DRAFT SAFETY GUIDE No. DS 507 – DRC Comments

COMMENTS BY REVIEWER Reviewer: Page.... of.... Country/Organization: FRANCE ASN 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	1.8	This safety guide addresses the following nuclear installations [2] : - Land based stationary nuclear power plants; - …. - ~~Storage for nuclear spent fuel~~ - … - Irradiators; - Particle accelerators; - Storage and management facilities for nuclear waste, or fissile material	In France, irradiators and particle accelerators are considered as nuclear installations and are submitted to the same seismic regulation. We propose to add these types of installations. We also have storage and management of fissile material (not only spent fuel) and nuclear waste.		.	X	IAEA safety glossary identifies the type of facilities covered by the term nuclear installation. Particle accelerators are not covered, probably because they do not form part of a licensed nuclear fuel cycle. However, the list provided in para. 1.8 does not completely tie in with the glossary. Therefore recommend, revising para. 1.8 to remove list: "This safety Guide addresses all types of facilities classed as nuclear installations in the IAEA Safety Glossary [2]." PLUS add para. Number to second part of 1.8, to make it 1.9.

Seismic Hazards in Site Evaluation for Nuclear Installations
DS 507 (Step 7)
Version from 18 September 2018

COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 8 Country/Organization: **Germany** Date: 22.10.2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	3.9	In the case of investigations for evaluating the potential for earthquake generated tsunamis ~~(see NS-G-3.6 [3])~~, the geological and seismological investigations should also include the study of seismic sources located at very great distances from the site.	The current text seems to imply that NS-G-3.6 discusses the generation of tsunamis by earthquakes. As this is not the case, it is recommended to delete the reference to NS-G-3.6.	X	NSG3.6 checked and comment is true.		
2	3.34	~~As indicated in para. 3.3, information and data in relation to pre-historical and historical periods is required to be collected for assessing the earthquake related external hazards; this might affect the safety of the nuclear installations at a site due to the need to consider~~ <u>To be able to reliably characterize</u> events that occur with very long recurrence periods (or very low annual frequencies of exceedance)~~. To meet such a requirement~~, the seismological database should include the consideration of past events that might have the potential to generate seismic hazards at the site. The database should recognize two different types of data related to two temporal scales -	In its current version para. 3.34 seems to make no sense. If the basic idea is that it is necessary to acquire pre-historical and historical data to be able to assess events with very long recurrence periods, the proposed new text might be clearer. If the paragraph is meant in any other way, thorough rephrasing would be appreciated.	X	Comment accepted but modify the suggested text as shown in the revision.		

		historical and archeological/geological or pre-historical - as defined below: a) Historical stage, i.e. the period that is described in written documents~~, including also palaeoseismological and archaeological evidence~~. This period is further subdivided as: b) Pre-historical stage, i.e. the period that is not described in written documents. It includes the period in which earthquake evidence might only be retrieved from archaeological sites as described in carvings, paintings, monuments, drawings and other artefacts, including palaeoseismological/geological evidence.					
3	3.35 b)	The temporal scales of the investigations should be divided as follows: a) Pre-historical stage, i.e. the period that is not described in written documents. It includes the period in which earthquake evidence might only be retrieved from archaeological sites as described in carvings, paintings, monuments, drawings and other artefacts, including palaeoseismological evidence. b) Historical stage, i.e. the period that is described in written documents~~, including also palaeoseismological and~~	To have a clear distinction between the "pre-historical stage" and "historical stage", "palaeoseismological and archaeological evidence" should be clearly attributed to only one of these stages. Although, admittedly, such evidence might also be available for events in the "historical stage" (and might then serve as additional information), the primary source of information in the	X	Comment accepted, but absorb this para in to 3.34 as indicated above.		

		~~archaeological evidence~~. This period is further subdivided as: …..	"historical stage" are the written documents.				
4	4.9	The validity of the proposed seismic source models ~~based on these~~ should be tested against existing knowledge and information, for example, by comparing long term strain rates predicted by the model against available and reliable geodetic and geological observations.	A word seems to be missing after "based on these". As this part of the sentence seems not to be essential anyway, the words should be deleted.	X			
5	4.20	In addition to the maximum potential magnitude, ~~a magnitude frequency relationship should be derived~~ for each seismogenic structure included in the seismic source model the following characteristics should be determined~~, to determine~~: (a) the rate of earthquake activity; (b) an appropriate type of magnitude– frequency relationship (e.g. characteristic or exponential); and (c) the uncertainty in this relationship and in its parameters. In the case of the characteristic earthquake occurrence model, the last event should be identified as far as possible.	The current version of para. 4.20 contains a circular statement: "[…] a magnitude–frequency relationship should be derived […] to determine: […] (b) an appropriate type of magnitude– frequency relationship […]". The proposed new text tries to resolve this problem.	X			
6	4.30	In addition to the mmax, ~~a magnitude–frequency relationship should be derived~~ for each seismogenic structure included in the seismic source model the following characteristics should be determined~~, to determine~~: (a) the rate of earthquake activity; (b) an appropriate exponential magnitude–frequency relationship (e.g. Gutenberg–Richter relationship); and	The current version of para. 4.30 contains a circular statement: "[…] a magnitude–frequency relationship should be derived […] to determine: […] (b) an appropriate type of magnitude– frequency relationship […]". The proposed new text tries to resolve this problem.	X			

		(c) the uncertainty in this relationship and in its parameters.					
7	6.3	The vibratory ground motion seismic hazard analysis should use all the elements and parameters of the postulated seismic source model(s) (see Section 4), including the quantified uncertainties. Alternative models proposed by the expert(s) ~~of the~~ in the field of seismic hazard analysis ~~team~~, should be formally included in the hazard computation.	The current formulation of para. 6.3 limits the hazard assessment to SSHAC Level 4 types of assessments as the existence of teams for the individual areas of the seismic hazard is assumed. To allow for lower level hazard assessments (e.g. SSHAC Level 2 or 3), a reformulation would be appreciated.	X	Comment accepted in principle, but note that SSHAC studies can involve multiple experts below Level 4. However, for sites with low radiological hazard the PSHA team might only have one expert providing seismic source models. Propose to slightly amend revised text as shown.		
8	6.9 2)	The evaluation of the vibratory ground motion seismic hazard by probabilistic methods should include the following steps: …. 2) Develop a detailed work plan with careful consideration of the experts that will constitute the project team, and the project reviewers who will participate in the independent peer review process. ~~The~~ If a participatory review is provided in the project plan, the work plan should consider the conduct of technical meetings to be held with participation of experts from the project team and from the review team to discuss topics related to (i) issues relating to the hazard determination and the availability and	Depending on the regulatory framework, the peer review might be performed only after the seismic hazard assessment by the licensee is already finished. In this case a meeting between the reviewers and the project team with the goals described in this paragraph (in particular (iii)) might not be reasonable, we suggest to change the text.	X	Comment accepted, but revised text amended as indicated to better reflect the SSHAC requirements.		

		quality of the compiled data, (ii) alternative interpretations, (iii) feedback for the project execution. If a participatory review is not included in the project plan, then this should be justified, since relevant good practice currently emphasizes the importance of the participatory peer review process.					
9	6.9 6)	The evaluation of the vibratory ground motion seismic hazard by probabilistic methods should include the following steps: …. 6) Build analysis models (logic trees) and perform hazard calculations including sensitivity analysis in a phased approach, starting with a preliminary analysis round, discussion of the preliminary results, ~~feedback from the review meetings,~~ and ending with a final analysis round that will provide the necessary deliverables defined in accordance with the user needs.	Depending on the regulatory framework, the peer review might be performed only after the seismic hazard assessment by the licensee is already finished. In this case a feedback from the reviewers cannot be used in the project.	X			
10	6.15	A deterministic approach can be used as an alternative to the probabilistic approach. Care must be given to select a conservative scenario of the relevant seismic hazards (e.g. a conservative level for the vibratory ground motion hazard) in line with national practice.	In its current version this paragraph recommends using a deterministic approach for design purposes. That is probably not the original intention. The proposed modification leads to a more meaningful statement.	X	Comment accepted. Note that revised text is amended slightly to include “national practice”, since as originally written, it implies that a deterministic approach MUST be used as input to a conservative		

					design process (as indicated by the MS comment), whereas the most common approach world-wide is to use PSHA to either support (or underpin) a standard design basis, or directly to derive suitably conservative design bases. The corresponding para 6.8 on probabilistic methods should be amended to say this. Similar comment form USA. Amended text is indicated.		
11	6.16 2)	The evaluation of the vibratory ground motion seismic hazard by deterministic methods should include the following steps (it should be noted that the first five steps of this process are essentially the same as those described in para. 6.8 for performing a probabilistic seismic hazard assessment): …. 2) Develop a detailed work plan with careful consideration of the experts that will constitute the project team and the project reviewers who will	Depending on the regulatory framework, the peer review might be performed only after the seismic hazard assessment by the licensee is already finished. In this case a meeting between the reviewers and the project team with the goals described in this paragraph (in particular (iii)) might not be reasonable.	X	Comment accepted, but see note against comment 8 and amend revised text in same way.		

		participate in the independent peer review process. ~~The~~ If a participatory review is provided in the project plan, the work plan should consider the conduct of technical meetings to be held with participation of experts from the project team and from the review team to discuss topics related to (i) issues relating to the hazard determination and the availability and quality of the compiled data, (ii) alternative interpretations, (iii) feedback for the project execution. If a participatory review is not included in the project plan, then this should be justified.					
12	6.16 8)	The evaluation of the vibratory ground motion seismic hazard by deterministic methods should include the following steps (it should be noted that the first five steps of this process are essentially the same as those described in para. 6.8 for performing a probabilistic seismic hazard assessment): …. ~~8) Compare the results of the deterministic and probabilistic assessments. This will help in the interpretation of the relevant annual frequency of exceedance for deterministic seismic hazard analysis. In addition, this will enable the deterministic assessment results to be calibrated against the probabilistic seismic hazard assessment results, allowing some risk and performance insights to be developed. This~~	According to the introductory sentence of para. 6.16 the items 1) to 10) should be part of the “evaluation of the vibratory ground motion seismic hazard by deterministic methods”. As 8) goes beyond this deterministic evaluation, it would be better to extract this item and make it a separate paragraph, e.g. 6.17 (with the following paragraphs being renumbered accordingly).	X			

		~~comparison should also take into consideration the evaluation of the results based on the available observations and data, in the same manner as for probabilistic assessment (see para. 6.11)~~					
13	6.17 New item	If both probabilistic and deterministic assessments are performed, the results from both should be compared. This will enable the deterministic results, including the dersign basis hazard level, to be calibrated against the probabilistic results, allowing some risk and performance insights to be developed. A further calibration exercise should be performed against the de-aggregation analysis to determine the characteristics of the design basis earthquake at the site. (see para. 6.11) Footnote added near start of document, suggested on first use of annual frequency of exceedance in para. 3.34: "The nuclear engineering community uses the term *annual frequency of exceedance* when mathematically the term *annual exceedance probability* is more accurate. At the low values of interest here, both terms can be used interchangeably and so this guide refers generally to annual frequency of exceedance in recognition of the expectations of the nuclear audience likely to use this guide."	See explanation to comment No. 12	X	The original text and the comment assume that both probabilistic AND deterministic assessments are undertaken. This is not always true, so making a comparison in this case way will not always be possible. Amend as indicated. Also, need to check that "assessment" and "analysis" are not used interchangeably. Note also that reference is made to "annual frequency of exceedance". The term annual probability of exceedance is becoming more widespread and is widely used in non-seismic areas.		

					Recommended that near the start of the document have a footnote that says the two terms are equivalent when used in this document. Text of footnote suggested.		
14	8.21, Line 5	…. In such cases, the part of the tsunamigenic sources that are included in the region relevant to the seismic hazard evaluation ~~(generally considered to be about 300 km in radius)~~ should be consistent with the seismogenic attributes of these faults, while taking into account that faults on land and those that do not generate significant vertical motion would not contribute significantly to the tsunami hazard.	The parenthesis seems to be a relic from a former version of SSG-9 as in the current draft no specific distance is mentioned. To avoid introducing a quantitative requirement for the overall seismic hazard assessment in this tsunami specific paragraph, it is recommended to delete the parenthesis.	X	This sentence as it was and as it has been revised is complex and unclear. Since seismogenic attributes implies a propensity to generate vertical uplift or subsidence of the sea bed, accepted with re-wording as below: "…The investigation should concentrate on those seismic sources with the potential to generate significant vertical displacement of the seabed, since it is this motion that is most likely to cause tsunamis."		

TITLE: External Events Excluding Earthquakes in the Design of Nuclear Installations (DS498)

COMMENTS BY REVIEWER Reviewer: AERB Country/Organization: India / AERB			Page.... of.... 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.	3.18	The data collected at regional scale should have a resolution necessary to reveal any features considered to be significant for the analysis of seismic hazard…	In line with conventional international practice and to have representation of regional study on an informative scale. Suggested scale of 1: 1,000,000 could lead to loss of details/ information needed for evaluation.	X	Comment accepted but it is not advisable to specify the map scale. Instead the map scale should be sufficient to reveal any features necessary for the assessment. Text revised as indicated.		
2	3.26	Existing text: Site vicinity studies should cover a geographical area sufficient to encompass all faults and other seismotectonic features requiring detailed geophysical investigation; this is typically not less than 5 km in radius from the border of the nuclear installation site area.	There is lack of clarity in definition of the term "site area". As per IAEA glossary definition "site area" may be identical to operations area or area within the security perimeter fence. The requirements related to the above in different countries vary significantly. Considering this aspect the stated stipulation could add a lot of subjectivity in the interpretation of the	X	Comment accepted in principle. In reality, the detailed investigations close to the site need to extend to sufficient distance to encompass all faults and features requiring detailed investigation. Text is amended to say this.		

			guidance. The proposed formulation "border of" may need reconsideration to minimize subjectivity.				
3	4.21	"…. This approach is viable because many studies have shown that the b value of the Gutenberg–Richter relationship varies over a relatively narrow range within a given tectonic setting". For 'a' values, an approach based on strain rates can be used if such data is reliably available from geophysical investigation. However, for many low seismicity areas, 'a' values are derived from the regional historical earthquake catalogue, since often this is the most reliable indicator of regional seismicity.	Generally, final results of seismic hazard analysis is not much sensitive to 'b' value. Average 'b' value for the site region can be used for assessment. Hence the specified requirement for 'b' value is adequate. However, the same is not true for 'a' value. Hence, state of art practice for determination of 'a' value for such region is added.	X	For a low seismic area, strain rates may not be available from geophysical evidence sufficient to predict 'a' values. Indeed 'a' values almost always are derived from the historical earthquake catalogue in low seismic regions. This latter approach is assumed to be what is meant by Poissonian model Suggest revised text as indicated.		
4	5.18	"….Any simulation approach, if used, should be carefully validated and calibrated against available ~~empirical~~ *recorded data from the region of interest* ~~data~~."	For better clarity.	X	Minor editorial change to improve English.		
5	5.20	…. …….(d) Subsurface structure parameters, such as shear and compressional (alternatively, Poisson's ratio) wave velocities,	The empirical factor Kappa (κ), governs the rapid decay of spectral amplitude at high frequencies and is one of			X	Debate on kappa not yet mature enough to include in a Safety Guide. Discussed in

		density and anelastic attenuation factor (i.e. seismic quality factor Q) *and empirical factor Kappa (κ).*	the important parameters required in the simulations of earthquake strong ground motions.				TECDOC-1796. No change recommended.

Japan NUSSC Comments on DS507, "Seismic Hazards in Site Evaluation for Nuclear Installations"

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 4 Country/Organization: Japan / NRA Date: 2 Nov. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	7.10.	If during the selection and evaluation stages of a new site for a nuclear installation, reliable evidence is collected demonstrating the existence within the site vicinity and site areas of a capable fault with potential for seismogenic (i.e. primary) fault displacement phenomena, the feasibility of design, construction and safe operation of nuclear installations at this site should be evaluated. IfIn such cases, if its effects cannot be compensated for by design/engineering protective measures, this issue should be treated as an exclusionary attribute (see para. 3.8 of IAEA Safety Standards Series No. SSG-35, Site Survey and Site Selection for Nuclear Installations [9]) and an alternative site should be considered.	To add some Member States practices keeping a consistency with the latest version of DS484, para. 5.4. The case that a capable fault exists and its effect cannot be compensated for by design/engineering protective measure is only treated as an exclusionary attribute. The text of para. 7.10 states the cases with a capable fault within both site vicinity and site areas but without stating the reason why the case with a capable fault within site vicinity is considered as an exclusionary attribute. The existence of any capable faults in the site area is considered as an exclusion condition, since, generally speaking, it is commonly recognized that there is not practical and reliable counter measures against the fault displacement hazard in the nuclear installations. On the other hands, the existence of a capable faults with potential of seismogenic faulting in the site vicinity is also considered as an exclusion condition without exception in the text.			X	1, This document is not the safety requirements (SR – DS484) but a safety guide providing an interpretation of these requirements. Every MS shall follow the SR, therefore the last sentence of para. 5.4 in DS484 has a broader scope than provided in this guidance. This SG at para. 7.10 is a more restricted interpretation than the SR, because this is providing a preferred interpretation in line with current accepted international practice. Therefore, this safety guide does not consider the potential for CF as anything but an exclusionary attribute.

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 4 Country/Organization: Japan / NRA Date: 2 Nov. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			Two cases (i.e. a capable fault within a site vicinity and a capable fault within site areas) should be distinguished since the experience of seismic design in Japan shows that engineering measures against the vibratory ground motion hazard are available and reliable. In detail, Japanese practices can be summarized as the following three conditions - that adequate design basis ground motions have been appropriately formulated (e.g., such as by application of ground motion simulation methods stated in Section 5), - that reliable practice of seismic design has been recorded in the past, and - that the adequacy of the seismic design plan is confirmed by the regulatory bodies. Given that the proposed new site has been adequately designed against the vibratory ground motion hazard and there is reliable practice of seismic design in Member States, the situation of a capable fault within the site vicinity could be considered as a discretionary condition.				2. In this paragraph, fault displacement hazard is discussed, but the MS discusses vibratory ground motion hazards only. 3. It is noted that uncertainty in the location of capable faults is high, and primary faults within the site vicinity may influence the potential for displacement on secondary faults within the site area, and therefore directly under the NPP.

COMMENTS BY REVIEWER Reviewer: Japan NUSSC member Page of 4 Country/Organization: Japan / NRA Date: 2 Nov. 2018				RESOLUTION			
No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
2.	7.13.	If a new nuclear installation is to be built on a site on which there is already one or more existing nuclear installations, and information comes to light that there is a potential capable fault in its site vicinity, it should be demonstrated that there are no traces of fault displacements related to the capable faults beneath the planned nuclear installations, and relevant ground motion hazards are appropriately evaluated to determine the input for seismic design if the capable faults have potential of seismogenic faulting. ~~the approach for the new installation should be as recommended in paras 7.10 and 7.11.~~	Clarification for the new addition nuclear installations in the same site. There is an inconsistency with the original text since it states the construction of new nuclear installations but allows the operation of existing nuclear installations given the same condition of "a potential capable fault in its site vicinity." It is proposed to explicitly state the two conditions for constructions of any new nuclear installations as mentioned in the new text. Note that the two conditions are also default requirements for the existing nuclear installations.			X	This paragraph doesn't discuss the capable fault beneath the nuclear installations. Capable faults within site area or within site vicinity are discussed.
3.	General	Add clear definitions as followings with differences; - vibratory ground motion hazard - fault displacement hazard	Clarification.			X	Distinction is clearly defined both in the DS484 and DS507 and no new proposed text from Japan.

TITLE: DS507 Seismic Hazards in Site Evaluation for 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	5.17/5	The methodologies to develop weights for individual GMPEs *should be* based upon the degree of confidence in each GMPE and/or approach and the conformance with existing data.	The expression of "should be" needs to be added to make the sentence clear and it is consistent with the description in para. 5.17.	X			
2	6.7/2	The design basis may be derived using either a probabilistic or a deterministic approach, *while* the probabilistic safety assessment of the nuclear installation can only be performed using the results of a probabilistic seismic hazard assessment. Requirements	The expression of "*while*" needs to be added to make the sentence clear and it is consistent with the description in para. 6.27	X			
3	6.22/1	If the first approach described in para. ~~6.20~~ *6.21*is utilized,	The paragraph number was corrected.	X			
4	6.22/3 from bottom	(6) Verify the site response analysis results with any available observed instrumental records~~)~~.	The right parenthesis was removed.	X			
5	8.29/4	… highly ~~uncertainty~~ *uncertain*.	The expression of "uncertain" seems to be appropriate in this sentence.	X			

TITLE: Seismic Hazards in Site Evaluation for Nuclear Installations (DRAFT SAFETY GUIDE No. DS 507)

COMMENTS BY REVIEWER Reviewer: WASSC Member Page.... of.... Country/Organization: Pakistan/PNRA Date: October 26, 2018				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	3.42/5	ii) assessment of uniform size measure to apply to each earthquake (this will include magnitude scale conversions to express all catalogue entries to a single magnitude scale, normally Mw).	In order to compile a project earthquake catalogue different magnitude scales need to be converted using different empirical relations to have a final uniformly converted catalogue.	X	The comment is technically correct and an important feature of compiling a catalogue. However, point (ii) covers this point in less detail. Suggested amendment incorporates MS text in to point (ii).		
2	3.47	f) All aspects of the development of the earthquake catalogue should be reported to justify the judgments that have been made in compiling it. Specific attention should be paid to the selection of empirical magnitude conversion relations, the selection of the magnitude scale for all catalogue entries, and compaision of the project catalogue with other similar catalogues relevant **to the region.**	f) Since different magnitude conversion relations are used therefore a comparison is required to analyze which one is better to be used for final hazard analysis. g) A discussion should be provided to justify the usage of finalized magnitude conversion relationship as compared to others.	X	This comment is supported principle. But it is incorporated implicitly in paras. 3.47 & 3.48. What could usefully be added is a further clause on reporting, as indicated in (f).		

			h) A comparison is required to ensure the reliability of final project specific composite catalogue while using other catalogue sources.				
3	Page 19	The title "Project Earthquake Catalogue" may be changed as "**Project Specific Composite Earthquake Catalogue**"	Since final catalogue is combination of various catalogue sources which may be called composite catalogue which takes input from other catalogues.			X	This comment is rejected because it adds complication to the title of the catalogue that may not always be appropriate.
4	4.17/7	.....is a poor and un conservative estimate of $m_{max.}$ **Consideration should then be given to the use of appropriate empirical relationships to derive** m_{max} **values from controlling or significant faults in the region (fault geometry, faulting mechanism etc.). But if the currently faulting mechanism cannot be reliably determined,~~considering detail fault geometry like length, width (seismogenic depth), etc. to have more appropriate and conservative m_{max} values.~~** the use of global analogues should ...	To calculate Mmax for a particular seismic source using available relevant and updated (if any) empirical relationships can give more better Mmax values as they will be using fault related data.	X	Comment accepted but modified since looking to fault geometry may not be practical in countries, say, where historical earthquakes cannot be tied to particular faults. Suggested change to amended text as indicated.		

5	5.9	~~**g) GMPEs should be compared with local strong motion data (if available) to check the applicability and suitability of GMPEs.**~~ **(e) They should make use of available local ground motion data as much as possible in their definition. If this is not possible, and GMPE's are used from elsewhere, if possible they should be calibrated by comparing with local strong motion data; if no suitable data is available from the region of interest, a qualitative justification should be provided for why selected GMPEs are suitable.** ~~**GMPEs can also be generated by stochastic simulation based on a representative range of vlues for stress drop, Q, etc**~~**.**	Applicability of GMPEs for specific NPP project is important to be checked through comparison with local strong motion data. Such comparison will provide better understanding of using right attenuation model.	X	This comment is partially captured by e) and so revised text suggested to e) to capture this comment explicitly.		
6	6.9(3)/1	Compile the integrated geological, **seismological,** geophysical and geotechnical database	Seismological database should also be integrated along with other databases to have better understanding of geological structures and associated seismicity.	X			

Comments on IAEA Draft Safety Guide
SPESS Step 7
***Seismic Hazards in Site Evaluation for Nuclear Installations* (DS507)**

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.	3.32 (a):	"…… (e.g. Poisson's ratio, Young's modulus, shear modulus reduction or non-linear properties, dynamic damping properties, density, relative density, shear strength and consolidation characteristics, grain size distribution, P-wave and S-wave velocities)."	Dynamic damping properties (hysteretic damping, and damping ratio as function of shear strain) are important parameters in ground motion and site response determination.	X			
2.	6.22	Add a requirement either after (3) or after (7): "(#) If the site strata are not horizontally uniform (e.g. valley, layers with inclination angle greater than 20 degrees), 2-D or 3-D effects in site response should be examined."	Irregular site strata will greatly affect site seismic response analysis results, therefore a 1-D model may not be able to provide realistic site response estimate.	X	Remove "20 degrees" and add after (3): "If the site strata are not horizontally uniform (e.g. valleys, layers with significant inclination), inhomogeneous effects in site response should be examined."		
3.	2.2/8	"…as well as relevant offshore areas…"	Consistency with 2.3	X			
4.	3.6	Replace 'project fault' with 'project seismicity'	In developing a database of seismogenic features, it is not			X	Comment not accepted because intent of para. 3.6 is to collect geological seismogenic

			always possible or feasible to identify the individual faults related to seismicity				features, which are primarily faults. Many projects have "Fault Data Sheets" for each identified fault and collect these in to a fault catalogue. The Seismological database is referred to in para. 3.7 and is implied to be a separate database to the geophysical one.
5.	Sections 8.21 – 8.23	We recommend that a new section be added to the tsunami analysis section to address "hydrodynamic impacts and associated effects." The draft guidance makes no reference to the associated effects due to tsunamis. Such effects would include but not be limited to static and dynamic loads. Consideration of various loading scenarios is an important consideration in the structural review of those structures system and components important to safety. Section 8.29 of this draft document references/alludes to this design theme.	The draft guidance calls for a tsunami assessment for sites near coastal/ marine settings (at page 49). The scope of those assessments is to be consistent with another IAEA Safety Standard, No. 18. The only design parameters of interest described in IAEA No. 18 are the tsunami wave run-up height and horizontal extent of inundation. What is absent from Draft Safety Guide 507 under review (as well as referenced IAEA No. 18) is consideration of associated effects			X	This is a useful comment from a design point of view. But the parameters noted refer to loading effects onto a coastal structure and would be derived from tsunami hazard parameters such as wave height and inundation etc. Since this is a hazard document and not a design document, then the comment is rejected. Another revision of safety guide NS-G-1.5 (the draft of which is presented to the same NUSSC as DS498) has the Section 5 that covers design themes of the protection of nuclear installations against hydrological hazards.

			such as hydrostatic and hydrodynamic loads. While definition of these design parameters may be beyond the intended scope of Draft Safety Guide No. 507, they need to be recognized as important design parameters to consider in the evaluation of nuclear power plant designs, especially when intake structures, water supply canals, or reservoirs factor into the basic power plant configuration.				
6.	8.23	Include a discussion of hydrodynamic loads/impacts.	While definition of these design parameters may be beyond the intended scope of Draft Safety Guide No. 507, they need to be recognized as important design parameters to consider in the evaluation of nuclear power plant designs, especially when intake structures, water			X	See comment above.

			supply canals, or reservoirs factor into the basic power plant design. As Section 8.29 of this draft document references this design theme, it is recommended that a new section be added to address "hydrodynamic impacts."				
7.						X	Comment missing. No response needed.
8.	Section 8.28 Page 51	On page 51 it is stated that "... This information should be properly analyzed, including the specific characteristics (e.g. water mass of the dams), to ensure the safety of the nuclear installation at the site or to implement adequate site related mitigation measures ...." It is suggested that "water mass of the dam" be replaced by "water mass controlled or retained by the dams." It is suggested that "to implement adequate site related mitigation measures" be extended to "including an emergency action plan."	The emergency action plan is prepared for handling emergency operation of power plant to shut-down when a potential dam break is imminent and the plant is expected to be inundated.	X X		X	Scope does not include emergency plans.
9.	Section 8.29 Page 51	On page 51, the author used "hydrological energy" in the context. It is suggested that "hydrological energy" be replaced by "hydrodynamic impacts."	"Hydrological energy" is not common terminology for a dam safety professional.	X			
10.	Section 8.29 Page 51	On Page 51, it is stated "... A landslide might produce natural dams and the potential for these dams to break is highly uncertainty...."	"Natural dams" is not clearly defined	X	Comment accepted, but		

		It is suggested that "natural dam" be replaced by "mud flows, floating debris, and temporary debris dams." Also suggest: the potential for these dams to break ~~is highly~~ has high uncertainty. the potential for these dams to break is highly uncertain.	for dam safety professional.		similar comment from Korean Republic. Amended text is indicated.		
11.						X	Comment missing. No response needed.
12.	8.28	Replace 'water mass of the dam' with 'water mass retained by the dam'	clarity	X			
13.	8.28	'to ensure the safety of the nuclear installation at the site or to implement adequate site related mitigation measures including an emergency action plan.'	The emergency action plan is prepared for handling emergency operation of power plant to shut-down when a potential dam break is imminent and the plant is expected to be inundated.			X	Repeat of comment 8.
14.	Page 12, para 3.15	Insert new text: "The size of the region to be investigated for assessing vibratory ground motion hazards should be large enough (are typically not less than 300 km in radius) to incorporate …"	Not specific enough.			X	Safety Guides should be wary of providing specific numerical guidance, although figure quoted is typical. However, 300km is a large region in a low seismic country. Suggest following amendment to end of sentence: "… a few hundred kilometres in radius, or in keeping with

							national requirements of Member States."
15.	Page 20, para 3.51	Insert new text: "In case the seismic network in the site area is not extensive to obtain necessary seismic information, to acquire …"	The US does not require installing a seismic monitoring system.	X	Comment accepted in principle but suggest alternative amendment to para. 3.51, as below: "To acquire … site response, it is advantageous to install or have access to a seismic monitoring network …".		
16.	Page 29, para 5.9, a)	Insert new text: "They should be current and well established preferably published in peer reviewed journals …"	Not specific enough			X	IAEA does not just recognize peer reviewed journal information. But (a) expects such GMPE data to be well established. Recommend no change.
17.	Page 33, para 6.8	Add to the phrase before the last phrase: "… and when probabilistic risk assessment (PRA) is required."				X	This is what the existing text currently says, notwithstanding use of PSA rather than PRA. No change recommended.
18.	Page 35, para 6.10	Don't recommend such extremely low probability as $10^{-}8$.	It is too uncertain for such probability. $10^{-}6$ can be the lowest that can be justified	X	Agree with comment. Safety Guides should not generally include numerical criteria. 10-8/yr for a natural hazard is very low and beyond the screening		

					frequency for fault initiators in some countries. Consider amending sentence as below: "This value can be extremely low ~~(e.g. 10-8)~~ when it is associated with seismic probabilistic safety assessment studies, where probabilistic criteria (such as ~~in which the nuclear power plant has very low c~~Core ~~d~~Damage ~~f~~Frequency ~~or~~and ~~l~~Large ~~e~~Early ~~r~~Release ~~f~~Frequency, in relation to non-seismic initiators) are themselves very low."		
19.	Page 36, para 6.15	Revise paragraph: "In these cases, conservative values of the key hazard parameters should be estimated to define an appropriate design basis for the nuclear installation in accordance with established safety margins within a defense-in-depth framework. The deterministic approach uses single individual values (i.e. a probability of 1) for key parameters leading for a single value for the result (as defined in IAEA Safety Standards Series No. SSG-3, Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants [8])."	It sounds like a deterministic approach is more conservative, and this is not correct.	X	Comment accepted but similar comment form Germany. Amended text is indicated.		

		A deterministic approach can be used as an alternative to the probabilistic approach. Care must be given to select a conservative scenario of the relevant seismic hazards (e.g. a conservative level for the vibratory ground motion hazard) in line with national practice.					
20.	Page 38, Para 8)	If both probabilistic and deterministic assessments are performed, the results from both should be compared. This will enable the deterministic results, including the design basis hazard level, to be calibrated against the probabilistic results, allowing some risk and performance insights to be developed. A further calibration exercise should be performed against the de-aggregation analysis to determine the characteristics of the design basis earthquake at the site. (see para. 6.11).		X	Comment accepted but similar comments made by Germany. Amalgamated text is indicated and placed in a new numbered paragraph.		
21.	Page 39, para (3)	Replace (3) it with: "Determine whether 1-D equivalent linear analyses should be performed for non-linearity, or more complex approaches are needed."	Equivalent linear method includes non-linearity.	X			
22.	Page 39-40, para (6)	Add "If possible, verify."	It is not clear how to implement this recommendation. A site may not have observational data.	X			
23.	Page 47, para 8.14	Insert: "In determining an appropriate duration (not less than 20 sec) for the time histories"	Not specific enough.			X	20s is a long strong ground shaking duration for a low seismic region and may not be appropriate to every MS.
24.	Page 50, para 3.25	Add at the end of paragraph:	Safety.	X			

	Means 8.25	"It is recommended to avoid potentially liquefiable sites."					
25.	General	In evaluation of seismic hazards, DS507 did not address hazards from potential releases **of radioactive waste** (HLW & LLW) stored onsite during operation and/or during decommissioning.	Completeness to address onsite radioactive waste storage.			X	Waste processing facilities are nuclear installations in the IAEA Glossary. Therefore no change required to text.
26.	1.8, page 3, line 2	Modify Para 1.8 statement as given below: "Also, the level of detail, the efforts and resources applied for evaluating the seismic hazards at an **existing** installation site should be commensurate with the probability of seismic event to occur, as well as anticipated magnitude of such events and potential consequences. Stability of the structure of the installation and integrity of its components should also be taken into consideration. The time remaining in installation lifecycle, particularly the timeframe for cessation of operation, removal of fuel, and plans for decommissioning of the nuclear installation should be considered in the graded approach as ~~and the~~ defined and established risk and performance goals."	Considering only the time remaining until decommissioning may not be a sufficient factor to ensure safety. The guidance needs to explain the graded approach concept for existing nuclear installation based assessment of probability and consequence of potential seismic hazard, as well as proper assessment of the integrity and function of basic structures and safety components, as long as the nuclear installation is going through its operational phase lifecycle.	X	Comment accepted in principle because sites undergoing decommissioning can be radiologically more hazardous than operating NPPs. Suggest revised simpler wording as below. "Also, the level of detail and effort devoted to evaluating seismic hazards at existing installation sites should be commensurate with a number of factors, e.g. the level of radiological hazard and the time remaining until it is remediated, the severity of regional seismicity in which the site is located, etc."		