipment qualification as the generation and maintenance of evidence to ensure that equipment will operate on demand, under specified service conditions to meet system performance requirements. In this sense, seismic qualification refers to a form of equipment qualification that relates to conditions that could be encountered in the event of earthquakes. 3.3. Taking those definitions as main reference, and for the purposes of this Specific Safety Guide, seismic design is the process of designing a nuclear installation to cope with the effects of the hazards generated by an earthquake event in accordance with the specified performance	Ref [4] defines 'equipment qualification'. Wording 'qualification of equipment' should be avoided, if there is no specific meaning.	Y			

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		criteria and to comply with the prevention and mitigation requirements indicated in previous Section 2. Therefore, seismic qualification is part of the process of seismic design and refers to the ~~qualification of~~ equipment qualification to comply with those objectives mentioned above.					
4.	3.10./ Line 4	If a probabilistic approach was performed for determining the site specific vibratory ground motion, hazard curves (mean and fractile curves) of the level of a relevant parameter, as the peak ground acceleration, and its annual frequencies of exceedance up to values compatible with the analysis needs (e.g. up to 10^{-6} to 10^{-7} per year) are the available results, including the derived uniform hazard response spectra for several annual frequencies of exceedance (e.g. 10^{-3}, 10^{-4}, 10^{-5} per year).	Clarifications of the unit.	Y			
5.	3.15./ Line 6	For performing the seismic soil response analyses, as defined in Ref. [4] the following site classification is used: • Type 1 sites: Vs > 1100 m/s; • Type 2 sites: 1100 m/s > Vs > 300 m/s; • Type 3 sites: 300m/s > Vs; where Vs is the best estimate shear wave velocity of the foundation medium just below the	Define "shear wave velocity (Vs)"			X	Vs designates velocity of propagation of waves in an elastic media transversal to the direction of propagation. Also they depend on dynamic Shear

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		foundation level of the structure in the natural condition (i.e. before any site work), for very small strains.					moduli and density of the elastic media $V_s = \sqrt{\frac{G}{\rho}}$ It is a well-known technical term characterizing dynamic properties of the elastic media. Even SSG-9 does not provide a definition of Vs.
6.	3.15.	Define "seismic soil response analysis".	Para 3.15 says "For performing the seismic soil response analyses, as defined in Ref. [4] the following site classification is used". However, ref. [4] does not define anything on this item.	Y	"Soil response analysis", in this document has same meaning of "site response analysis" To ensure consistency with SSG-9, the text of the paragraph 3.19 was changed to "site repose analysis". The term site response analysis is defined in SSG-9.		
7.	3.31. Footnote 8	[8] ~~Some Member States defines~~ Low-to-medium seismicity countries use a factor of 1.4, 1.5 or 1.67.	These values are used in the low-to-medium seismicity countries.	Y	For low/moderate seismicity where seismic margins is used Some Member States		

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					define a factor of 1.4, 1.5 or 1.67.		
8.	3.33.	The whole sets of SSCs of the nuclear installation should be grouped in different categories at the beginning of the seismic design process to assign them specific levels of the vibratory ground motion earthquake and the performance criteria according to their safety significance. Therefore, seismic categorization is the process by which an item of the nuclear installation is assigned to a seismic category in accordance with its required performance during and after the occurrence of an earthquake event, in addition to other classifications such as safety, quality assurance and maintenance classifications. The relevant acceptance criterion associated with the item is part of the categorization.	Clarification for "quality assurance" and "maintenance classifications".	Y	It is a wide practice (see SAR Chapter 3 Design of SSCs) to classify the SSCs according to Safety Class, Quality Class, Seismic Category, etc.). The data sheet of equipment sent to manufactures should include all requirements derived from safety classification, Quality requirements (defined in Quality Assurance or just Quality standards" and seismic qualification requirements in addition to functional requirements and characteristics. To avoid confusion "quality assurance" was modified to "quality".		

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
9.	4.4.	e) Avoiding buildings with large aspect ratios in plan. Plan aspect ratios should be as close to 1 as practicable and large aspect ratios ~~above 3~~ should be avoided;	The concrete value should not be specified in the Safety Guide.	Y			
10.	4.8.	f) Wide enough seismic gaps between structures above ground level should be provided to avoid interaction (pounding) during seismic motion. Utilities crossing the gaps should be able to accommodate differential seismic displacements. Otherwise, the structural integrity should be confirmed in case of occurrence of interaction between the structures.	Suggested to be included that interaction between the structures might be allowed, when the structure integrity would be demonstrated by appropriate analysis.	Y			
11.	4.19./ Line 2-3	Isolators should be seismically qualified using full scale testing of prototypes as well as during the fabrication stage or, where appropriate, on properly jusitified reduced scale models. The prototypes should be tested dynamically and ~~subjected, at least, to~~ the maximum displacements considered in the design or in beyond design conditions should be investigated by static loading.	To keep consistency with para. 6.24., which state "a properly justified use of a reduced scale models may be permitted for qualification purpose". Dynamic effect can be sufficiently qualified with even reduced scale models. However the maximum displacements should be qualified by	Y	This paragraph refers to seismic isolation devices not to the isolated structure or equipment. The word Dynamically was deleted to allow selection of appropriate test method (dynamic or static loading).		

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			static loading, not by dynamic loading.				
12.	4.19.	c) Damping, as a function of frequency and/or maximum displacement ~~(friction pendulum)~~ of damping devise.	There are several types of damping devise.	Y	"Isolation device": instead of "damping device"		
13.	4.22.	(e) Room temperature control, consistent with qualification of isolators ~~(typically, between 5 and 25°C)~~;	The specific value should not be described in main text of the Safety Guide. If needed, these values are suggested to be provided in footnote. Also the temperature affecting isolators might depend on their type.	Y			
14.	Between 4.29 and 4.30	4.29.....support of the line. TANK 4.30. Seismic experience shows that...	Add subtitle for better understandings.	Y			
15.	4.46.	In accordance with accepted engineering practice, seismic design of ~~seismic design of~~ HVAC...	Duplication.	Y			
16.	5.4. b)	b) The analysis model should adequately represent the behaviour of the structure under the seismic action, taking considering properly the	Completeness. Damping is suggested to be added as essential	Y			

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		inertial ~~and,~~ stiffness and damping distribution of the structure	elements of vibration evaluation.				
17.	5.4. e)	e) Potential second-order effects ~~should~~ may be considered for all vertical load path elements (P-Δ effects[16]). Particularly, all vertical load path elements ~~should~~ may be designed for the lateral displacements induced by seismic loads.	Consideration of P-Δ effects depends on design conditions.	Y	…should be considered, if relevant,…		
18.	5.9.	*Split this para into two paras as follows;* The model used for computing the seismic response should include the mass of the structure, the mass of permanent equipment and the mass of the expected live load concurrent with seismic loads. *Add after para. 5.33. with footnote as follows;* Mass of snow should be considered too for sites where design snow load is relevant[x2] ~~(e.g. larger than 1.5 KN/m^2)~~. Footnote [x2] e.g. larger than 1.5 kN/m^2	The mass of expected live load concurrent with seismic loads should be described in other para (e.g. after para 5.33) with other additional loads than snow, if relevant. In addition, the specific value of "larger than 1.5 kN/m^2" should be stated in footnote with clear basis of the value.	Y	Was moved to 5.33: Mass of snow should be considered too for sites where design snow load is relevantx2 (e.g. larger than 1.5 KN/m2).		
19.	5.13.	Coupled analysis of a primary structure and a secondary structure, system or components should be performed	Completeness. In coupled analysis, secondary structures can	Y			

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			also be the subject of analysis.				
20.	5.16 Footnote 17.	~~[17] Typical values used by Member States are ±15%.~~ [17] Some Member States define ±15%.	The value "±15%" is not typical in Member States.			x	Peak broadening of design FRS with +/- 15% is quite typical in North and south America, Europe (including Russia) and some Asian countries: China and South Korea – which covers most of the NPPS from the world. The footnote is not a mandatory part of the Safety Guide.
21.	5.21.	Uncertainties in the SSI analyses should be considered, either by the use of probabilistic techniques or by bounding deterministic analyses which cover the expected range of variation of ~~soil properties~~ analysis parameters affecting response, including soil properties.	Completeness. In the probabilistic approach, analysis parameters with large influence on response are considered. It is not limited to ground variation.	Y			
22.	6.15.	Simplified analytical or design procedures could be used. All such simplified techniques should be	Methods of validations should not be limited to	Y			

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		fully validated to show their degree of conservatism in comparison with more refined modelling techniques or test results, and they should be suitably documented.	'more refined model analysis'.				
23.	7.2.	If seismic failure of a main safety function occurred for the hazard severity close to the seismic design base capacity and seismic performance goal is not achieved such conditions correspond to seismic induced cliff edge effect. The design should provide adequate seismic margin to (i) protect items important to safety and to avoid cliff edge effects[XX]; (ii) protect items ... *Add new footnote XX;* [XX] The concept of margin (safety margin) and cliff edge effects is shown in Section 8 of TECDOC 1791.	Clarification. Seismic margin, cliff edge effects and seismic margin capacity are described in Section 8 of TECDOC 1791, and should be referred in footnote.			x	According to IAEA rules a TECDOC cannot be used as a reference in a Safety Standard.
24.	7.3	Define HCLPF itself physically in footnote.	For user friendliness.	Y			
25.	7.6. Footnote 25	[25] In ~~many~~ low-to-medium seismicity countries in the Member States the adequate seismic margin (at facility level) is defined by HCLPF > 1.5x SL-2.	This value is used in the low-to-medium seismicity countries as specified in the TECDOC-1791.	Y	When Seismic Margin Assessment is used for sites with low/medium seismicity the adequate seismic margin (at facility level) is typically defined by HCLPF > 1.5x SL-2.		

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					Also a new paragraph was added: 7.8. Seismic Margin Assessment is typically performed for low/moderate seismicity and Seismic -Probabilistic Safety Assessment S-PSA is recommended for sites with high seismicity. S-PSA will provide in addition to facility seismic margin, more insights about seismic robustness of the design, seismic performance of the facility expressed in S-CDF and S-LRF or S-LERF and the significant contributors to seismic risk that may include human errors associated to recovery actions.		

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
26.	8.6.	Processing, interpretation and use of the data obtained from the seismic instrumentation, should be part of the operational procedures (including emergency operating procedures) of the installation and managed according to the established management system.	Clarification. Processing, interpretation and use of the data from the seismic instrumentation should be part of emergency operating procedures as well as normal operating procedures considering lessons learned from prolonged accidents with failures of data acquisition and transfer.	Y			
27.	Chapter 9 General	Chapter 9 contains specific methods of applying the graded approach and additional items such as the impact of chemical hazards. Please explain clearly so that each of these understandings will advance.		Y	The facility Seismic Design Category (SDC) is defined based on the hazard that facility will pose to the workers, public and environment. Since this apply to nuclear fuel cycle facilities e.g. UF6 storage, the facility may have both radiological and chemical hazards that		

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					should be considered in the graded approach. Table 9.1 defines the SDC (hazard category) based on potential consequences of the un-mitigated failure of the facility. Table 9.2 defines seismic performance Goal based on SDC and this can be achieved by certain combination of hazard severity (defined by return period) and deign code (Nuclear or conventional).		
28.	9.5.	Structures, systems and components (SSCs) should be seismically designed to account for: a) The seismic design category of the nuclear installations where they are to perform should a SL-2 occur;	Add description of "c)" for SSCs that are not safety classified. The description in paragraph 9.5 is not consistent with Table I in paragraph 3.45.	Y			

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 10 Country/Organization: Japan / NRA Date: 29 Oct. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		b) The appropriate state limit should a SL-2 occur (specify the analysis methodology, design procedures, and acceptance criteria). c) SSCs whose seismic failures do not have any interactions with safety function should correspond Seismic Category 3. National practice for seismic design of non-nuclear installations apply.	Clarify the relation between Table I, and Table 9.1 and Table 9.2.				

Seismic Design of Nuclear Installations (rev. of NS-G-1.6)

COMMENTS BY REVIEWER Reviewer: Anders Hallman, Kostas Xanthopoulos Page 1 of 1 Country/Organization: SSM Date: : 26th October 2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	3.31, ref. 8	The reference mention that "Some Member States define a factor of 1.4, 1.5 or 1.67"	It may be of interest to provide a brief description of the background to the choice of these factors in the reference or the paragraph itself. It would make it easier for the user of the guide to choose such a factor. For clarification.		1.5 is mainly coming from US IPEEE confirmed later in other SMA/SPSA studies. 1.4 some from some countries from Europe. In USA 1.67 comes from agreement of vendors with USNRC (for central and eastern USA) assuming design/SSE for 0.3g and required margins of 0.5g. It is not our intention to have such discussion in the safety guide however this		

					could be a good topic for a TECDOC showing in details what is behind this numbers.		
2	3.44	Add the following information " SSCs in seismic category 3 should not jeopardize any safety functions of SSCs in seismic category 1 or 2".	To comply with paragraph 6.14, page 36.			x	Redundant. Definition of Category 2 includes already item that may affect items from Category 1.
3	5.4	Add to the item list f) "Hydrodynamic effects of large volumes of water in for instance fuel- and service pools should be considered".		y	Slightly modified: "f) Hydrodynamic effects should be considered for SSCS containing large volumes of water in for instance fuel-pools and service pools".		

Comments on IAEA Draft Safety Guide
[SPESS Step 7]
***Seismic Design of Nuclear Installations* (DS490)**

COMMENTS BY REVIEWER Reviewer: US Nuclear Regulatory Commission Country/Organization: United States of America/US NRC Date: 26 Oct 2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	Para 1.7, Line #4	After the 1st sentence, add: "The sound engineering principles and design practices provided in this guide also apply to designs of nuclear installations that are based on generic site conditions. Thus, ~~it~~ this Specific Safety Guide…"	This Guide is intended for site-specific designs of nuclear installations. However, in certain member states such as the U.S., the seismic designs are done on a generic basis before a site is selected – Standard Designs. A licensee only need to justify that the standard design is suitable for the site. Therefore, some aspects (e.g., site seismic hazard estimates) may not apply. Nonetheless, good engineering design practices should always be exercised regardless	X	Add new paragraph as follows: "In several member states, the designs of new nuclear reactors are being developed generically to meet the needs of many sites across a large geographical area. The intent is that each generic design uses design bases that envelope the potential seismic hazard challenges at all the candidate sites. Confirmation of this is required when a design is nominated for a particular site. At this point the site-specific seismic hazards should be assessed and		

			of site-specific or generic designs.		compared with the generic seismic hazard design bases to ensure there is an acceptable enveloping margin between them."		
2.	Page 9, 1st para in 3.7	The site evaluation stage conducted before the starting of ~~the design and~~ construction of the nuclear installation …	Design of the NPP may be done long before a site evaluation (e.g., USA's Design Control Document that establishes a design first)	X	Recommend adding footnote to refer to potential for generic design. "Unless a generic design is intended for the site, in which case the site evaluation stage may occur after the reactor design. In this case the generic seismic design bases should be shown to envelope the site-specific seismic hazard challenges at the relevant hazard frequencies."		
3.	Page 9, last sentence	Delete the last portion of the sentence and replace it with "…usually ~~at the free field conditions~~ as an outcrop motion at the surface or as the free field at the competent rock level."	Outcrop is the correct term to use.	X	Add "rock outcrop" but retain "free-field", since some member states still use the free-field soil surface as the control point.		
4.	Para 3.10	The 1st sentence should be revised "…of the level of ~~a~~ relevant parameters, as the peak ground acceleration and peak spectral accelerations,…)	PHSA is typically performed for several frequencies	X			

			in order to construct UHRS for the site.				
5.	Page 10, para 3.12, second line	Delete word "design" "…in para 3.7 above, at the ~~design,~~ pre-construction stage …"	Same as comment 2.	X			
6.	Page 11, para 3.15, last phrase	Add sentence or note: Some member states recommend not using Type 3 soft soil sites.	Recommend using sites with Vs>1000 ft/sec (305 m/sec).	X	Add sentence as a footnote to end of last sentence in para.		
7.	Page 11, footnote 4	Definition of 'hard rock' varies between Member States. Generally, a site is considered to be a hard rock site when the ~~average~~ shear wave ~~velocity in the first 30 m of ground (Vs30)~~ is larger than 1100 to 2800 m/s, depending on the particular national practice.	The way the phrase is written is not correct.	X	Re-worded.		
8.	Page 11, para 3.18, last line: insert	… point location, usually the free field ~~ground level,~~ or a competent rock or foundation level:	U.S. uses these levels more often than free field.	X	Accepted but retain "ground level" since this apply for a wide range of nuclear installations.		
9.	Page 12, para 2)	Simplify #2 as 'Evaluate the correlation of soil layer properties: ~~, i.e. determine whether they correspond at the same time for each layer so that their characteristics should be correlated or uncorrelated in the simulations;~~	It is too prescriptive, and is unclear on how to achieve it.	X			
10.	Page 12, bullet #3)	Determine whether ~~other than~~ 1-D equivalent linear analyses should be performed~~; if so, non-linearity of the soil properties should be required~~ or more complex approaches are needed.	Equivalent linear method includes non-linearity.	X	Simplifies paragraph.		

11.	Page 12, bullet #6)	~~Verify the site response analysis results with observed instrumental records (including microtremor measurement).~~ Replace with: "If possible, verify the site response analysis with observations."	The way it is written it is not clear how it can be done.	X	Comment accepted but include intent of original as follows: "If possible, verify the site response analysis with observed instrumental records ~~(including~~ and/or microtremor ~~measurement)~~ surveys"		
12.	Para 3.20	Revise as highlighted: ...structures, systems and components of the nuclear installation should remain functional during and after the occurrence of…	The expectation for SL-2 should be that SSCs remain functional both during and after the event.	X			
13.	Page 14, Para 3.26, second sentence from the end.	Revise as highlighted: "…free field ground surface at the foundation level."	The minimum ground motion of 0.1g should be defined at the foundation level.	X			
14.	Para 3.27	The 2nd sentence is unclear. Suggest to replace it with: "…the design shall provide for an adequate safety margin for those SSCs ultimately required for preventing core damage and mitigating an early radioactive release or a large radioactive release, ~~complying~~ consistent with prevention/mitigation measures ~~required to fulfil~~ for SSCs involved in Level 4 of the defen~~s~~e in depth concept ~~and the main room of the installation,~~ as well as to avoid the cliff edge…	The terms "prevention" and mitigation" are used to associate them with different stages of reactor accidents.	X	Further editorial change to: "…the design ~~shall~~should provide for an adequate safety margin for those SSCs ultimately required for preventing core damage and mitigating an early radioactive release, or a large		

					radioactive release, ~~complying~~ consistent with prevention/mitigation measures ~~required to fulfil~~ for SSCs ~~involved in~~ supporting the Level 4 of the defence in depth concept ~~and the main room of the installation,~~ and ~~as well as~~ to avoid the cliff edge…		
15.	Page 14, para 3.29	Need to explain what Review Level Earthquake is.	Introducing too many different levels can result in confusion.	X	RLE is not referenced anymore		
16.	Page 28, footnote 14.	Definition of 'hard rock' varies between Member States. ~~Very generally,~~ Generally, a site is considered to be a hard rock site when the ~~average~~ shear wave velocity ~~in the first 30 m of ground (Vs30)~~ is larger than 1100 to 2800 m/s, depending on the particular national practice.	Same issue as with footnote 4 on page 11. (See Comment 7 above)	X	Footnote #14 deleted. Updated text is in the footnote #6.		
17.	Para 4.9	Modify as: "Structures in Seismic Category 1 ~~can be~~ are designed within essentially elastic limit state with adequate ductility and energy absorption capacity to withstand limited non-linearity induced by BDBE ~~to exhibit nonlinear behaviour~~, provided that their acceptance criteria (as expressed in terms of the value of a design parameter such as maximum crack opening, absence of buckling or maximum inter story drift) are met with a safety margin consistent with the seismic categorization.	As Seismic Cat 1 structures are required to remain functional during and after the event, the design is typically limited to essentially elastic limit state. In addition, the design in the elastic limit			X	Prefer original wording because this provides a functional (rather than a stress) level of service requirement for Seismic Cat. 1 and apply to a wide range of nuclear installations.

			state allow for combining with other load effects in a straightforward manner.				
18.	Para 5.17 – 5.21	Add one paragraph: "For structures containing pools of water large enough to impact the SSI, the SSI model should incorporate the fluid-structure interaction (FSI) effect."	Many designs of reactors include large pools of water located in the containment structures for passive cooling functions. The potential FSI effect should be considered in the SSI analysis.	X			
19.	Para 7.8	Add to the end of paragraph: "…The plant level HCLPF can also be determined using sequence based (PRA based) seismic margin analysis."	There are several sequence based margin assessment method such as PRA-based SMA being used in the US for new reactors.	Y			
20.	Page 41, para 8.1	Seismic instrumentation — an array of strong motion accelerographs installed at the plant site plays a key role in collecting ~~site~~ specific seismic ~~instrumental~~ data during the life cycle of the nuclear power plant. ~~from site selection, to site characterization and to the operational stage until decommissioning. The site specific seismic instrumental data are required for various purposes, ranging from helping in the assessment of the seismic hazard at the site to recording the actual~~	Main purpose of seismic instrumentation at the plant is to assess ground motion at the plant, and if OBE is exceeded to shut down the plant.	X	OBE exceedance is US specific. We suggest different wording with same meaning.		

		~~seismic response of SSCs, in the event of a felt earthquake, and assisting in the consequential post-earthquake actions. For such reasons,~~ Seismic instrumentation should be installed at nuclear installations for the following reasons:	This should be added to the list as well.				
21.	Page 41, para 8.3	Consider separating into two sentences before and after the comma since they are distinct thoughts, as follows: Seismic categorization and safety classification of seismic instrumentation should be decided based on the relevance of the postulated seismic initiating event. ~~for system design and, in general, on~~ In addition, the need for ~~of~~ the seismic instrumentation~~'s significance for~~ in the emergency procedures for the nuclear installation should be taken into account.	This paragraph is not clear.	X			
22.	Page 42, para 8.7, d)	~~One triaxial strong motion recorder installed on the most representative floor of the reactor building in a nuclear power plant, or in the basemat of the building of structure with the biggest amount of radioactive material in other than nuclear plant installations.~~ Replace with: A minimum of three triaxial strong motion recorders installed at the basemat, and at the two more representative elevations (floors) of the reactor building.	The way it is written is not sufficient for post- earthquake seismic analysis.	X		X	

SEISMIC DESIGN OF NUCLEAR INSTALLATIONS

DRAFT SAFETY GUIDE No. DS 490
ENISS Comments

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: ENISS Country/Organization: ENISS			Page 1 of 3 Date: 26/10/2018				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	Sec 3	With regards to text on DBE and BDBE it would be very useful to specify the expected confidence levels in deriving the seismic hazard. Mean and 84% confidence level is the norm and most codes and standards either adopt the 84% fractile as a conservative starting point or adopt the mean and apply factors to convert to a design response spectrum. Our understanding is that the current thinking in the seismology field is that a mean level hazard is more appropriate.	Add clarity to what's required as there is more to the hazard spectra than simple return periods.	Y	Mean UHS or Mean PGA + 84% NEP spectral shape or mean UHS x design factors. are acceptable for defining the DBE in some MS. The new added paragraph just indicate that adequate design conservatism should be considered: "3.25 The design basis earthquake level should include adequate		

					design conservatism considering the uncertainties associated to the peak ground acceleration and spectral shape based on results of the seismic hazard assessment"		
2	Sec 5	Para 5.6 states that "Modelling of stiffness for seismic analysis should follow national/international practice for nuclear applications. It is suggest that the requirement to follow national and international best recommended practice is added to Para 5.1 or 5.4. The analysis text presented isn't quite in line with modern day requirements in ASCE 4-16 for example.	Adds emphasis to follow establish practices for analysis as a whole.	Y	5.6. Modelling of stiffness for seismic analysis should follow the national/international practice for nuclear applications. For example, in the first step the gross area of reinforced concrete sections is used to compute the stiffness using linear elastic analysis. Based on the stress level identified in step 1, stiffness reduction factors are evaluated for each structural element. The corrected stiffness is then		

					used in a second iteration, if necessary.		
3	Section 6.3	Please add section that covers qualification by "earthquake experience".	It appears that qualification by "Experience" seems to be missing as an option for seismic qualification. In the previous Guide (NS-G-1.6) there is a section called "Seismic qualification by means of testing, earthquake experience and indirect methods". Qualification by means of experience is a method that may be used for new or replacement components as well as seismic evaluation for assessing BDBE conditions for new designs, e.g., [1] SQUG Report "*Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment*" Rev. 3A			x	Seismic Experience approach was never accepted for design of safety related SSCs of a new nuclear installation since there is no sufficient quality in application of seismic experience. Was used for mainly for seismic evaluation of existing nuclear installations or for evaluation of Seismic Margins (BDBE) but not for seismic qualification of the design.

			[2] SQUG Report NARE Guidelines "*Implementation Guidelines for Seismic Qualification of New and Replacement Equipment/Parts (NARE) – Using the Generic Implementation Procedure (GIP)*" Rev. 5.				
4	Sec 7, Para 7.4 & 7.6	Please define what the acronyms CDF, LRF and LERF are as this isn't identified elsewhere.	For clarity and understanding.	Y	CDF = Core Damage or Frequency, LRF = Large Release Frequency and LERF Large Early Release Frequency		
5	Sec 8, Para 8.13	The triggers of 0.01g to 0.02g seem very low for a freefield recorder and would need to be located very carefully on site to avoid spurious operation from non seismic events. It is suggested that 0.05g is more appropriate to represent $5x10^{-2}$ to $1x10^{-2}$ events which would require the operators to manually trip.	0.01g seems very onerous and likely to frequently alarm leading to operator confusion and/or erroneous actions.	Y	Modified: values of 0.01 to 0.05 This level is for triggering the recording of the earthquake is not the shutdown threshold. Shutdown criteria is based on SL1/SL2 exceedance + CAV criteria.		

DS490, DRAFT Standard 'Seismic Design of Nuclear Installations'.

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1 General		In-structure response spectrum	The wording 'in – structure response spectrum' suggests a response spectrum inside a cabinet for example. But the drafter may mean any response spectrum e.g. floor response spectrum. Mostly a floor response spectrum is used. Would it make sense to further clarify this wording ? e.g. free field response spectrum (primary spectrum), floor response spectrum (secondary response spectrum) and in-structure response spectrum (tertiary response spectrum)	X	In-structure and floor response spectra are terms often used interchangeably. It would be worth adding a footnote under para. 4.27c) first use of term. Suggested text: "The term in-structure response spectrum is used to mean a response spectrum computed at a point within the structure representative of the loading input point for an item of equipment. The term floor response spectrum is also often used for this		

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					purpose, but the term in-structure is preferred because not all such loading points are coincident with a floor level."		
2	3.13 b)	Variability of the thicknesses and ground layer properties to determine: - **either** the Best Estimate (BE), Upper Bound (UB) and Lower Bound (LB) strain compatible soil profiles and accounting for the uncertainties on soil layers geometry and soil properties**,** - **or the probability distributions of the soil parameters to be used in fully probabilistic analyses.**	This remark is the text is intended to cover probabilistic approaches as well as deterministic.	X	Common practice is to develop BE, UB and LB properties from statistical analysis of bore hole and other geotechnical data. However, the comment simply adds to this and allows for the possibility that a fully probabilistic analysis might be undertaken. Some minor editorial edits to the amended text have been added as below.		

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					"Variability of the thicknesses and ground layer properties to determine: - either the Best Estimate (BE), Upper Bound (UB) and Lower Bound (LB) strain compatible soil profiles, accounting for the uncertainties in soil layer geometry and soil properties, - or the full probability distributions of the soil		

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					parameters if the subsequent site response analysis is to be fully probabilistic"		
3	3.14	where Vs is the best estimate shear wave velocity of the foundation medium **in the 20 m** just below the foundation level of the structure in the natural condition (i.e. before any site work), for very small strains.	These 20 m are just a proposal. If not retained it must be replaced by another guidance because it would not be acceptable to take, for example, just 1 m below the surface.			X	It is more common to use the VS30 value. In any case it should be up to the site operator to properly characterize the soil profile, and the operator should use whatever VS measurements will do this. This interpretation is consistent with [4] para. 3.1.
4	3.14 This should be 3.15	Seismic soil response analysis should be performed for all type of soil **except if demonstrated to have a negligible effect**. ~~soil types 2 and~~	Some soil resonances do also exists with stiff soil site.	X	Amended the text of the para. 3.15 to better retain the sense of the original:		

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		~~3 while soil type 1 is usually considered as a hard rock site4.~~			"Seismic site response analysis should be performed for soil types 2 and 3. Soil type 1 is normally considered a rock[1] site and a soil response analysis is not required if it can be demonstrated that negligible effect on modifying the control seismic motion".		
5	3.18 1)	Determine the best estimate soil profile parameters based on the geophysical and geotechnical databases, for the full depth from the bedrock outcrop layer to the free surface including their uncertainties. That means **either** to determine the mean values and their uncertainties **or to determine Best Estimate (BE), Upper Bound (UB) and Lower Bound**	To keep compatibility with 3.13	X	Amended text revised to improve English: "Determine the best estimate soil profile parameters based on the geophysical and geotechnical databases, for the full depth from the bedrock outcrop		

[1] Definition of 'rock' varies between Member States. Generally, a site is considered to be a hard rock site when the average shear wave velocity in the first 30 m of ground (Vs30) is larger than 1100 to 2800 m/s, depending on the particular national practice.

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		(LB) values for each site soil layer of the following parameters:			layer to the free surface at the site, including their uncertainties characterized either as BE, UB and LB values, or as probability distributions."		
6	3.26	„…and (iv) the minimum level for seismic design should correspond to a peak ground acceleration of 0.10g **and a minimum duration of 30s with 10 s strong motion part if not otherwise stated in the site specific seismic hazard assessment.**	There exists a lot of spectra reports without information about the seismic duration. Such information is most time not given by the licensee and so it is difficult to generate a time history e.g. for analysis or testing. Therefore a minimum should be introduced in the standards and used for qualification, unless otherwise specified by the licensee.			X	As stated, this para. conveys the common understanding of minimum seismic withstand. Operators designing at this level would probably want to show a fully elastic design and may not need the benefit or more complex time history analysis. However, if they did, this is a complex area and

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							best dealt with via a code like ASCE 4.16, rather than making recommendations here.
7	3.27	For such earthquake level, noted as Beyond Design Basis Earthquake (BDBE), the design shall provide for an adequate safety margin for those SSCs ultimately required for preventing an early radioactive release or a large radioactive release, complying **with the requirements associated with** ~~mitigation measures required to fulfil SSCs involved in~~ Level 4 of the defence in depth concept and the main room of the installation, as well as to avoid the cliff edge effects within the uncertainty of the determined DBE values. At least SSCs ensuring mitigation of design extension conditions with signification core degradation	Clarification + precision of the scope of SSCs	X	Modified based on other MS comments.		

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		(specific to reactors) should be checked against BDBE.					
8	3.34.	~~3.34. The seismic categorization should be performed by the design organization of the nuclear installation through a multi-disciplinary team of specialists led by the system engineers.~~	To be removed. Not the responsibility of this guide to define organization of the work.	X			
9	3.37	General	Included SSCs should follow as much as possible categories defined in SSG-30 without being specific for reactor			X	SSG-30 does not define seismic categories. The mapping between seismic categories and safety classes is made in Table 1.
10	3.37	~~a) SSCs whose failure could directly or indirectly cause accident conditions;~~	Entirely removed : on NPP, SSCs required for prevention of accidents are not classified SC1.			X	See above
11	3.37	b) SSCs required to ensure the 3 fundamentals safety function in design basis accidents. ~~for shutting down the reactor and maintaining the reactor in a safe shutdown~~	As far as practicable, reference to reactors hould be avoided as the scope of the guide is any nuclear installation. Use of Fundamental safety			X	See above

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		~~condition, including the removal of decay heat~~;	functions seems more appropriate. The requirement should defined the appropriate plant state : Design Basis accident. Reactor examples might be presented in appendix. However, in specific cases, it is still necessary to refer to reactors, otherwise, there would be a gap in the recommendations.				
12		c) SSCs of at least on defense lines that are required to practically eliminate situations with large or early radioactive releases. ~~prevent or mitigate non-permissible radioactive releases (with limits established by the national regulatory body), including the spent fuel storage pool structure and fuel racks~~;	It is understood as SSCs required for practical elimination of large or early releases, thus modified accordingly. References to fuel pool is removed as this document is not specific to NPPs.			X	Comment rejected See above. Text modified for clarity. c) Items related to infrastructure needed for the implementation of the emergency plan

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13		d) SSCs required to mitigate the consequences of design extension conditions with significant core degradation (specific to reactors), and whose failure would result in consequences of 'high' severity as defined in Ref. [6].	Addition to differentiate DEC-A (multiple failures) from DEC-B (severe accidents)			X	See above
14		e) SSCs of support, monitoring and actuating systems that are needed for fulfilling the functions indicated in b), c) and d) above. f) SSCs required to prevent or mitigate the consequences of internal or external hazards induced by DBE level earthquake.	Addition of a point regarding internal/external hazards			X	See above
15	3.39	~~3.39. The items of nuclear installations included in Seismic Category 1 should be designed to withstand the effects of the SL-2 earthquake level and, as said in para 3.36, remain functional during and/or after an earthquake of such level.~~ For any item in Seismic Category 1, appropriate acceptance criteria10 should be established through the acceptable	First sentence is a total repetition of 3.36 thus should be removed.	X			

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		values of design parameters indicating, for example, functionality, leak tightness, maximum distortion and/or deformation, maximum stress level, etc.					
16	3.44	„3.44. The items of nuclear installations included in Seismic Category 3 should be designed as a minimum in accordance with national practice for seismic design of non-nuclear applications, **only if for conventional risk a seismic assessment is required by industrial standards.** ~~such a seismic and, therefore, for facilities at conventional risk.~~	The sentence can be misinterpreted that for everything a seismic proof is needed. E.g for office buildings and the installed equipment / structure, which is not state of the art. (not in the past nor by current projects)			X	The para. is correct as originally stated. The amended text does not add anything useful. No change.
17	4 Mechanical equipment items	**General comment : see in the next column**	Missing parts on handling equipment (i. e. cranes) and storage racks which are also sensitive to earthquake loads. If it is the case, it should be expressed that and why fuel, fuel handling			X	Not sure what point is being made here. A SSC item that has a missing part important to safety would be outside its design and therefore not in keeping with

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			systems and primary components are deliberately excluded from the scope and reference to the relevant safety guides should be made				any safety case claims on it. It would be captured at the next inspection/maintenance interval if not before. If the point being made is that some specific reference should be made to non-reactor SSCs, then section starting with para. 4.26 could add items such as overhead cranes that have known vulnerability to seismic loads. No change to existing text.
18	4.27	c) The seismic demand at each support point should be computed from the ~~in structure~~ **floor** response spectra, using the **quasi static method or** response spectrum	For the determination of anchor loads a quasi static calculation (using the peak value) is conservative and faster.			X	Quasi static method is included in simplified conservative approaches. Some

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		method with the level of damping accepted by the design standard for each particular equipment class. Simplified conservative approaches are acceptable, ~~if justified~~;	Otherwise you have to module everything in a FE program and to calculate it. High effort with reducing the safety margin.				editorial changes made: "c) The seismic demand at each support point should be computed from the in-structure response spectra, using the quasi static method or response spectrum method with the level of damping accepted by the design standard for each particular equipment class. Simplified conservative approaches are acceptable, if justified"
19	4.35/p. 25/sec. 4	Electrical equipment (…) should be seismically qualified if functionality during and/or after earthquake is required (Section 6). Methods such as type testing,	We should be free in the selection of the method in dependence on the requirements (during or after) and the kind (design) of the equipment			X	Qualification methods are discussed in Section 6. There is no need to add more to this paragraph.

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		analysis or a combination of both, or qualification by similarity/analogy are applicable. A technical justification of the methods used is recommended.	to be proven. All known (recognized) qualification methods should be applicable.				
20	4.36	Hence, the portions of the load path **that** is not covered by the test ~~it~~ should be designed and assessed separately.	editorial	X	Further editorial revision added. "Hence, the portion of the load path that is not covered by the test should be designed and assessed separately."		
21	4.36	**g) if bolted connections are included in the load path, they should be designed so as not to lose their pre-stressing during the earthquake, which could lead to a detrimental change of stiffness.**	Important aspect, missing in the initial text			X	Some confusion here between bolted joints e.g. in steelwork and bolted anchorages, which is intended here. Bolted connection is not the same as a bolted anchorage. Therefore, no change to existing text.

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22	4.37/p. 26/sec. 4	*Delete the first sentence of the clause.* ~~Vibration isolation devices not designed for earthquake loads have failed during earthquakes affecting industrial facilities~~.	Otherwise, if it is permitted put it in a footnote since it is only additional information.	X	Add a footnote since it is useful context. "Vibration isolation devices not designed for earthquake loads have failed during earthquakes affecting industrial facilities."		
23	4.39/p. 26/sec. 4	… for equipment containing relays, contactors or breakers susceptible to chatter.	There might be not only relays. There is other electromechanical equip-ment too.	X	Further revision to text to broaden its applicability, rather than being relevant to specific types of equipment. "… for equipment containing relays, contactors or breakers susceptible to chatter, or items sensitive to damage from impact or impulse loading."		
24	4.41	~~Sufficient slack in cables should be provided to accommodate large relative movements between cable~~	Redundant with 4.38	X			

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		~~supports and the particular equipment item.~~					
25	4.42/p. 26/ sec. 4	- sufficient vibrational stability of parts in the interior of the battery cells	This should be included in addition since inadequate mechanical design of the electrodes and potential spacers might jeopardize the function during and after the earthquake. Short circuits may occur.			X	The batteries used are normal industrial batteries. These are generally robust. Since there is little experience data that batteries fail like this, this amendment should not be added. No change to existing text.
26	5.1	On the other hand, seismic analysis of building and civil structures provides the seismic demand (e.g. in-structure response spectra **and in-structure acceleration or displacement time histories**) for seismic qualification of structures, systems and components housed by these structures.	Important for all nonlinear analyses of components.	X			
27	5.4 c)	Soil-structure interaction should be considered **at least** for soil and soft rock sites15, taking into	Not only	X	Modified based on comments from another MS.		

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		account uncertainties in ground properties;					
28	5.5	5.5. It is common practice to apply the **two** horizontal and vertical components ….	There exists still some calculations which shows the result of one horizontal direction and one vertical direction. Here it is mostly not known if the horizontal has to be applied in both horizontal directions or if the horizontal is already a resultant one. This can lead to underestimations.	X	Minor editorial change accepted.		

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29	5.15	The in-structure (floor) response spectra, typically used as the seismic input for **linear or pseudo-linear** equipment, should be obtained from the structural response to the design ground motion. For each soil-structure configuration, the number of required analyses depends on the national practice, but not less than three sets of ground-response-spectra-compatible acceleration time histories will be used as input for in-structure response spectra generation. Depending on the number of analyses, the resulting in-structure spectra will be either averaged or enveloped to produce the final result. **The in-structure (floor) acceleration or displacement time histories, typically used as the seismic input for nonlinear equipment or distributed systems, should be directly resulting from the structural**	Otherwise we are missing a complete part of the component analysis (primary components, storage racks, cranes and so on…)	X	The added text represents too much detail. The editrorials to first paragraph accepted, with some further editorial amendments, as below: “The in-structure (floor) response spectra, typically used as the seismic input for linear or pseudo-linear seismic calculations of equipment, should be obtained from the structural response to the design ground motion. For each soil-structure configuration, the number of required analyses depends on the national practice,		

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		response to time history excitation. For each soil-structure configuration, the number of required analyses depends on the national practice, but not less than five sets of ground-response-spectra-compatible acceleration time histories should be used as input. Depending on national practices, either the average or the average with a defined confidence level, including the variability of the equipment response, should be used for the equipment design.			but not less than three sets of ground-response-spectra-compatible acceleration time histories will be used as input for in-structure response spectra generation. Depending on the number of analyses, the resulting in-structure spectra will be either averaged or enveloped to produce the final result.”		

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30	5.16	In order to be used as design seismic input for the structures, systems and components housed by the main structure, the calculated floor response spectra should be peak-broadened to account for possible uncertainties in the evaluation of the vibration characteristics of the building's components. **If time histories are used as design seismic input for the structures, systems and components housed by the main structure, the equivalent of spectra widening could be achieved:** **- either by adding more calculation cases changing the stiffness of the soil-structure model to achieve the desired frequency shift,** **- or by scaling the time steps of the floor time histories to the amount required to achieve the desired frequency shift.**	Same reason as previous comment.			X	These changes provide additional detail beyond the scope of a safety guide and are better covered by industry standards such as ASCE4-16. No change to original text recommended.

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31	5.19	**Except for specific sites where significant inclined waves or surface waves may be induced by the topography, the simplifying assumption of** ~~V~~vertically propagating seismic waves should be considered acceptable for SSI analyses~~, as far as effects caused by non-vertically~~	More in line with the current practice than the original formulation. Besides, there is no guidance in the document for treating non-vertically propagating waves.	X	Amendment accepted, but slight editorial change as below: "Except for specific sites where significant inclined waves or surface waves may be		

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		~~propagating waves are taken into account by other means~~.			induced by the soil configuration, the simplifying assumption of vertically propagating seismic waves should be considered acceptable for SSI analyses."		
32	5.22 a)	Development of the soil-foundation-structure model, ~~normally~~ **usually** using a finite element discretization;	editorial			X	Editorial change not an improvement. But following editorial change proposed: "Development of the soil-foundation-structure model, normally using a finite element modelling method."
33	5.24	Lateral boundaries should also be located so that the structural response is not significantly affected by **a slight change in** these boundaries **locations**.	It's the location of the boundary that affects the model.	X	Point is well made but improved editorial revision added:		

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					"Lateral boundaries should also be located at sufficient distance so that the structural response is not significantly affected by these boundaries."		
34	6.7/p. 34/sec. 6	… simplified item[footnote]; or … [footnote] simplified item means, the qualification subject is reduced to parts of the component necessary to ensure the safety function. Modularization of the equipment should be allowed if the interfaces and boundaries are sufficiently considered.	Include a footnote to elaborate what is intended by 'simplified item'. In addition, we should allow the testing/qualification of separate parts of the equipment in scope.	X	Point accepted but improvement made to suggested footnote. Replacement text below: "… simplified item[footnote]; or … [footnote] A simplified component in this context is one that has been reduced to just those parts required to deliver the safety function."		
35	6.7/p. 34/sec. 6	*Put a sentence similar to the following in the clause*	Not only the analysis has limited significance, also	X	Suggested text re-worded as below:		

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		Test results have always a limited significance because they are linked closely with the boundary conditions used for the test. Thus, it is recommended that boundary conditions of the test should be comprehensively described, and the results should be discussed in relation to these boundary conditions.	each test is limited in its results and statements. We should point it out.		"It should be noted that testing is limited by the ability of the test rig, or other test conditions to properly re-create the actual n-service conditions that a component will see. When using test results to qualify components, extent that the test process is applicable should be made clear."		
36	6.10/p 35/sec. 6	~~6.10. Embrittlement of non-structural materials, such as polymers used for electrical insulation of cables, could limit the seismic capacity of some nuclear installation systems. The design should consider this age-related potential degradation mechanism when defining the seismic qualification program.~~	There are some uncertainties: - not only cables are concerned - design is not responsible for qualification. For the sake of quality management the qualification and the design should be separated.	X	The point made here is reasonable, but gets dragged in to a lot of detailed comment which is out of context for this document. Suggested simplified re-word of amended text as below: "Embrittlement of		

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		Ageing of polymers (organic) materials may have an impact on the functional behavior of electrical and I&C components due to the impact on the dielectric strength. Moreover, ageing of polymer materials may have also an impact on gaskets of (electro-) mechanical components because they may lead to a decrease of characteristics needed for their sealant function. Whether the ageing of polymers is to be considered in the seismic qualification is result of the ageing analysis (see clause 6.23) taking the design of the component into account. If the ageing analysis shows that polymers are used for parts in the load path of the component pre-ageing of the component should be generally considered.	However, the fact of ageing should be considered, see proposal. Moreover, the aging of polymers does not play the same role in seismic testing as for LOCA or severe accident testing, since the seismic event does not occur at elevated conditions exceeding the environmental design values of normal operation. If polymers are used for non structural parts, the aging analysis may show that mechanical stress on the polymer parts as a result of displacement/ acceleration etc. is negligible. During the event, typical characteristics like		non-structural materials, e.g. ageing of polymers used for insulation of electrical cables, or seals and gaskets in mechanical equipment, could …”		

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			insulation resistance remain in the same order of magnitude than under normal operating conditions. Therefore, not in all cases practical aging of components before seismic testing is needed. See our proposal.				
37	6.11	Seismic input should be given by the seismic loading at the location of the candidate SSC, normally expressed as in-structure response spectra **or in-structure time histories**.	Different options are possible	X			
38	6.12 a)	The input to the SSC should be defined by either design spectra, by **in-structure time histories** or by response spectra compatible **synthetic** acceleration time histories;	Different options are possible	X	Comment accepted but further sentence added to justify use of design spectra, as below: "The input to the SSC should be defined by either design spectra, by in-structure time histories or by		

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					response spectra compatible synthetic acceleration time histories. If design spectra (or related time histories) are used, these must be shown to envelope or be conservative to the in-structure loading conditions at the location of the SSC;"		
39	6.12 f)	**The energy dissipation in the SSCs response should be represented by an equivalent damping in the model. In the case of an analysis performed on a modal basis, the damping could be represented by modal damping values extracted from the relevant nuclear design codes, national practices, or experimental results. If different modal damping values are assigned to several parts of the**	A paragraph describing damping is really missing in the document. It is important since it is a recurrent source of errors in seismic analysis.	X	Accept the need for an additional paragraph, but believe the one offered is too complex. Suggest revision as below: "Energy dissipation should be accounted for and can be modelled for SSCs in a number of ways. If a modal analysis is		

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		model, the use of composite modal damping could be acceptable as far as these values are not too different from each other and there are no highly localized damping elements. If the analysis is not performed on a modal basis, any representation of dissipation might be used as far as it is demonstrated that it produces to same effects as the targeted modal damping in linear condition. A special care should be taken not to superpose spurious damping effect on top the energy dissipation mechanisms directly represented in the calculation such as friction, yielding, fluid turbulence effects or others.			being performed, modal damping values can be and are available for common types of components and materials from nuclear design codes."		
40	6.13/p.35/sec. 6	The mechanical insulation against vibrations, the size, location and number …	We should not mix-up the term insulation with electrical insulation.	X	Accept the change in principle, but since this entire paragraph refers to mechanical equipment. Suggest		

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			This may be prevented by our proposal.		revision to amended text as below: "For mechanical equipment, the isolation devices against vibrations, the size, location and number …"		
41	6.18/p. 36/sec. 6	In addition to inertial effects, careful consideration should be given to the effects of differential seismic motions between supports, ~~since experience of earthquakes has demonstrated that this phenomenon can be a major contributor to the seismically induced failure of piping systems.~~	The second part of the sentence brings additional information which should be put in a footnote rather than in the clause.			X	Original text seems OK as is. No change.
42	6.19	When the integrity or functional capability of an item **is not demonstrated** ~~cannot be demonstrated with a reasonable degree of confidence by~~ means of analysis,	Sometimes it's just cheaper to make a test. Or sometimes the test is made to prove some more capacity than in the calculation.			X	A minor editorial point that is implied by the original text. No change.
43	6.21	Low Impedance (dynamic characterization) tests should normally be carried out as a first	Additional example given in the parenthesis	X			

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		stage of proof tests to identify the main dynamic characteristics of the item (e.g. natural frequencies, **damping**).					
44	6.23/p. 37/sec. 6	… should account for those significant ageing effects which may cause ~~deterioration~~ the weakening of the structure or parts of the system or components needed to withstand seismic loads or alter the dynamic characteristics of the item during its service life. *After the last sentence, add the following:* To identify ageing effects an ageing analysis prior to testing should be conducted.	The term deterioration is too general. What should be expressed here is that we have taken into account ageing effects which may lead to a detrimental change in the mechanical behavior. This is the case if the load path of the component leads through parts of organic materials. As a matter of fact, an ageing analysis should be carried out prior to testing.			X	Too much detail. No change to original text recommended.
45	6.24/p. 37/ sec. 6	*Rephrase the second and the last sentence. Second sentence should be deleted.* Seismic tests may be performed on the item itself or on a full-scale model or, where appropriate, on	The statement "… should be tested without any simplification …" is in contradiction to the clause 6.7.			X	Redundant. The paragraph was deleted

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA			Date: 15/10/2018	RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		reduced scale models. ~~For qualification purposes, the component itself or a full-scale model should be tested without any simplification.~~ ~~However, if there is no other~~ For practical reasons ~~alternative, a~~ if properly justified, use of a reduced scale model or simplification of the structure may be permitted for qualification purposes. In general, the utilization of reduced scale models or simplification of the structure or component or parts of it is permitted for qualification purposes, if technically justified. In other words, it should be explained that the demonstration of the safety function is not affected adversely by reducing the scale or by the simplification of the original structure or component in scope.	Furthermore, there is a contradiction in the clause itself. First sentence → it is allowed; second sentence → there is a limitation, third sentence → the limitation is softened. We should generally speak about systems and components.				

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
46	6.25/p. 37/sec. 6	A technical specification for ~~each~~ qualification test should be developed. The following should be considered in the test ~~technical~~ specification: *Add an item in the item list:* - Definition of Acceptance criteria	A specification may be used for more than one test. The word technical is not necessary. Acceptance criterial should be defined in the specification.	X			
47	6.27/p. 37/ sec. 6	… in the test ~~technical~~ specification	See justification in the previous comment.	X			
48	6.28/p. 37/sec. 6	*Delete the clause and shift the information into clause 6.25* ~~6.28. The number of repetitions of testing or cycles of loading per test is prescribed in the test technical specification and applicable seismic qualification standards.~~ .	The number of repetitions etc. should be defined in the test specification.	X	Comment accepted and added to para. 6.25 as a sub-clause, but "seismic qualification standard" added to main text of paragraph.		

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
49	After 6.27/ p. 37/sec. 6	*Following clause should be added:* 6.28 Modal testing before and after the integrity testing and testing of passive equipment is recommended in order to identify changes in the dynamic characteristics of the systems or components as a consequence of the seismic event. Modal testing may not be necessarily conducted if "active" components are tested, since meeting functional acceptance criteria is sufficient for qualification purposes. However, modal testing may provide additional information on the condition of the component in scope after submittal to seismic event testing.	It may indicate whether The seismic event may affect the dynamic mechanical properties of the component adversely (shifting of eigenfrequencies). We can identify the effect of the seismic event using modal testing before and after the seismic test. Furthermore, it is not needed for testing "active" equipment since the specified acceptance criteria are sufficient (e.g. relay does not close the contacts during the event). Whether there is a shift of the eigen-frequencies is of minor importance, but might be helpful.			X	Not clear what this adds to the general aspects of testing raised above. Too detailed. No change to original text recommended.

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			We modified the text accordingly.				
50	6.31/p. 38/sec. 6	*Add an information to the item list* e) Avoid over-testing of the equipment	It is essential to know if assumed test conditions (e.g. accelerations, displacements) may lead to the excess of component limits.			X	General comment – There are a lot of comments from WNA on testing, which has the danger of unbalancing the guide, which is not a manual for how to conduct a test. However, for this particular issue of over testing – one would not normally exceed proof test limits on a component that was being returned to service, whereas other components can be tested to failure. So, it is not clear what over-testing means in this

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
							context. No change to original text recommended.
51	-- /p. 38/ sec. 6	*Clause number is missing.* 6.32 The combined analysis …	Editorial. Put a clause no. in the text or put it in a footnote – it is only supplemental information on a specific aspect.	X			
52		Development of an analytical model with ~~modal~~ **natural or eigen** frequencies, damping, etc., verified by testing of a typical component, enables the effects of component configuration	Usually, in the international standards the results of a resonance search are the natural frequencies			X	Terminology is OK either with original text or with changed text. No change recommended.
53	6.32/ p. 38/sec. 6	*The last part of the first sentence could be deleted.* … a reference item previously qualified. ~~by means of analysis or testing~~.	The qualification of the reference component could be based on all methods. Thus, the sentence could be shortened.			X	This is a very minor point and does not clearly improve the text. Not worth changing.
54	6.33/p. 38/sec. 6	*Delete the last part of the last sentence of the clause.* … for the utilization of indirect methods. ~~and should be explicitly~~	The second part of the sentence is releated with QM measures and should be stated elsewhere in the SRS but not in the technical part. Thus, we			X	The second sentence of the original text provides good context to the first sentence. Recommend no

COMMENTS BY REVIEWER Reviewer: **WNA – Step 7** Page.53.of. x Country/Organization: WNA Date: 15/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		~~recorded in the safety document-tation.~~	should reduce it to the knowledge of the staff involved.				change to original text.

DRAFT SAFETY GUIDE No. DS 490 – DRC Comments

COMMENTS BY REVIEWER Reviewer: Country/Organization: FRANCE ASN 26/10/2018			Page.... of.... Date:	RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	2.8 Paragraph 2, page 7	2.8. For seismic design of research reactors, requirements from Ref [10] should be used. For fuel cycle facilities, requirements from Ref [11] should be used. Other types of nuclear installations than those or NPP should also use these requirements, as far as practicable. Application of these requirements [10] and [11] should be done using the graded approach described in Section 9.	[10] is for research reactors [11] is for fuel cycle facilities These guides should be used for plants such as research labs or nuclear waste facilities	Y			
2	3.9 Paragraph 1, page 10	If a deterministic approach was used for determining the site specific vibratory ground motion, a single value of such parameters (peak ground acceleration and spectral representation) ~~is the available result, finally obtained from such assessment~~ should be selected.	The previous wording was unclear	Y			

DS490, DRAFT Standard 'Seismic Design of Nuclear Installations'

COMMENTS BY REVIEWER Reviewer: Civil Engineering section Page.... of.... Country/Organization: Switzerland / Swiss Federal Nuclear Safety Inspectorate Date: 25/10/2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
General			The draft represents a valuable development of the existing Safety Guide NS-G-1.6. It addresses a number of new issues in the field of seismic design, particularly stimulated by the Fukushima experience and the lessons learned from it. Examples of extensions are: beyond design basis earthquake, safety margins, event response.				
General			Furthermore, we recommend to better address the following issues in the draft: - to have a more clearly formulated distinction in the requirements for deterministic vs. probabilistic design analysis, i.e. along the different analysis steps as e.g. site-response analysis, soil-structure interaction analysis, floor response spectra evaluation. - to have a more clearly formulated distinction in		Response to clarifications request: Design is mostly deterministic. Assessment of the seismic design robustness can be done using deterministic and/or probabilistic methods. BDBE is used for assessment of the seismic design robustness not for the design itself.		

			the requirements for design basis (DBE) and beyond design basis (BDBE) design analysis (incl. seismic capacity evaluation) - to include references to IAEA standards/guides related to the topic (e.g. recent SSI Tecdoc) - to include up-to-date regulation or references on the topic QM requirements on the documentation of the seismic design results (e.g. scope of electronic FE model data, input and output data of calculations, etc) - to include up-to-date regulation or references on the topic peer review of the seismic design results (strongly related to the above topic of documentation)		Based on IAEA rules TECDOCs cannot be referenced in a Safety Standard. This Safety Guide is aimed to respond to the IAEA applicable Safety Requirements not to national regulations that can be more prescriptive.		
	1.9		- The guide addresses an extended range of nuclear installations, including independent spent fuel storage facilities. This statement can be misunderstood in the sense that long-term underground facilities are included. We recommend to define the			Y	Nuclear installations are defined in IAEA Safety Glossary – does not include west disposal facilities (underground facilities).

			scope more specific in this aspect.				
	3.10	If a probabilistic approach was performed for determining the site specific vibratory ground motion, hazard curves (mean and fractile curves) of the level of a relevant parameter, ~~as the peak ground acceleration~~ as the ground motion Intensity Measure (IM), and its annual…	Relevant parameter is IM.			X	This paragraph refers to PSHA. Based on SSG-9 PSHA results does not include Intensity Measures. IM are basically used in conventional seismic codes.
	3.11		To what depth the soil properties should be available? There is information in sections 5.23 and 5.28 of this document. Please indicate depth and/or provide reference to item 2.14 in NS-G-3.6.			X	This level of details is not appropriate for this paragraph. It is specific to the type and configuration of the nuclear installation and soil profile.
	3.13. a)		Ground water table is missing in the list.	Y			
	3.13. b)		Definition of UB and LB is corresponding to the deterministic approach of uncertainty treatment. In the probabilistic approach uncertainty is treated directly. It is recommended to more clearly define how to treat uncertainties in the soil properties for both approaches.			x	We cannot get in such details in a Safety Standard. Such details are covered other technical publications.
	3.16.		It should be noted that the first approach with GMPEs is implemented in the framework of the PSHA. It cannot be performed a posteriori, as it is the case with the site response analysis (second approach).			x	First approach is based on GMPEs develop for rock or rock outcrop conditions + site response analysis. Second use GMPEs considering dynamic properties of the soil

							conditions at the site (e.g. using Vs30) . Depending of which approach was used in PSHA – confirmation of the control motion using much more detail geotechnical data in site response could be different.
	3.18.		It should be clearly noted that results of site response analysis for the vertical component (1D vertically propagating harmonic P-waves) by simply replacing Vs with Vp are considered nowadays to be inadequate. Special guidance on site response for the vertical component is needed here.			x	It is very clear mentioned in 3.18, 1) e).
	3.18. 1)	e) For vertical component, compressional wave velocity (VP) or Poisson ratio.	And ground water table is missing			x	Poisson ration is determine from Vs and Vp (measured).
	3.18. 2)		It should be indicated that usually a negative correlation between G and D exists.			x	Inappropriate level of details.
	3.18. 4)		The term “hazard curves” is used to describe the ground motion response spectra. It could be misunderstood.	y			
	3.18. 5)	…~~Note that the final design basis ground motion should be developed with enough safety margin beyond this level.~~	When the seismic hazard is determined by SSHAC method such as Level 4, there is no need for further safety margin.			x	Design Seismic Ground Motion includes always conservative factors (e.g. design factors).

	3.18. 6)	~~Verify~~ Validate the site response analysis results with the observed instrumental records (including microtremor measurement).	We have doubts that the site response analysis in the design calculations can be validated with microtremor records.			x	Verify is more appropriate.
	3.19.		The specification of the reference level (or control point) of the input ground motion should be explicitly addressed as an important early step in the process of DBE development. This step is a frequent source of misunderstandings between licensees and regulators.			x	Control point is mentioned in Para 3.22.
	3.19.	... (e.g., low seismically active areas), one level of seismic ground motion hazard, may be defined for design considerations (SL-1 = SL-2).~~., named as Safe Shutdown Earthquake or Maximum Design Earthquake.~~	The proper IAEA term for Safe Shutdown Earthquake is SL-2 earthquake.	y			
	3.23.	"…of being exceeded in the range of 1 x 10^{-3}~~-~~ to 1 x 10^{-5} (mean values) per reactor per year. The applicable annual frequency depends on the method used for the seismic hazard assessment.	When the seismic hazard is determined by SSHAC method such as Level 4, an AFE = 10^{-5} (mean values) would result in an unrealistic and too high hazard!			X	Severity of the hazard depends on the frequency of exceedance and needs to be selected on considerations related the required performance goal. The applicable frequency of exceedance does not simply depends on the methods used in hazard assessment.
	3.23.	(see para 3.5), the SL-2 ~~should~~ could be calculated with due consideration of additional margins and rounding aspects[7].	See comment on 3.18. 5). If PSHA uses a method such as SSHAC Level 4 there is no need for additional margins.			x	Since there is very limited experience on application of SSHAC Level 4 it should not dictated the

							conservatism needed to be considered in the Design Seismic Input. See resolution of 3.18 5)
	4.9.		For new seismic category 1 structures of nuclear installations it is considered good practice to limit the stresses to the linear range of material behaviour. This would be a more conservative and robust approach, providing margins which help to manage beyond design events.			x	4.9 says that if some limited nonlinear behavior is accepted – the adequacy of the remaining margins should be confirmed. This is appropriate since the Safety Guide address all nuclear installations
	4.17.		Crack width of reinforced concrete structure in the vicinity of the equipment support should be considered too.			x	para 4.17 talks about seismic design of the earth structures.
	4.19. c)	Damping, as function of frequency and/or maximum displacement (friction pendulum) and number of cycles expected during beyond design conditions.		y			
	5.17. ff		Consideration of incoherency effects of the ground motion is not mentioned in this chapter. If this effect will not be treated, then a reference should be provided.	y			
	5.38.	…radiation embrittlement, cracking in concrete structures, fatigue, corrosion…				x	Too much details for a Safety Standard. 5.38 simple says to consider ageing effect – is not intended to

							provide a comprehensive list of ageing mechanism.

DS490 Draft Safety Guide "Seismic Design of Nuclear Installations"

COMMENTS BY REVIEWER Reviewer: SSTC NRS Page 1 of 3 Country/Organization: Ukraine Date: 26 Oct 2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	1.2	"The previous versions of the IAEA Safety Guides on the evaluation of the seismic hazards and the seismic design and **qualification** were ones of the most extensively used by Member States …" or "The previous versions of the IAEA Safety Guides on the evaluation of the seismic hazards and the seismic design **of new and evaluation of existing nuclear installations** were ones of the most extensively used by Member States …"	Clarification of the wording			X	1.2 paragraph refers to the design safety guides (for new NPPS and nuclear installations) not for evaluation of the existing ones. Paragraph 1.10 clear mention: "The assessment of the seismic safety of an existing nuclear installation is beyond the scope of this Specific Safety Guide; such an assessment should follow the approaches and procedures outlined in Ref. [3].
2.	3.15	"For performing the seismic soil response analyses, as defined in Ref. **[5]**, the following site classification is used …"	Such site classification is indicated in reference [5] (NS-G-3.6), not in [4] (Terminology Used in Nuclear Safety and Radiation Protection).	Y			

3.	3.22	"The SL-2 design earthquake level is defined based on the results and parameters obtained from the seismic hazard assessment, as indicated in para **3.7** above, and according to specific criteria established by the regulatory authorities to achieve a certain target level for its annual frequency of exceedance"	Reference to para 3.7 seems to be more appropriate.	Y			

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COMMENTS BY REVIEWER Reviewer: SSTC NRS Page 2 of 3 Country/Organization: Ukraine Date: 26 Oct 2018				RESOLUTION			
4.	3.23	"Thus, using the seismic vibratory ground motion hazard curves and uniform hazard response spectra obtained for such level of established annual frequency of occurrence (see para **3.10**), the SL-2 should be calculated with due consideration of additional margins and rounding aspects[7]"	Reference to para 3.10 seems to be more appropriate.	Y			
5.	3.31	"The determination of the BDBE should be based on the specific hazard evaluation for the site **(e.g. based on considerations derived from the probabilistic seismic hazard assessment[8]).** **An alternative to define the BDBE and the associated loading conditions is to define the BDBE earthquake level by a factor times the SL-2 earthquake level[9]"** *(change references 8 and 9 respectively)*	Determination of the BDBE from PSHA results is not an alternative of its determination based on site-specific hazard evaluation (it is a special case of site hazard evaluation).	Y	3.31. The determination of the BDBE and the associated loading conditions can be by: "a) Defining the BDBE earthquake level by a factor times the SL-2 earthquake level . b) Defining the BDBE earthquake level based on considerations derived from the probabilistic		

					seismic hazard assessment."		
6.	3.28	"Therefore, during the seismic design of a new nuclear installation, two different sets of earthquake levels should be determined: (i) one set, noted as DBE and constituted by the SL-2 and SL-1 levels, as defined in paras **3.19 to 3.26** above, for which adequate safety margins should be provided by the seismic design …".	Reference to paras 3.19-3.26 seems to be more appropriate.	Y			

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COMMENTS BY REVIEWER Reviewer: SSTC NRS Country/Organization: Ukraine			Page 3 of 3 Date: 26 Oct 2018	RESOLUTION			
7.	3.33-3.45, Table 1	Add to the Chapter "Seismic categorization for structures, systems and components" item regarding consideration of SL-1 DBE	Such requirement is contained only in Table 1: "Both **SL-1** and/or SL-2 should be used as prescribed by applicable regulations and nuclear codes". How many SL-1 DBE should be considered in the design of a new NPP (for example in case of seismic qualification of components by test)? We propose to add such recommendation to the document.			x	Seismic categorization is not describing how to seismically qualify.

TITLE:
DS490 Seismic Design of Nuclear Installation

COMMENTS BY REVIEWER Reviewer: KINS Page 1 of 1 Country/Organization: Republic of Korea / Korea Institute of Nuclear Safety Date: Nov. 5, 2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	3.19/2	~the Design Basis Earthquake (DBE) should be determined *and* aimed to define the level of the seismic vibratory ground motion hazards for the design of the SSCs of the nuclear installation~	The expression of "and" needs to be added to make the sentence clear.	x	"…Design Basis Earthquake (DBE) should be determined. It is aimed to define…"		
2	7.4/2 and 7.6/5	There is a correlation between hazard level used to define SL-2, seismic margin capacity (HCLPF) and seismic performance goal (e.g. Seismic CDF/LRF). For prevention of early or large releases the minimum facility level seismic margin HCLPF should be consistent with the required seismic performance goal (e.g. LERF < 1.0^{-6}).	It needs to define the "seismic performance goal clearly (e.g. LRF or LERF)" since the LRF or LERF are used to define the seismic performance goal in paras. 7.4 or 7.6, respectively.	x	Considering the comments, S-LERF/S-LRF as well as S-CDF are defined in paragraph 7.4 and 7.6. The footnotes 31 and 32 are improved, as well. Quantitative targets for LERF/LRF are established by national regulatory bodies. Facility HCLPF represents a point of facility level mean seismic fragility curve. If HCLPF is		

					changed the seismic fragility is changed and S-LERF/LRF will change as well. This defines the correlation between DBE, HCLPF and Seismic Performance Goal. In some MSs LERF risk matric is used as a surrogate for Level 2 PSA. One set of sequences is that in which the effects of the external hazard might compromise containment integrity and thereby possibly contribute to LERF It is out of scope of this publication to get in a detailed discussion about CDF, LERF/LRF.		