DS 520 –Human induced External Hazards in Site Evaluation for Nuclear Installations - Step 7

COMMENTS BY REVIEWER Reviewer: Page.... of.... Country/Organization: Belgium Date:				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	General comment	Insert guidance on Design Extension Conditions (DEC) for HIEEs or refer to other SGs where guidance on DEC for HIEE can be found.	In this SG, no guidance is given on Design Extension Conditions (DEC) for external hazards. This seems nowadays unacceptable. It is now common practice to consider DEC in complement to DBA, even for external hazards.			X	DEC refers to a plant state and the term 'beyond design basis events' refers to the basis for a loading condition. They are separate and should not be confused. This safety guide covers the characterisation of the human induced external events and their loading conditions. Beyond design basis external events are addressed in the design guide (DS498).
2	General comment	Insert guidance on combinations of hazards, as well as natural+human induced (e.g. a seismic event, causing the release of toxic or explosive substances), as human induced+human induced.	In this SG, no guidance is given on combinations of hazards. Guidance on that topic should be included, or reference should be made to other SGs where guidance on this issue can be found.			X	This safety guide is on the human induced external events and their loading conditions. Combination of hazards is discussed in the design guide (DS 498).

3	1.10	To be added by IAEA: information on disposal facilities	From footnote 2, it seems that this SG is not applicable to waste disposal facilities (which we find logic). It would then be good to indicate explicitly in which SG(s) similar information on protection against HIEE can be found for disposal facilities.			X	The scope of this safety guide addresses nuclear installations, as defined in the IAEA Safety Glossary.
4	1.16	Section ~~0~~ 11 provides recommendations on applying a graded approach to the evaluation of nuclear installations other than nuclear power plants.	Typographical correction	X			This error occurred during conversion of the document from MS Word version to PDF version. It is corrected.
5	2.2	To be indicated by IAEA: relevant articles in [16] and [17]	2.1 referring to [1] is very detailed by quoting a lot of text from [1]. Article 2.2 at the contrary is very short in information. It would be good to indicate explicitly (at least) the articles in [16] and [17] that are relevant for HIEE.			X	[1] is applicable to all nuclear installations by applying a graded approach. Refs. [16] and [17] are specific safety requirements of research and fuel cycle facilities and provided for information.
6	2.3	Human factors relevant to the identification and analysis of HIEE hazards include direct human action (e.g. exceeding a safe speed limit or energising an incorrect item of equipment), indirect human action (e.g. sub-standard design of equipment, poor maintenance practice), errors of commission and omission ~~and data uncertainty~~ etc	Delete “data uncertainty” because that is not a human factor	X			

7	2.7	… They could affect both the ~~plant~~ installation's associated offsite facilities …	The SG is now applicable to a large scope of installations, not only to "plants" (often understood as NPP). Please do a search throughout the document for similar occurrences.	X			
8	3.12	If the probability of occurrence of a~~n~~ family of events ~~under consideration~~ is less than the specified Screening Probability Level (SPL)4, no further analysis is necessary	It is not a good practice to apply a probabilistic screening criterion on specific events. It has to be applied on a "family of events", such as aircraft crash, explosion, external fire, etc. Applying a probabilistic screening criterion on specific events makes it easy to screen out those individual events.			X	Each event has to be considered independently and its probability of occurrence has to be estimated.
9	3.12	… ~~The SPL should be chosen with due consideration, given that the radiological risk associated with hazards associated with HIEEs should not exceed the range of radiological risks associated that are used in when applying the principle of 'practical elimination' [18]~~. …	"Practical elimination" (PE) is a complex concept, which cannot be solely demonstrated by a probabilistic criterion. Therefore, it is not good to bring PE in relation to probabilistic screening and it is better to delete this sentence.		X Para. is modified and reference to practical elimination is deleted.		
10	4.9	…~~Since~~ In case Military instances do ~~may~~ not give information, ~~use of~~ generic data can be used ~~is recommended~~.	Generic data is not the preferred option. Therefore this rewording.	X			

11	4.20	… Information should be collected for both general aviation, civil and military air traffic. …"	General aviation (often up to 5.7 ton) is a specific category of aircrafts to be considered.	X			
12	5.2	… are covered in detail in other Safety Guides […],	Please indicate explicitly which SGs, by adding references in […]	X eg.DS498			
13	5.13	Clouds of toxic or asphyxiant gases can have severe effects on the personnel of a nuclear installation, with special attention to be devoted to control room and emergency centers habitability.	(Long term) Control room habitability for the operators and emergency center habitability are the most important issues and is worth to be mentioned explicitly.	X			
14	5.19	… If the probability of occurrence of ~~that particular event~~, PPE is less than SPL, it can be screened out. …	To be reworded, cf. comment on 3.12. It is not a good practice to apply screening on particular events. It has to be done at the level of a "family" of events, the "family" here being the risk of endangering safety due to the release of toxic substances.			X	Each event has to be considered independently and its probability of occurrence to be estimated.
15	5.21	… or sweeping conservative assumptions should be made.	What are sweeping assumptions? To be reworded with a more common term?	X "sweeping" is changed with "extremely"			
16	5.24	… distinction should be made between:	Word missing	X			

17	6.5	… The ways in which explosion hazards affect structures, systems and components and personnel at a nuclear installation are covered in detail in other Safety Guides […], but …	Please indicate explicitly which SGs, by adding references in […]	X e.g. DS498			
18	6.1 to 6.9	To be reworded or to be deleted.	These nine paragraphs are only descriptive on phenomena. They do not contain guidance. They have to be reworded to provide guidance or they should be deleted. From 6.10 on, the articles provide guidance and that is OK.		X They are reworded.		
19	6.20	… if the probability of occurrence of ~~that particular event~~, PPE is less than SPL, it can be screened out.	Same comment as for 3.12 and 5.19, the "family" here being the risk of endangering safety due to the external explosions.			X	Same reply as above at #14

20	7.4	We propose to add the following at the end of 7.4: "In the case of external fires, alternative fire spread paths may be identified such as airborne dispersion of firebrands (embers) or transportation of liquid fuel in the sewer system."	In view of discussions regarding the need to use spark arrestors on the intake of ventilation systems, or the flammability requirements of the roofing material. For the second point, while fuel storage areas usually have a dedicated drainage system, this is not the case of transportation ways (roads) and special spill management material may be required.		X The proposed te3xt is included as "In the case of external fires, alternative fire spread paths **should** be identified such as airborne dispersion of firebrands (embers) or transportation of liquid fuel in the sewer system."		
21	8.1	…~~There are only few examples of nuclear installations other than NPP that have been designed against airplane crash.~~ …	This is not correct. Even in Belgium alone, there are several non-NPP nuclear installations that have been designed and protected against aircraft crash, albeit with a graded approach.	X			
22	8.9	To be re-worked completely. Distinction should be made between 3 types of aircraft: • General aviation (up to 5.7 ton); • Commercial civil aviation; • Military aviation; and for each type distinction should be made between crashes due to airport operations (landing and takeoff) and crashes related to nonairport operations (in-flight).	The 3 types given in 8.9 are not appropriate; They are a mixture of types of aircrafts and types of "movements".			X	The 3 types given in 8.9 (with slight correction) are widely accepted and being followed by MSs for a long time. Any changes will lead to confusions especially NP embarking countries.

23	8.11	To be reworked.	8.11 is incorrect, due to the inappropriate type definitions in 8.9. For type 1 (mentioning general aviation), SDV are applicable for airport operations.			X	Please see resolution # 22.
24	8.12	… for each type of both civil and military crashes …	Type 1 speaks of "general aviation" but this is normally limited to aircrafts up to 5.7 ton; They do not include commercial civil and military aircrafts. This illustrates the inappropriate definitions in 8.9.		X "General aviation traffic" in para. 8.9 has been changed as "general traffic".		
25	8.22	Typical screening parameters that should be applied in this phase are ~~design robustness,~~ distance and magnitude and probability, and zones of influence.	Design robustness is not a screening parameter. The design robustness that is needed for adequate protection should be a result of the hazard assessment, not an input to the screening.			X	Design robustness is a very important parameter when considering hazards from HIEEs for a NPP as compared to a small RR or fuel fabrication plant.
26	8.24	The systematic approach to the evaluation should consider the buildings containing nuclear ~~fuel~~ material and the buildings housing the SSC important for safety ~~equipment for heat removal~~:	"Fuel" and "heat removal" are terms that are most applicable to NPP, but this SG is now wider in scope and covers different types of nuclear installations. Therefore slightly reworded.	X Sentence is reworded.			

27	8.25	… equipment necessary to prevent ~~damage of fuel in the reactor or the spent fuel pool~~ …: to be reworded to make it wider in scope	Cf. comment on 8.24: Again too specific and thus too narrow in scope.		X Sentence are reworded.		
28	8.29	Move up this paragraph to the beginning of "Hazard assessment" (before 8.20)	This paragraph gives the data that are needed for the hazard assessment and is therefore better at the beginning of the text on hazard assessment.			X	A uniform pattern has been adopted for all hazards from Chapter 5-11. Changing one will disturb this format.
29	8.30	Terminal energy ..	What is "terminal energy": to be reworded? Maybe "Impact energy"?	X			
30	9.10	… if the probability of occurrence of ~~that particular event~~, PPE is less than SPL, it can be screened out …	Same comment as for 3.12, 5.19 and 6.20, the "family" here being the risk of endangering safety due to the transport events.			X	Please see resolution # 14.
31	9.15	— Type of missile – soft, …	Something missing after "soft"?	X "soft missile"			
32	11.4	~~(k) The potential for on-site and offsite contamination resulting from the volcanic event.~~	A volcanic event is not a HIEE		X "resulting from the volcanic event" is deleted.		
33	11.12	In the grading of nuclear installations, ~~it should be borne in mind that most installations other than NPPs may not have sufficient inherent robustness against HIEEs.~~	The second part of the sentence has to be reworded. It "accepts" a priori that installations might not have the required robustness. If the robustness is not sufficient (even taking into account a graded approach), the installation has to be backfitted (for an			X	This safety guide is not only for the design of new installations, but also for the operation stages of existing installations.

			existing one) or has not to be licensed (for a new one).				
34	Many §§	The term “NI” should be replaced by “nuclear installation”	“NI” appears several times in the document. Please do a search to find them all and to replace them by “nuclear installation”.	X			
35	Many §§	The acronym “SVD” should be replaced by “SDV”	“SVD” appears several times in the document (especially in Chapter 8). Please do a search to find them all and to replace them by “SDV”.	X			

COMMENTS BY REVIEWER Reviewer: M-L Järvinen, J. Leino Page.... of.... Country/Organization: Finland - STUK Date:7th October 2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	1.1, footnote 1	Footnote number should be superscript. Last sentence of footnote 1: A slightly different definition of the term ‘external event’ is used in this publication compared to the IAEA Safety Glossary.	It should be defined from what the definition is different.		X Footnote number is superscripted. A slightly different definition used to remove the ambiguity and will be modified in the next glossary		
2.	1.12	”a new nuclear installation site” could be replaced with “the site of a new nuclear installation”	The Guide should be applied also when evaluating the suitability of	X			

			an existing site for a new installation.				
3.	1.16	replace “section 0” with “section 11”		X			This error occurred during conversion of the document from MS Word version to PDF version. It is corrected.
4.	2.8	As different from <u>most</u> natural external hazards,	Add “most” because some natural hazards may also evolve quite fast, e.g., animal or vegetation species causing fouling may spread rapidly.	X			
5.	3.4	Second sentence: In case of any peculiar site condition or significant specific hazard, the screening should not be based on the distance only.	The formulation of the second sentence is confusing.	X It is reworded.			
6.	9.1	Add under Marine transport and River transport additional point: • ships carrying large amounts of sticky chemicals or other materials with the potential of causing blockage of cooling water systems or intakes.	Large amounts of some bulk materials may have the potential of causing water intake blockage, especially materials with density close to the water density and suspended in middle water. The most important such material is oil, especially crude oil or heavy fuel oil, which are also hazardous materials. However, the potential of blockage should be considered in addition to the chemical hazard.		X 9.1 lists the main hazards from mobile sources. 9.6 and 9.18 cover oil and sticky chemicals, etc. Sticky chemicals are also included in 4.22.		
7.	10.1	Third point: <u>Stray currents</u> and eddy currents to the ground.	Stray currents or leakage currents may be a hazard, we are not aware that eddy currents in the ground		X Eddy current is deleted.		

			would be a hazard to nuclear installations.				
8.	10.18	Stray currents or eddy currents can lead to:	Stray currents or leakage current from electric railways may cause problems mentioned in para 10.18.		X Same as above		
9.	10.19 and 10.20	Consider removing or reformulating paras 10.19 and 10.20.	The methods for minimizing the internal effects of eddy currents in electric devices does not seem to be relevant to protection against external hazards. May be the intention is to discuss Electromagnetic induction survey methods where eddy current method is used to investigate ground properties, minerals or hidden objects. https://mineclosure.gtk.fi/electromagnetic-induction-surveys/ Appropriate applications 1. Mineral exploration – metallic elements are found in highly conductive massive sulfide ore bodies. 2. Groundwater investigations – groundwater contaminants such as salts and acids significantly increase the groundwater		X Same as above		

			conductivity. 3. Stratigraphy mapping – rock types may have different conductivities. 4. Geothermal energy – geothermal alteration due to hot water increases the conductivity of the host rock. 5. Permafrost mapping – there is a significant conductivity contrast at the interface between frozen and unfrozen ground. 6. Environmental – locate hazards such as drums and tanks, contaminant plumes.				
10.	10.21–10.24	Replace “eddy currents” with “stray currents or eddy currents”	Stray currents or leakage currents in the ground may cause problems mentioned in para 10.18.		X Same as above		

COMMENTS BY REVIEWER Country/Organization: FRANCE Date: pages				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection

1.	1.9	1.9. In this Safety Guide, the HIEEs are grouped into following Event Categories: – External release of hazardous substances; – External explosions; – External fire; – Aircraft crash; – External transport events excluding aircraft crash; – Other human induced external events.	Consistency of the wording	x			
2.	2.4	Potential sources of HIEEs are classified as either stationary, or mobile sources and both should be considered: — Stationary sources, are those that handle, process or store potentially hazardous substances such as explosive, flammable, corrosive, toxic or radioactive materials, and for which the location of the initiating mechanism (explosion centre, point of release of explosive or toxic gases) is fixed, such as chemical plants, oil refineries, storage depots, pipelines and other nuclear facilities at the same site. Facilities such as dams that control large volumes of water are stationary sources of HIEEs but are covered in a different Safety Guide [3]. — Mobile sources are those for which the location of the initiating mechanism is not totally constrained, such as any means of transport for hazardous materials or potential projectiles (by road, rail, waterways, air~~, pipelines~~). In such cases, an accidental explosion or a release of hazardous material may occur anywhere along a road, or route~~, or pipeline.~~	Considering pipelines as a stationary source not a mobile source. From the nuclear installation point of view, an operating pipeline always hold dangerous materials. These cannot be considered mobile as for road or rail tanks.			x	Pipelines are stationary but liquid inside of pipe is mobile similarly road railway etc.
3.	3.X	Create news paragraph between current 3.6 and 3.7. Text suggestion : For each type of effect that could arise from a HIEE, a maximum acceptable loading limit should be established, based on structures, systems and components vulnerabilities.	That will make it clear to define when there is a possible interaction between the HIEE and the nuclear installation. see also comments 6 and 7 related to 3.14 and figure 1	x			
4.	3.10	~~For sources generating effects of the same nature, a further screening should be performed which would depend on an enveloping criterion and which should exclude those sources that generate events that are enveloped by those for other selected sources, even if the site is inside the SDVs for these sources~~.	Suggestion to delete this paragraph. Regarding §3.12, this § reduces the number of events that could affect the nuclear installation, and thus the probability.			x	Para. is modified as per other MS comments.

5.	3.12	For each potential source (mobile or stationary), if the probability of occurrence of ~~an~~ event under consideration is less than the specified Screening Probability Level (SPL), no further analysis is necessary (see box 7 in Fig. 1). The SPL should be chosen with due consideration, given that the radiological risk associated with hazards associated with HIEEs should be consistent with the safety objectives of the nuclear installation ~~not exceed the range of radiological risks associated that are used in when applying the principle of 'practical elimination'~~ [18].	Il the comparison to SPL is performed considering each event individually, most of them would won't need further analysis as there probability of occurrence should be low. Consider that radiological risk within the context of HIEEs would only lead to require that radiological consequences of these EE would not exceed large releases is not sufficiently ambitious and not consistent with SSR-2/1.		X This process should be repeated for each source in 3.17. Para. is modified. Practical elimination has been deleted.		
6.	3.14	Hazard analysis should be performed to check whether hazard(s) will interact with the nuclear installation site. It is considered that the hazard could interact with the nuclear installation if the resulting loading can be over a maximum acceptable loading limit. If the results of hazard(s) show that they will not affect the nuclear installation site, no further action is necessary (see box 9 in Fig. 1)	It is important to define what "interaction" means.			x	This safety guide is for evaluation of nuclear installation site for HIEEs. Scope odf the guide includes characterization of load due to HIEEs, not to check whether resulting loading is over the maximum acceptable loading limit.
7.	3.14	Fig. 1 : New box (3') between current boxes 3 and 4 (3') Define maximum loading limits for each type of effects or phenomena that could arise from HIEE	That will make it clear to define when there is a possible interaction between the HIEE and the nuclear installation			X	Same as above
8.	4.14	Pipelines carrying hazardous materials that leave or transit between different stationary source locations should be included as ~~mobile~~ stationary sources.	Consistency with comment n°2. From the nuclear installation point of view, an operating pipeline always hold dangerous materials. These cannot be considered mobile as for road or rail tanks.			X	Please refer to resolution # 2.

9.	5.19.	If a hazard cannot be screened out by distance, generic events data can be used. Pragmatic conservative judgment can be applied to establish the occurrence of potential event~~s(s)~~ that can release hazardous gas. If the probability of occurrence of events that could lead to similar more severe effects, PPE, is less than SPL, it can be screened out. The screening exercise ~~of each~~ events that could lead to the generation of a hazardous gas at the nuclear installation site should be completed, and the screened-in sources should be listed. This process should be performed considering, for each source (mobile or stationary), all events that could generate similar effects.	Il the comparison to SPL is performed considering each event individually, most of them would won't need further analysis as there probability of occurrence should be low.			X	First the process should be performed for each event. "events that could lead to similar more severe effects" is not clear. Para. 3.17 (new para. 18.) already said the process should be repeated for each event.
10.	5.33	• Toxicity and asphyxiant limits ~~– e.g. LD50 (Lethal Dose 50%)~~	The LD50 is not appropriate to conduct safety operations in case of external event (the EEGL *Emergency Exposure Guidance Level* could be a better reference)	X			
11.		4.23 Harbours should be studied as stationary sources	Even if the ships change, the presence of dangerous cargo is almost continuous. The danger is therefore permanent as a stationary source.	X			
12.		4.24 Marshalling yard should be studied as stationary sources	Even if the trains change, the presence of dangerous cargo is almost continuous. The danger is therefore permanent as a stationary source.	X			
13.	8.1	There are only few examples of existing nuclear installations other than NPP that have been designed against airplane crash. This is because in general they lack the inherent structural robustness of NPPs. In order to protect these existing installations against aircraft crash, every effort should be made to screen out the hazard through distance and/or probability.	Add "existing". To be clearer. Maybe will change for the future installations other than NPP	X Para. is already deleted due to comments from other MS.			

14.	8.3	Malicious aircraft crash is not considered in this Safety Guide however some of the methods recommended herein, may also be applicable to malicious aircraft crash. Also, in some nuclear power plants, specific protection is provided against malicious aircraft crash; such protection measures are generally sufficient to envelope the risk from accidental aircraft crash hazard significantly, such that it can be screened out.	§ Reformulate			X	Proposal text is in the scope of protection measures which is out of scope of this safety guide.

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
3	1	1.16, line 5	[...] Section 11~~0~~ provides recommendations on applying a graded approach to the evaluation of nuclear installations other than nuclear power plants. [...]	editorial	X			This error occurred during conversion of the document from MS Word version to PDF version. It is corrected.
1	2	2.4, 1st bullet, line 3	[...] and for which the location of the initiating mechanism (explosion centre, point of release of ~~explosive~~ flammable or toxic gases) is fixed, such as chemical plants, oil refineries, storage depots and other nuclear facilities at the same site.. [...]	Flammable gases are released and they may form explosive clouds. (cf. 5.1 bullet 1)	X			
1	3	2.4, 1st bullet, line 4	[...] such as chemical plants, oil refineries, storage depots and other nuclear facilities at the same or a nearby site. [...]	To ensure that nearby nuclear sites are not overlooked, they should be mentioned explicitly.	X			
2	4	2.9, line 5	[...] A number of potential HIEE sources are presumed to exist around a nuclear installation (e.g. a chemical process site); each source is capable of	“at the site” seems to be redundant as the sentence ends with “at a nearby nuclear installation”.	X			

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			one of more events (e.g. plant failure causing explosion and releasing stored process gas); and each event may create one or more hazardous conditions (e.g. explosion pressure wave, release of toxic gas) ~~at the site~~ with the potential to challenge nuclear safety at a nearby nuclear installation. [...]					
2	5	3.2 New footnote	Screening Distance Value (SDV)[footnote] is the distance from a nuclear installation site beyond which a hazard from an HIEE is considered insignificant to safety of nuclear installation. For some sources, a simple deterministic study, based on information on the distance and characteristics of the source, may be enough to show that no significant event can occur. [footnote] SDV is as a simple and conservative tool that ignores any additional factors like involved mass or typical atmospheric conditions.	SDV is defined in IAEA Safety Glossary 2018 and its benefit has been an issue among experts e.g. on the technical meeting on April 2019 and It is proposed to add an explanatory footnote that the SDV is introduced as a simple and conservative tool that ignores any additional factors like involved mass or typical atmospheric conditions.		X Proposed text is added n the para. as further clarification.		
1	6	3.4, line 2	[...] In case of any peculiar site condition or significant specific hazard, it should be considered that the site has not been screened out with respect to distance~~.~~ and therefore a thorough evaluation of the site conditions and the hazard is necessary.	The current formulation leaves open what the consequence of the fact that the “site has not been screened out with respect to distance” should be. We suggest to complete this formulation		X Para. is modified.		

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Relevanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
2	7	3.12, line 2	[...] The SPL should be chosen with due consideration~~,~~ given to the fact that the radiological risk associated with hazards ~~associated with~~ due to HIEEs should not exceed the range of radiological risks ~~associated~~ that are used ~~in~~ when applying the principle of 'practical elimination' [18]. [...]	The original formulation was hard to understand. The proposed changes aim at clarifying the idea behind the sentence.		X Sentence is deleted as per one MS proposal and internal discussions.		
2	8	3.16, line 2	[...] Typical screening parameters to be applied are probability, magnitude and distance of the HIEE ~~event specifics~~ and on-site characteristics (e.g. design conditions and zones of influence). Details are provided in Ref. [19]	The original formulation was hard to understand. The proposed changes aim at clarifying the idea behind the sentence.	X			
1	9	4.5	[...] In these cases, state and local government authorities (in addition to the site operator) ~~may~~ should have a responsibility for population safety and such sites ~~may~~ should be legally obliged to provide sufficient data to enable these authorities to construct regional emergency plans, for example. Such government authorities ~~may~~ should have useful data on regional sources of HIEEs and should be collected.	3 times "may" -> "should" because IAEA should make recommendations about the procedures.		X First tow "may" have been changed to "should". Last one is kept as "may".		
1	10	4.17	Fracking activities and exploitation of natural gas fields should also be considered as they may be hazardous to nuclear installations and are similar to mining activities in that they can cause ground vibrations, subsidence and even	Not only fracking but also other types of natural gas extraction are known to cause potentially hazardous effects such as earthquakes (treated in		X Fracking is a proven drilling technology used for extracting oil, natural gas, geothermal energy,		

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			ground failure.	another Safety Guide) and subsidence. Therefore, they should be mentioned here to make sure they are not overlooked.		or water from deep underground. Fracking includes natural gas fields also. As one MS suggested, a footnote is added. Subsidence is included.		
1	11	4.22	The conveyance of hazardous materials by sea or inland waterways may present significant hazard. Besides the accidental release of flammable or toxic gases / vapours, ~~V~~vessels, together with their loads and the possibility of water borne debris, could have the potential for mechanically blocking or damaging cooling water intakes and outfalls associated with ultimate heat sinks.	Currently this paragraph focuses on the effects of ship accidents on the cooling water supply. But an equally important hazard is the release of airborne hazardous materials and explosions. Therefore, also this aspect should be mentioned here.	X			
1	12	4.22 New issue	… Other cargo that is not formally classified as hazardous material, like pasty liquids or swelling bulky freight (e.g. wood pellets) could also jeopardize cooling water intakes and outfalls associated with ultimate heat sinks.	It is important that this para is not limited to “hazardous” materials.	X			
1	13	4.25	The following is a typical set of data and information that should be collected for pipelines: — Location of pipe routes local to the nuclear installation site;	The type of installation is relevant for evaluating the explosion risk. E .g., for natural gas pipelines this risk is higher in case of		X Proposed text is added with slight change as per one MS proposal.		

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			--- Type of installation (i.e., buried or on the surface) and diameter of the pipe; — The nature of the substance transported, flow capacity, internal pressure; [...]	buried pipelines as an explosive mixture can develop (e.g., explosion near Ghislenghien, Belgium in 2004) whereas this is less likely for natural gas pipelines on the surface.				
1	14	5.1, bullet 2	Toxic and asphyxiant ~~Asphyxiant and toxic~~ gases which can threaten human life and impair safety functions,…	Please pay attention that “asphyxiant” is not mentioned in line 1 of Para. 5.1 and this term is not included in classification for hazardous material. We would like to point out, that asphyxiant gases are practically irrelevant because real asphyxiants (if they are not additionally toxic like CO_2) are needed in enormous concentrations for a dangerous depletion of oxygen. We suggest to add an explanatory footnote that generally • Toxic gases may become harmful in levels starting from		x First proposal is accepted. But, second proposal is not acceptable as it is too detailed information for a safety guide. For example, values are different for different toxic gases.		

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/reje ction
				ppm-concentrations. • Flammable gases become explosive in levels of some volume-percent concentrations. • Corrosive gases and liquids will become harmful in short time at higher levels. • Pure asphyxiants in contrast will become harmful for depletion of oxygen below about 17 volume percent in concentration.				
3	15	5.3, footnote 6	Substances considered here are fluids since these can flow and therefore spread from source to nuclear installation. Hazardous solids of concern in this guide are explosives, which are considered in Section 6.	Editorial	X			
1	16	new paragrap h after 5.10	The dispersion of liquids on bodies of water depends on the characteristics of the liquids (e.g., density compared to the density of water) and the characteristics of the body of water (e.g., sea, river or lake). Whereas on standing water bodies, dispersion is slow, hazardous liquids on bodies of flowing water may be transported over large distances quickly. The concentration of hazardous liquids in a	Currently dispersion of hazardous liquids on bodies of water is missing here (although it is addressed in Para. 9.19). As this is an important mechanism not only in case of ship accidents but also in case of accidents at industrial facilities close to bodies of water,	X			

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/reje ction
			given distance from the source will depend on the specific situation. Besides the toxic, corrosive or explosive properties of the liquid also its potential to clog the cooling water intake should be considered.	all its aspects should be duly addressed in this section.				
1	17	new paragrap h after 5.12	As drifting clouds of explosive or flammable gases or vapours can adversely affect the nuclear installation without entering buildings, defence against these hazards relies on protection from the potential source by means of distance and robust design of safety related buildings. In addition gas sensors might be used to provide early warning. More details on the protection against explosions and fires can be found in Sections 6 and 7 of this Safety Guide.	Drifting clouds of explosive or flammable gases or vapours are currently not addressed in this section and also not fully in Sections 6 and 7. Therefore, the issue should be addressed here including a link to the following sections on explosions and external fires.		X There is already some description of in this section. However, it can be further emphasized by adding a new para: Drifting clouds of explosive or flammable gases or vapors can adversely affect the nuclear installation without entering buildings, defence measures should be taken. More details on the protection against explosions and fires can be found in Sections 6 and 7 of this Safety Guide.		
1	18	5.21, line 6	[...] ~~As explained at 5.11, these liquids are not likely to reach a NI,~~ At least liquids released in the hydrosphere and gases emanating from ~~these~~ liquids are	The first part of the sentence should be deleted as it holds only for liquids that disperse	X			

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/reje ction
			extremely important and should be considered.	across land (cf. our comment “new paragraph after 5.10“). (Besides this, the reference to Para. 5.11 is wrong.)				
1	19	5.32, 2nd bullet	~~Mechanical~~ Physical properties	“Physical” is more appropriate for the listed properties, also because it goes on with “chemical”.	X			
1	20	6.4	~~Explosions at industrial sites are usually the result of:~~ ~~- Over-pressurisation of contained liquids/gases,~~ ~~- Unintended exothermic chemical reactions,~~ ~~- Dust explosions.~~	The sentence and the bullet list lack logical consistence (e.g., “Explosions [...] are usually the result of [...] -- Dust explosions.”) and a substantiation why only these three reasons for explosions are mentioned. Therefore, the paragraph should be deleted or thoroughly rewritten.		X Para. has been modified.		
1	21	6.6	~~Over-pressurisation event is an event arising from an over-pressurised contained liquid or gas that can cause an explosive release of stored liquid or gas if the container fails~~. However, ~~w~~When ~~such~~ a release is also associated with heating, [...]	The first sentence makes little sense (Basically it says that an over pressurization event results from overpressure.) and should therefore be deleted.			X	The first sentence is definition. It is preferred to keep it.

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Relevanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
2	22	7.3	Fires arising from highly flammable materials such as petroleum products typically occur as fireballs, e.g. ignition of a flammable vapour cloud, or pool fires from ignition of a pool of liquid material. Flammable vapour clouds can ignite under certain conditions leading to explosive fireballs called Boiling Liquid Expanding Vapour Explosions (BLEVEs), which are addressed in Section 6 of this Safety Guide. ~~especially violent events and should be covered~~.	BLEVEs and other explosions are extensively discussed in Section 6. Therefore, a link to this section should be given instead of an unspecific recommendation.		X Sentence, "Flammable vapour clouds can ignite under certain conditions …….", is deleted as BLEVEs is not possible under this condition.		
1	23	7.4	Fire can spread horizontally ~~in two ways: either~~ by radiation heating from the thermal flux associated with the fire, ~~or~~ via flammable material situated between the fire source and the site/installation, and by sparks and firebrands. [...]	Spreading of fires by sparks and firebrands can occur over significant distances (up to several hundreds of meters). Therefore, this mechanism needs to be mentioned.	X			
2	24	8.1, last sentence	[…] In order to protect these installations against aircraft crash, every effort should be made to screen out the hazard through distance and/or probability.	Unclear. Wrong formulation. The effort should be e.g. to increase distance that it could be screened out. Screening out is the result and not the motivation.	X It is deleted.			
1	25	8.2	Aircrafts should be considered to be a mixture of hard and soft missiles and impact onto reinforced concrete structures typically results in damage	The effects of soft missiles, i.e. local punching and bending failure, are currently	X			

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/reje ction
			modes such as perforation, penetration, scabbing, local punching, bending failure and vibrations.	missing. They should be added for completeness.				
1	26	8.3	In some nuclear power plants, specific protection is provided against malicious aircraft crash; such protection measures are generally sufficient to envelope the risk from accidental aircraft crash hazard significantly, such that it can be screened out. Nevertheless, it should be carefully checked whether the assumed scenarios for malicious aircraft crashes fully cover potential accidental scenarios and also the protection means are suitable for accidental aircraft crashes. [...]	The scenarios for malicious aircraft crashes my be based on specific assumptions regarding aircraft type (e.g., airliner), angle of attack etc. In an accidental scenario the boundary conditions might be very different (e.g., crash of a military jet during an air show) and not necessarily covered by the malicious crash scenario. The same holds for protection measures (e.g., measures to irritate/deter terrorists have no effect in case of an accident).	X			
3	27	8.7	Fire from oil spillage can result into fireball or pool fire ~~pool~~ or both and should be considered. Details are provided in Ref. [20].	editorial	X			
1	28	8.7 New issue	…should be considered. Combustible cabin materials, payloads or carbon fibre based structural materials will also be involved into fire and should be counted as fire loads. Details are provided in Ref. [20].	The added materials should not be ignored.			X	This is too much detail. The relevant safety report is referenced for details.

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/reje ction
3	29	8.16	If a hazard cannot be screened out by distance, probability of occurrence of particular types of crashes should be determined and it should be <u>compared</u> with SPL. [...]	editorial	X			
1	30	9.1, third bullet	— Marine transport, • Ships carrying hazardous substances (cargoes), <u>• Ships carrying other relevant substances (cargoes), like pasty liquids or swelling bulky freight (e.g. wood pellets) that could jeopardize the water intake.</u> • Ships that possess significant kinetic energy, …	It is important not only to focus on formally classified hazardous material/goods but to all relevant cargo.		X These are sub-headings and not appropriate to provide such details. Suitable to add in 9.6		
1	31	9.6 New issue	… but secondary effects of oil spill, fire, explosion, release of gases etc are possible and should be considered as per the guidance provided in the previous sections. <u>Other cargo that is not formally classified as hazardous material, like pasty liquids or swelling bulky freight (e.g. wood pellets) should also be considered to jeopardize the water intake.</u>	It is important not only to focus on formally classified hazardous material/goods but to all relevant cargo.	X			
2	32	9.8	Sources of marine/river vessels include ships and barges (Table III). ~~First the regions should be located based on SDVg values (Table II).~~ [...]	Table II does not contain any information related to marine/river vessels. Therefore, the sentence should be deleted.	X			

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Relevanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
2	33	9.8., line 2	[...] ~~Data of potential sources should be collected and source/nuclear site distance values, D_S, should be calculated.~~ [...]	A collision of a vessel with, e.g., intake structures, implies zero distance to the critical SSCs of a nuclear installation, i.e., D_S is zero. Therefore, this sentence makes no sense in the context of ship collisions and should therefore be deleted.			X	The sources in this case are different types/sizes of vessels, ships and barges passing close to the site. How close these sources can reach a critical SSC depends on the bathymetry/water depth.
2	34	9.9, headline	~~Screening by distance~~ Screening by physical possibility	A collision of a vessel with, e.g., intake structures, implies zero distance to the critical SSCs of a nuclear installation, i.e., D_S is zero. Screening by distance is not applicable in this case. Therefore, the headline before Para. 9.9 should be changed in a way that reflect the content of Para. 9.9.			X	A collision of a vessel/ship with intake structure depends on the bathymetry as bigger ships require bigger water depths. As such, Ds cannot be zero in such cases.
2	35	9.10	If it cannot be screened out by ~~distance~~ the physical situation, generic event data can be used. Pragmatic conservative judgment can be applied to establish the occurrence of an event that can initiate an impact. [...]	Screening by distance is not applicable in the case of ship collisions with nuclear installation structures. Therefore, the text should be amended to			X	Same as above

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/reje ction
				better fit the content of Para. 9.9.				
1	36	9.10, line 4	[...] The probability of an impact of a commercial ship with the intake structure could be very low as ~~administrative measures are strictly in-place and~~ protective embankments are constructed with an opening for the cooling water. [...]	Administrative measures are without any effect if a ship is not steerable due to some failure/damage. This is substantiated by the experience with several almost-collisions of ships with off-shore wind parks. Therefore, no reference to administrative measures should be made.	X			
1	37	9.14	The following are example of parameters that should be considered and are given in Table III: — Passage routes and frequency of passage, e.g. ~~road & rail routes,~~ seaways, ~~— Location and routing of pipelines and associated pumping stations, etc.,~~ — Frequency, type and route of movements to/from the source, ~~— Existing protective measures on vehicles or routes~~.	9.14 belongs to the section on "HAZARD ASSESSMENT FOR MARINE AND RIVER VESSELS THAT POSSESS SIGNIFICANT KINETIC ENERGY". Therefore all references to land transport should be deleted.		X "Location and routing of pipelines and associated pumping stations, etc." is deleted. "Existing protective measures on passages/routes" is modified.		
1	38	9.18, line 5	[...] Consideration should be given to the fact that spillage of ~~explosive or highly flammable~~ liquids on water may produce floating pools, which may approach a nuclear installation on the	The concern is about the formation of a floating pool by liquids. This is independent of the characteristics			X	It is important also that explosive or highly flammable liquids should

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			shore or along a riverbank. [...]	"explosive" and "highly flammable".				not enter the intake structure
1	39	9.18, new line	[...] Other cargo that is not formally classified as hazardous material, like pasty liquids or swelling bulky freight (e.g. wood pellets) should also be considered to jeopardize the water intake.	It is important not only to focus on formally classified hazardous material/goods but to all relevant cargo.	X			
2	40	9.19, line 5	[...] Modelling of the way discharges are dispersed should be carried out. Alternatively, it can be assumed conservatively that no dilution occurs.	Depending on the specific situation it might be easier to assume no dilution at all. As this would be a conservative assumption, this option should be mentioned.	X			
1	41	9.23	If the potential hazard from screened-in sources is likely to be less than that due to similar materials stored on the nuclear site itself and against which protection has already been provided that is also effective against hazards from off-site sources, then it can be screened out. [...]	Protection against on-site hazards often focuses on avoiding releases or explosions by preventative measures. Such measures would not provide protection against hazards from off-site sources.	X			
3	42	9.25 + 9.26	9.25. The following are hazard parameters that should be considered for load characterization: — Location of transport route around the closest approach to the nuclear site. — Nature/quantities of transported substances and spillage. — Meteorological and hydrological	9.26 seems to have become a separate paragraph erroneously. It fits much better as a last bullet in Para. 9.25	X			

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/reje ction
			conditions. ~~9.26.~~ ---Relevant bathymetric, tidal and river current conditions around this route that might influence the dispersion and hazardous characteristics of a release.					
1	43	10.2	Ground at a NI site can subside due to a local geotechnical issue under the site-specific location or from outside the site area due to human-made features such as mines, exploitation of natural gas fields, water wells and oil wells if such activities are foreseen in the site vicinity area.	Natural gas extraction is known to cause potentially hazardous effects such as earthquakes (treated in another Safety Guide) and subsidence. Therefore, it should be mentioned here to make sure they are not overlooked.	X			
1	44	10.5	Huge mining activities, exploitation of natural gas fields, extraction of oil and ground water in the site vicinity area can lead to subsidence. [...]	Natural gas extraction is known to cause subsidence. This is a known problem particularly in Europe (but certainly also near other gas fields). Therefore, it should be mentioned here to make sure they are not overlooked.	X			
1	45	10.6, line 2	[...] Engineering solutions to counter subsidence from human induced events can be established after detailed evaluation is made and may or may not be possible but administrative measures	Whether the problem can be solved by administrative measures depends on the legal (possibility to limit the	X			

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/reje ction
			~~are~~ might be available. [...]	amount of mining or oil/gas extraction) an political (relative priority of mining work and oil/gas extraction compared to nuclear) boundary conditions. Therefore, such measures should not be stated as a fact.				
1	46	10.18-10.25	*Delete paragraphs or add explanation on potential sources*	Relevant off-site sources for eddy currents strong enough to affect the safety of a nuclear installation are hard to imagine. Therefore, either a description of potential sources should be provided or the paragraphs on eddy currents should be deleted as eddy currents probably constitute no relevant external hazard.	X They are deleted.			
2	47	12.13	One of the following t~~T~~wo methods of peer review should be used: participatory peer review ~~and~~ or late stage peer review. [...]	Normally IAEA recommends only one peer review. The current formulation could lead to the impression that both peer reviews are required.	X			
1	48	Table I (a) and	*Either the references under (b) should include a reference to case (2) of Table*	Explosions of drifting gas clouds are currently not	X			

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS) Pages: 17 Country/Organization: **Germany** Date: 08.10.2020				RESOLUTION			
Rele - vanz	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		(b)	*II* *or "explosive gas clouds" should be mentioned under (a).*	covered.				
1	49	Table III (1a) right column	~~mechanical~~ physical properties	"Physical" is more appropriate	X			
1	50	Table III (1b) right column	Max. credible pressure (over- and under-pressure) & thermal release at source location, …	Both pressure parts are important	X			
1	51	Table III (1c) external fire, right column	Max. credible substance (soot, toxic products) /thermal release	The term substance release is clarified	X			
1	52	Table IV (b) explosion, second column	~~Release of flammable, explosive, asphyxiant, corrosive, toxic or radioactive substances.~~	Wrong context, the category is explosion. Releases may be mentioned as secondary effect.			X	Releases mentioned as secondary effect, hollow circle
1	53	Table IV (d) aircraft crash, second column	Release of flammable, explosive, ~~asphyxiant~~, corrosive, toxic or radioactive substances.	Aircrafts may release hazardous materials while crashing, but to our understanding not asphyxiants in relevant amount. Please clarify			X	Aircrafts may release asphyxiant.
1	54	Table V 12) water intake	Mass of the ship, lost cargo, impact velocity and area, degree of blockage.	Cargo added as potential hazard.	X			

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

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

	COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** (with comments of GRS and BASE) Page 1 of 2 Country/Organization: **Germany** Date: 2020-09-10				RESOLUTION			
Relevance	Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
3	1	1.16	Section ~~0~~11 provides recommendations on applying a graded approach to the evaluation of nuclear installations other than nuclear power plants.	Wrong reference	X			This error occurred during conversion of the document from MS Word version to PDF version. It is corrected.
3	2	2.1	Requirements 6, 7, 9 and 24 are reproduced here for convenience:	Either delete this statement or if it should stay, include Req. 14 because it is also reproduced later.	X			
3	3	2.1	~~"5.33. Human induced events to be addressed shall include, but shall not be limited to:~~ ~~(a) Events associated with nearby land, river, sea or air transport (e.g. collisions and explosions);~~ ~~(b) Fire, explosions, missile generation and near the site;~~ ~~(c) Electromagnetic interference.~~ ~~"5.34. Human activities that might influence the type or severity of natural hazards, such as resource extraction or other significant re-contouring of land or water or reservoir-induced seismicity, shall be considered.~~ ~~"Aircraft crashes~~ ~~5~~ ~~"5.35. The potential for accidental aircraft crashes on the site shall be assessed with account taken, to the extent practicable, of potential changes in future air traffic and aircraft characteristics.~~	Can be deleted. Maybe accidently quoted.			X	Exact requirements of human induced events are quoted from SSR-1.

			~~"Chemical hazards~~ ~~"5.36. Current or foreseeable activities in the region surrounding the site that involve the handling, processing, transport and/or storage of chemicals having a potential for explosions or for producing gas clouds capable of deflagration or detonation shall be addressed.~~ ~~"5.37. Hazards associated with chemical explosions or other releases shall be expressed in terms of heat, overpressure and toxicity (if applicable), with account taken of the effect of distance, and non-favorable combinations of atmospheric conditions at the site. In addition, the potential effects of such events on site workers shall be evaluated.releases of hazardous gases from industrial facilities~~					
3	4	4.6	The government planning authority for the region surrounding the nuclear installation may be able to provide useful information on sources of HIEE ~~and~~ that should be collected.	Wording	X			
3	5	General	The terms nuclear installation and the shortcut NI are mixed in the text. This should be adapted.	Consistency	X			

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

COMMENTS BY REVIEWER Reviewer: Salam K. Al-Nasri and Nabeel Al-Tameemi Page.1,3,4 and 63. of...DS520. Country/Organization: Iraq/ Radiation and Nuclear Safety Directorate (RNSD) Date: 6/10/2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.1/ 5	References should be [2-6] instead of [2], [3], [4], [5], [6].	Organization	X			
2	1.15/7	References [9-14] instead of [9], [10], [11], [12], [13] and [14].	Organization	X			
3	2.1 /last line	"Aircraft crashes'', move from page 4 to page 5.	Organization	X			
4	TABLE IV	Tsunami waves on to the nuclear site.	Earthquakes followed by Tsunami waves was found to be potential external hazard to the nuclear site.			X	Tsunami is not a HIEE.

COMMENTS BY REVIEWER Reviewer: Japan NUSSC Member Pages: 3 Country/Organization: Japan / Nuclear Regulation Authority (NRA) Date: 9 October, 2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	2.1.	SSR-1 [1] establishes Requirement 6 for identification of site-specific	SSR-1 Requirement 8 should be referred here.	X			

COMMENTS BY REVIEWER Reviewer: Japan NUSSC Member Pages: 3 Country/Organization: Japan / Nuclear Regulation Authority (NRA) Date: 9 October, 2020				RESOLUTION			
		hazards, Requirement 7 for evaluation of natural and human induced external hazards, Requirement 8 for Measures for site protection, Requirement 9 for site evaluation for multiple nuclear installations on the same site and on adjacent sites, Requirement 14 for data collection in site evaluation for nuclear installation and Requirement 24 for evaluation of hazards associated with human induced events. These requirements are of particular interest to the evaluation of nuclear installation site for hazards associated with HIEEs. Requirements 6, 7, 8, 9, 14 and 24 are reproduced here for convenience: **……** **Requirement 8: Measures for site protection** **If the projected design of the nuclear installation is not able to safely withstand the impact of natural and human induced external hazards, the need for site protection measures shall be evaluated.**	There found some engineering solutions in para. 2.12 and 2.13. with regarding to the interface between site evaluation and design. Requirement 14 is missing.				
2.	2.10.	To illustrate the notion of 'interacting mechanism', as how hazardous events originating at a source can lead to sequences of further events, creating a hazardous situation at a site, examples of HIEE event categories, generic screening distance values, identification	It is appropriate that these parameters and values are examples in member states so that those should be stated in Annex, not in Appendix.			X	Tables III and IV are updated version of Tables in NS-G-3.1. Table I is categories of HIEEs. Table II presents generic SDVs used in some

COMMENTS BY REVIEWER Reviewer: Japan NUSSC Member Pages: 3 Country/Organization: Japan / Nuclear Regulation Authority (NRA) Date: 9 October, 2020				RESOLUTION			
		of sources along with required information, potential HIEEs at sources, possible hazards at site, load characterisation parameters and possible consequences at a nuclear installation site are provided in Tables I-V, ~~Appendix~~ Annex.	The same missing words are found in 3.3, 3.15 and appendix itself.				member states. So, they should be Appendixes.
3.	3.9. Figure 1	Box 5 to the right box: No further ~~analysis~~ action Box 7 to the right box: No further ~~analysis~~ action	To keep a consistency with para. 2.9 and 3.14.		X To keep the same term used in NS-G-3.1, 'analysis', para. 2.9 and 3.14 corrected for consistency.		
4.	3.9. Figure 1	Explain "Ds" in the box 5 in Fig. 1.				X	Defined in box 3
5.	4.17.	Fracking activities should also be considered as they may be hazardous to nuclear installations and are similar to mining activities in that they can cause ground vibrations and even ground failure.	Specify "fracking activities" in the footnote.	X It is specified in the footnote as "Fracking is a proven drilling technology used for extracting oil, natural gas, geothermal energy, or water from deep			

COMMENTS BY REVIEWER Reviewer: Japan NUSSC Member Pages: 3 Country/Organization: Japan / Nuclear Regulation Authority (NRA) Date: 9 October, 2020				RESOLUTION			
				undergrou nd.”			
6.	8.9. /L4	- Type 1: Aircraft c~~C~~rash deriving from general aviation traffic, sometimes called the background crash rate.	It is better to have a unified description with ‘Type 2’ and ‘Type 3’	X			
7.	11.4. (k)	~~(k) The potetial for on-site and off-site contamination resulting from the volcanic event.~~	It is not related to the hazard directly to other NIs. The other chapters on natural hazards for nuclear power plants do not mention volcanic hazards.		X Only remove ‘resulting from the volcanic event’ as written in other safety guides.		

COMMENTS BY REVIEWER Reviewer: Page 1 of 1 Country/Organization: Republic of Korea / Korea Institute of Nuclear Safety (KINS) Date: 05/10/2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.9 / Line 4	- ~~External fire~~ Fire	Since the word ‘HIEEs’ is an abbreviation for ‘human induced external event’, this word already connotes external event. Therefore, the word ‘external’ in front of ‘fire’ is not needed. Also, other events listed as HIEEs in para 1.9 except fire do not include the word ‘external’ (e.g. Explosion, Air crash, etc.). Moreover, the word			X	External Fire is a term used in many SGs (e.g. DS498) and MSs are familiar with this term. Moreover, it removes the ambiguity that it is external to a NI.

			"external fire" is also used other parts of this Safety Guide, it is recommended to change the word "external fire" to "fire" throughout this Safety Guide.				
2	TABLE II	TABLE II. GENERIC SOURCE DISTANCE VALUES (SDV^{sg}) WHICH ARE USED BY SOME MEMBER STATES	In the title of the TABLE II, the superscript "s" is used to mean 'specific' not 'generic' throughout this Safety Guide.	X			

COMMENTS BY REVIEWER Reviewer: G.Delfini / S. Carelsen / A. Koppert Page x of 8. Country/Organization: Netherlands/ ANVS Date: 05-10-2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	General	Check notation throughout the Guide (e.g.: SVD instead of SDV in 8.14, 8.15, 10.26,…; SDV^{s} instead of SDV^{g} in the header of Table II (pag. 54)		X			
2	General	Some parts of NS-G-3.1 are not included in this guide, without a clear reason. It would be useful to have more information about the rationale behind the decision to adopt/change/delete parts of NS-G-3.1				X	NS-G-3.1 was issued in 2002. A revised version after almost two decades is not likely to include all parts. First, gap analysis was performed, and technical meeting was organized with a participation of many member states. Then 2 consultancy service meetings were organized to develop

COMMENTS BY REVIEWER Reviewer: G.Delfini / S. Carelsen / A. Koppert Page x of 8. Country/Organization: Netherlands/ ANVS Date: 05-10-2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
							this version. Decisions for adopt/change/delete parts of NS-G-3.1 was taken during this whole process based on MS practices.
3	3.6	Option 1: *"A Source Display Map (SDM) showing all potential sources* (both present and foreseeable sources) *should be prepared and sources should be listed along with the distances from the nuclear installation site. Uncertainties related to these should be estimated (see box 3 in Fig. 1)."* Option 2: *"A Source Display Map (SDM) showing all potential sources shouldbe prepared and sources should be listed along with the distances from the nuclear installation site* (see 4.27 and 4.28)*. Uncertainties related to these should be estimated (see box 3 in Fig. 1)."*	Clearer definition of potential sources being both present and foreseeable ones. Note that SDM's are repeated in paragraphs 4.27 & 4.28. A reference to these paragraphs would also suffice. 4.28 states: "*These maps should reflect any foreseeable developments in human activities that may potentially affect safety over the projected lifetime of the nuclear power plant."* For clarity, please consider also changing the text in box 3 in fig. 1.	X Option 1 is incorporated.			
4	5.26-5.31	Suggestion to split 5.29 in two paragraphs: *5.29. The formation of a large cloud is more likely for gases liquefied by pressure and non-condensable compressed gases than it is for*	Improve clarity. In NS-G-3.1 two section were made for both gas types (subcooled liquefied and pressurized/ non-	X			

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		subcooled liquefied gases. The detailed analysis is easier because the source is more easily defined and in some cases dispersion of the plume is governed by simpler phenomena. 5.29a *As with subcooled liquefied gases, the release* of gases liquefied by pressure and non-condensable compressed gases *should be characterized by a leak rate or by a sudden total release, and a similar evaluation should be carried out. The assumptions to be used will depend on the type of storage tank, the process vessels, their associated piping and the associated failure probability.* 5.31. *In making an appropriate assumption …*	condensable). Paragraph 5.24 in DS520 states that distinction should be made between "subcooled liquefied gases" and "gases liquefied by pressure and non-condensable compressed gases", but in the following paragraphs both gas types are combined and it is not clear to which gas type they refer. It should be clear which statements are valid for both types, and if not, this should be clearly stated per paragraph (or reinstate the subdivision/headers). Examples: - 5.30 and 5.31 were previously in the category "gases liquefied by pressure and non-condensable compressed gases" and are now written as valid for both gas types. - 5.26 (1st line), 5.27 and				

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			5.28 were previously in the category "subcooled liquefied gases" and is now written as valid for both gas types.				
5	6.2	*6.2. Explosions are highly energetic and often destructive events. They can occur for many reasons, but once an explosion has occurred, its effects are propagated into the surrounding environment by means of an expanding pressure wave. There are two types to consider:* *— Deflagrations,* which generates moderate pressures, heat or fire. *— Detonations,* which generates high near field pressures and associated drag loading but usually without significant thermal effects.	Explanation difference of deflagrations and detonations are omitted (as compared to NS-G-3.1) and are deemed useful to the reader.	X			
6	6.1 – 6.2	Reinstate par. 7.2, 7.3 and 7.4 (NS-G-3.1) as background information to the reader.	This background information from NS-G-3.1 is very useful for the reader.			X	Such background information was very useful. On the other hand, some are deleted to keep the balance in the different Sections.
7	7.4	*7.4 Fire can spread horizontally in two/three ways: either by radiation*	Missing mechanism of fire spreading through		X Instead of		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		heating from the thermal flux associated with the fire, or via flammable material situated between the fire source and the site/installation, or via transport of ignited flammable debris by wind (e.g., embers causing spot fires).	burning/smoldering debris which is not necessarily originally situated between the source and NPP (example from wildfires is an ember attack but similar debris may come human induced sources such as places with high amount of timber (e.g. stacked pallets) or other flammable material causing airborne particles to be transported by wind.		two/three ways, it is written "…different ways…". The proposed text "or via transport of ignited flammable debris by wind (e.g., embers causing spot fires)" was added in last para. with different wordings.		
8	8.5	… *Secondary effects* • … • *Rapid spread of flammable liquid from the point of impact, including impulsive damage to structures from the released momentum of the liquid when ejected from the aircraft* • Entry of combustion products into ventilation or air supply systems • *Fire and explosion generating heat and blast effects and generating tertiary missiles* • …	Missing secondary effect.	X			
9	9.4	*9.4. Road, rail, marine and river vehicles and vessels routinely transport dangerous goods and the potential for release of hazardous substances is always a potential risk to nearby*	Paragraph 9.1 and table III and Table IV include road transport and rail transport as HIEE hazards to be considered. A more	X Guidance for hazard assessme			

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		nuclear installations and should be considered. Similarly, pipelines routinely convey hazardous liquids and gases and should also be considered. The text suggests that in the following paragraphs attention will be given to road and rail vehicles and related hazards. This is actually not the case. (The following paragraphs only deal with marine and river vessels and pipelines etc.). Please add paragraphs dealing with road and rail hazards, and how to perform the hazards assessment.	extended discussion about the way this should be done (in a similar way as for vessels and pipelines is missing.	nt is included.			
10	10.4	*10.4. … The issue is more complicated when nuclear power plants are founded on* saturated *soft soils with high water table and ~~massive~~ dewatering is required. In those cases,* it should be well justified that dewatering does not lead to unacceptable (differential) settlement of the existing nuclear installation and this should be monitored. Reinjection of the extracted water may be necessary to keep pore pressures at the existing nuclear installation unaltered during dewatering and the restoring period thereafter. ~~*water should also be injected so that water table around the existing NPP does not go down*~~.	Water injection is not always necessary. It depends on the foundation type, soil characteristics, drain setup, formation from which water is going to be extracted, duration of extraction, etc. It could be meaningful to have water reinjected at the NI to remain pore pressures but other justification and subsidence monitoring may be acceptable. Changed NPP to NI (as per title of guide).	X			

COMMENTS BY REVIEWER Reviewer: G.Delfini / S. Carelsen / A. Koppert Page x of 8. Country/Organization: Netherlands/ ANVS Date: 05-10-2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
11	10.26	*10.26. This hazard should be handled in a special way if the bombing and firing ranges are within the ~~SVDg~~ SDVg of 30 km as such information is not easily available.* For military institutions, e~~E~~*fforts should be made through the Governmental channels to obtain the required information. ~~from the military institution~~s….*	A shooting range is not necessarily a military institution. If only these are addressed covered by this guide (looking at table III this might be the case), then please make it explicit.	X			
12	10.26	*10.26. This hazard should be handled in a special way if the bombing and firing ranges are within the ~~SVDg~~ SDVg of 30 km as such information is not easily available.* For military institutions, e~~E~~*fforts should be made through the Governmental channels to obtain the required information. ~~from the military institution~~s….*	Please clarify: It is not clear what information is requested (see yellow marks). Possibly "*information about the activities on the bombing and firing ranges*"?	X It is clarified.			
13	10.26 and Table II, source nr. 6)	Suggestion to make subdivisions in the SDVg (and add these to table II) 10.26 *…SDVg of 30 km.…* *TABLE II* … *Distance from military installations or air space usage such as practice, bombing and firing ranges: 30.0 km*	The SDVg of 30 km is very generic and it would be beneficial to make it dependent on the activities on the site (for a rifle shooting range, 30km would be overly large).			X	Information about the activities in military installations is not available and therefore it is recommended to keep a conservative SDV.
14	Chapter 11	Please consider alignment of this chapter with DS511 (revision of SSG-22) where the application of the graded approach (to RR) is extensively	Avoid inconsistencies. There are differences between the way grading is approached in DS511 and			X	Uniform approach has been used in the safety guide related to hazards (e.g. SSG-

COMMENTS BY REVIEWER Reviewer: G.Delfini / S. Carelsen / A. Koppert Page x of 8. Country/Organization: Netherlands/ ANVS Date: 05-10-2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		discussed.	this guide.				18).

COMMENTS BY REVIEWER Reviewer: Page..1. of....4 Country/Organization: UK/ONR Date: October 2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
Headline technical comment – ONR's view is that this Safety Guide provides good comprehensive coverage of the specified scope. In addition, the Safety Guide was found to be generally well written and easy to follow. The only notable observation is that further discussion on hazard combinations would be merited (see comment 1)							
1	Paragraph 1.9	Insert a new paragraph after 1.9. which states, "This guide includes some discussion of consequential hazards arising from HIEEs, e.g. aircraft fuel fires following an aircraft impact. However it does not address hazard combinations more generally. Hazard combinations are covered in Safety Guide number XXX" [insert relevant safety guide number].	Hazard combinations are an important topic. HIEEs may combine with other HIEEs, natural hazards, plant failures or operator errors to produce more severe consequences than the initial HIEE would alone. This Safety Guide should highlight the need to consider such combinations even though they are not discussed comprehensively in this Guide.	X			
Noting an editorial review is still to be conducted, some grammatical errors have been spotted							

where correction should help with comprehension as the guide moves through the review process							
2	Paragraph 2.8	Replace the first sentence with this text, "Unlike natural external hazards, new sources of HIEEs can evolve rapidly."	"Unlike" is better grammatically than, "As different from". Also natural external hazards can evolve, e.g. due to climate change, however HIEEs tend to evolve more rapidly, hence the addition of "rapidly".	X			
5	Paragraph 2.8	In the second sentence replace, "is possible to" with, "could realistically".	Improved clarity/ grammar.	X			
6	Paragraph 2.9	In the third sentence replace, "capable of one of more events" with, "capable of one or more events".	Improved clarity/ grammar.	X			
7	Paragraph 2.10	In the first line replace, "as how" with, "as to how".	Improved clarity/ grammar.	X			
8	Paragraph 2.11	Replace the first 3 lines with the following text, "In general, there are two types of protection against HIEE for a nuclear installation: (i) protection through a robust design of the safety related structures, systems and components, including site protection measures such as barriers, (ii) protection". Also replace the final sentence with, "It should be kept in mind that administrative measures are a less reliable means of protection and they should be considered as complementing the first."	In the current text (ii) may be regarded as a specific example of (i). Although this is simply a matter of definition it is important that such site protection measures are treated as structures, systems and components and are not overlooked for planned maintenance purposes, hence it is preferable to include (ii) within (i) and delete it as a separate category.			X	IAEA Safety Standard SSR-1 (para. 4.7) address three type of protection against external hazards for a nuclear installation.
9	Paragraph 3.8	In the final sentence replace, "gas vapor cloud will travel" with, " gas vapor cloud may travel".	In low wind conditions a cloud less dense than air may initially rise to high in the atmosphere, decreasing in concentration, and if any subsequently reaches the ground, e.g. via	X			

			precipitation, it may be very dilute and not pose a hazard. However it is recognised that the SDV is likely to be greater for the cloud than the pressure wave to allow for the worst case weather conditions.				
10	Paragraph 3.10	Add the following final sentence, “Care is needed here to ensure that the enveloped sources are considered if/when the event frequency is estimated.”	Enveloping the sources bounds the event consequence but it may not bound the event frequency.	X			
11	Footnote 4 on page 8 and page 9.	Replace the final sentence with, “However such grouping of similar events may not be appropriate where a specific single event has very severe consequences and requires a very low SPL.”	Improved clarity.	X			
12	Footnote 5 on page 12	Transfer this footnote to be the final sentence of paragraph 4.7. See Reason column.	This is a good point and easily overlooked in locations where new developments are common that can affect the traffic on site access and egress routes. It could be overlooked as a footnote.	X			
13	Paragraph 5.18	On the second line replace "gases" with "fluids".	Improved clarity.	X			
14	Paragraph 5.19	Replace "gas" in this paragraph with "fluid".	Improved clarity.	X			
15	Paragraph 5.27	At the end of the fourth line replace, "for the" with, "for in the".	Improved clarity/grammar.	X			
16	Top of page 23	On the third line replace, "Liquid Petroleum Gas (LNG)" with "Liquid Petroleum Gas (LPG)/Liquid Natural Gas (LNG)".	Improved clarity.	X			

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: US Nuclear Regulatory Commission							
Country/Organization: US Nuclear Regulatory Commission Date: 10/13/2020							
Comment No.	Para/ Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	4.20 additional text item	— Information on crash rates of each aircraft type flying near the nuclear facility in the respective flight mode (enroute, landing, and taking off including normal or special flight mode for military aircraft)	Aircraft crash rate is needed to assess the annual frequency of aircraft crash hazard on to a site/facility.	X			
2	4.25 additional text item	— Whether the pipeline is on the surface or buried near the nuclear installation site;	Nature and severity of hazards may change whether the pipeline is buried or on the surface. For example, explosion of a buried pipeline may create a crater when ruptured; however, it is unlikely that a substantial crater would be created in a rupture of surface pipelines.	X			
3	4.27/Line 1	…, preferably using a Geographical Information System (GIS) platform.		X			
4	5.7/Line 3	The extent of dispersion of liquids, i.e., the extent of pooling given a rate of release, typically would require ~~very~~ large quantities to be released for the liquid to affect directly an adjacent nuclear installation ~~some kilometers away~~. ~~A more likely safety concern is that~~ The liquid substance will pool and give off toxic or flammable or explosive vapors, and it is these secondary hazards that are likely to pose the most significant hazard to nuclear safety and should be	Hazardous fluids may be brought close to a nuclear installation by tankers to replenish the site storage tanks. For example, propane, natural gas, gasoline etc. can be brought close to the installation to fill up the storage tanks for use at the site.	X			

		considered.					
5	5.22/Line 4	In the evaluation, the worst case meteorological conditions should be assumed as inputs to the …	The worst case meteorological conditions can happen. If the facility is proven safe from these conditions, they should be safe for all other scenarios. See 5.23 for assumption of maximum credible inventory and occurring at the point of closest to the site or most unfavorable release point; otherwise, a justification is needed why the assumed meteorological conditions would provide the worst consequence for the nuclear installation.	X			
6	5.29/Lines 6 and 7	The assumptions to be used will depend on the type, … associated piping, pipelines with associated flow rate and operating pressure, and the associated failure probability.	Rupture or leak from a pipeline can be a source a large vapor cloud.	X			
7	5.32	• ~~Mechanical~~ Physical properties	Physical properties makes more sense here for the properties of interest.	X			
8	6.4 New item	— Leak or failure of storage tanks, pipelines etc.	They can be a source of explosions at industrial site.	X			
9	6.11	… close to the event can generate projectiles and initiate fire.	In 6.10, used projectile. To be consistent with 6.10.	X			
10	6.19	… approach based on the engineering relationship between the TNT equivalent mass and the distance. Note that it only applicable for high explosives with potential for mass casualties. Other methodologies appropriate for hydrocarbon-air vapor cloud explosions should be used.	This paragraph is applicable only for high explosives and military explosives with potential for mass casualties. TNT equivalent is a poor model for vapor cloud explosions (VCEs). TNT equivalent model gives erroneous results both	X			

			in near-field (overpredicts) and far-field (under predicts) for VCEs. Both TNO Multienergy and BST models are more appropriate for VCEs (See for example, AiChE, 2010. Guidelines for Vapor Cloud Explosion, Pressure Vessel Burst, BLEVE, and Flash Fire Hazards).				
11	6.23	Similar modifications	Same comment as the comment for paragraph 6.19.	X			
12	6.26	• Physical properties	Physical rather than mechanical properties is a more appropriate term for the properties of interest in this case.	X			
13	7.3	~~Flammable vapour clouds can ignite under certain conditions leading to explosive fireballs called Boiling Liquid Expanding Vapour Explosions (BLEVEs), which are especially violent events and should be covered.~~	Flammable vapor cloud can ignite (e.g., from sparks of electric motors, hot surfaces, etc.) in a deflagration and that will not necessarily lead to a BLEVE. A BLEVE requires a sudden loss of containment to rapidly drop the pressure on the liquid.	X			
14	7.16 (Repeated twice, second one) additional text or replacement	— Thermal load vs time	A fire will not generate substantial overpressure.	X			
15	8.1	— Frequency analysis — Frequency analysis	As the unit is number of crashes per year per square kilometer area or number of crashes per year, not unitless.	X			

16	8.7/Line 1	Fire from fuel spillage can …	Fuel makes more sense here than oil.	X			
17	8.24	— Impact locations … (such as type of aircraft, nature of flight, angle of impact, etc.) ~~and maneuverability)~~	Defining maneuverability of an aircraft during an accident and use it in the hazard analysis are extremely difficult tasks because maneuverability of an aircraft during an impending crash also depends on pilot training, pilot's mental conditions (distraction of the pilot, spatial and situation awareness of the pilot before the crash), conditions of the aircraft (such as engine failure). Most of the cases, maneuverability of the aircraft before the accident is not known unless the pilot described it to the accident investigation team.	X			
18	8.29 Additional text item	— Characteristics of the aircraft by type, nature of flight, and crash rate	Aircraft crash rate is one of the most important parameters to estimate the annual frequency of aircraft crashes on to a site. The crash rate depends on the aircraft type, mode of flight (for military aircraft besides whether the aircraft is taking off, landing, or enroute phase of all types of aircraft).	X			
19	10.26 Additional text	Frequency of overhang ordnance, flight path(s) taken to a recovery site, and frequency of dropped ordnance should	Military flights carrying ordnance to a bombing range may encounter hang	X			

		be collected.	ordnance while discharging and have to recover to a recovery airport/airfield. Additionally, information on accidentally and intentionally (to reduce aircraft weight) dropped ordnance is important. In addition to direct hit by an ordnance, an ordnance can generate significant overpressure when exploded nearby of important to safety structures and systems.				
20	General	This document needs to be reviewed by a technical editor or other experienced reviewer. The are numerous grammar, syntax, and punctuation errors throughout.	The document is currently difficult to read in certain places because of the errors present throughout, particularly in Sections 1 and 2.	X			
21	2.8, first sentence	[Unclear, consider deleting sentence altogether or consulting author]	The intended meaning of this sentence and relevance to the remainder of the paragraph is unclear as it is currently written.		X Sentences is re-worded.		
22	2.9	Second sentence should be moved to end of paragraph	As it currently reads, the first sentence of the paragraph would benefit from an example immediately following. Sentence 3 contains such an example, but Sentence 2, as it is currently positioned, interrupts the thought process.	X			
23	2.10	Add word “further” to sentence: i.e. “To *further* illustrate…”	An example is already provided in the preceding paragraph.	X			

24	2.12	The statement contained in this paragraph should include some discussion of the risk-informed nature of screening. Here is a proposed addition (*in italics*): "…which have not otherwise been excluded from further consideration through the screening process *(e.g. through a probabilistic screening, as discussed in paragraph 3.12)*, either the site…"	As it is currently written, the discussion in this paragraph reads as if any potential hazard identified, which cannot be entirely protected against, would warrant excluding a site from consideration. Highly improbable HIEEs, however, can be screened out through the use of PRA and/or other analytic tools. Paragraph 3.12 appears to touch on this subject and including a mention here would be helpful for the reader.	X			
25	3.4	An example should be provided, or a reference to additional guidance on how to consider topographical and meteorological effects should be provided.	As written, it is unclear how to consider such factors.	X Example is provided.			
26	4.4	A precaution should be added about verifying the validity of information received from source operators and, wherever possible, ensuring that information has been validated via an independent reviewer/organization	A trust-but-verify mindset should be maintained when considering self-critical information provided by private entities.	X			
27	General	HIEEs for nuclear installations are addressed in five phases: Phase 1: Identification and screening of hazard sources; Phase 2: Evaluation of hazards and characterization of loading conditions; Phase 3: Design and evaluation of structures, systems and components; Phase 4: Performance, assessment and acceptance criteria of the nuclear installations on the site; and	Integration and harmonization of outputs from Phases I and II of HIEEs (e.g.; evaluation and characterization of hazards) are important to address further in more detail particularly for non-power reactors and newly advanced reactor installations.			X	Section 11 provides recommendations on applying a graded approach to the evaluation of nuclear installations other than nuclear power plants. General guidance on graded approach were given on the basis of their complexity,

		Phase 5: Operator response to potential HIEEs. As indicated, DS520 concerns only Phases I and II. We emphasize the importance of integration and harmonization of outputs of Phases I and II with subsequent action to be carried out in Phases III, IV, and V. In addition, the current guidance used methodologies and approaches for the follow-up actions based on current nuclear power plants. It is unclear how these actions or recommendations would be applied to other nuclear installations particularly of smaller size and less risk impact or risk consequence. In addition, other installations may have no resources to address such large potential risks consequence assumed for conventional NPPs. Therefore, we suggest the guidance adopt specific PRA approach in addressing events consequences in more elaborative fashion for other facilities and adopt the concept of reasonable assurance for safety. For example, it is impractical to design and construct a dome to resist aircraft crash for a small reactor installation including research and test reactors. Therefore, we recommend the guidance address the concept of "reasonable approach to safety," in assessing and dealing with such hazards. In addition, it is unclear how to derive a probability of potential event (e.g.; $<10^{-7}$ for small and non-power reactor facilities. We believe the guidance could benefit in addressing					potential radiological hazards and hazards due to other materials present.

		such limit to screen out certain events for non-conventional nuclear power generating facilities and other small nuclear facilities.					
28	General	This guidance intended to cover areas of screening, evaluation, and assessments of HIEEs hazards. In this context, we suggest that the guidance allocate a section on use of updated remote technologies for hazardous identification and characterization. We note that screening approaches to hazards identification and characterization may rely heavily on advanced remote technologies.	Recommendation for addressing use of advanced remote technologies for screening and identification of HIEES hazards.			x	Remote technologies for hazardous identification and characterization for nuclear installations are unknow.
29	General	We suggest that Phases I and II in this document address use of the concept "defense-in-depth" approach to assess and evaluate performance of redundant components to eliminate certain HIEEs hazards which may reduce the risk factor or prevent occurrence of such assumed HIEEs hazards to occur. In addition, overlapping security measures could also be critical in assessing probability of an event to occur.	Addressing the concept of Defense-in-depth and consideration of security measures in reducing probability of an event to occur.			x	This document is addressing characterization of nuclear installation site for HIEEs. The concept of Defense-in-depth is out of scope of this safety guide. Security aspects are out of scope of this safety guide.

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: T. Languin Page 1 of Country/Organization: France/Département de la sécurité nucléaire Date: 12/10/2020							
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.15	Considerations relating to the **~~physical protection~~ nuclear security** of nuclear installations	Current wording	x			

		against malicious activities, i.e. deliberate acts of sabotage, damage etc., by third parties are outside its scope.					
2	1.15.	Complete 1.15. or add section After 1.15.: “Due consideration should be given to the fact that information on externals hazards can be highly sensitive from a security point of view. For example, information on human induced external hazards that can be beyond the safety design basis is highly sensitive because terrorists could use it as a potential way for an attack. Therefore, such	It may be difficult to find a balance between transparency and security information. Good dialogue with security specialists is essential	x			

		information should be handled carefully in cooperation with nuclear security specialists.					

COMMENTS BY REVIEWER Reviewer: NSGC representative from Germany Page 1 of Country/Organization: Germany/ Date: 12/10/2020				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.15	DS520: Assuming - as in 1.15 - all external human induced events considered in this Safety Guide are all of accidental origin is a valid position to limit the scope of a paper. This assumption should be questioned, when response and mitigation are discussed. I would appreciate, if the author team could find a small spot to mention this		x			

COMMENTS BY REVIEWER Reviewer: Karel Deknopper Country/Organization: ENISS			Pages: 1 of 10 Date: 23/10/2020	RESOLUTION ENISS			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
General comment		Consistency should be checked with recent SSG-35 (e.g. on SDV), SRS 86 (& 87/88) on screening distance and relationship to DBE/DEE (design basis / design extension events).					
1	P1 Footnote	An external event is an event that originates outside the site, and for which the operator has a very limited or no control over its occurrence, and whose	It is remarked that this definition is not the same as in the 2018 IAEA Glossary *("Events unconnected with the operation of a facility or the*		We have to say something about the changes in definition as the		

COMMENTS BY REVIEWER Reviewer: Karel Deknopper Country/Organization: ENISS			Pages: 1 of 10 Date: 23/10/2020	RESOLUTION ENISS			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		effects on the nuclear installation should be considered. Such events could be of natural or human induced origin and are identified and selected for design purposes during the site evaluation process. Events originating on the site but outside the ~~safety related~~ buildings important to safety should be treated the same as off-site external events, but taking into account the higher level of control over these events (this includes any coupled facilities on the site, e.g. to produce hydrogen). ~~A slightly different definition of the term 'external event' is used in this publication.~~	*conduct of an activity that could have an effect on the safety of the facility or activity."*). So one can not say that it is "a slightly different definition", if it is compared to the IAEA definition. Next to that some elements are missing : What do you consider "the site" ? e.g. if you foresee H2 production on your site, does it include this facility ? An important aspect is whether you have control over the hazard (by your license and operation) or if it is from an independent party, or from an outside party but still connected by a contract between you. In that sense, it seems not appropriate to consider events originating on the site but outside the safety related buildings as external events. "safety related buildings" should be "buildings important to safety" (as IAEA terminology is).		wordings used in this SG are not the same used in 2018 IAEA Glossary. Last sentence modified: A slightly modified definition of the term 'external event' is used in this publication.		
2	P2 §1.10	… ~~The methodologies recommended for nuclear power plants need to be applied to other nuclear installations through a graded approach.~~ A graded approach may be applied to the methodologies, in function of the radiological risk. …	SMRs are also NPPs but for these you also need to be able to apply a graded approach. Maybe also to reactor technologies other than LWR.			X	The sentence is clear and used in other SGs also. It can be applied to SMRs.
3	P3 §1.11	The evaluation of hazards associated with HIEEs needs to be performed or reviewed at all stages of the lifecycle of a nuclear installation from site selection to ~~end of operational stage~~ permanent shutdown.	§1.11 seems to suggest that lifecycle ends at end of operational stage. §1.13 makes difference between operational stage (a) and temporary or permanent shutdown with nuclear fuel still in facility (in core, in spent fuel pool, …) (c); hence confusion	X			

COMMENTS BY REVIEWER Reviewer: Karel Deknopper Country/Organization: ENISS			Pages: 1 of 10 Date: 23/10/2020	RESOLUTION ENISS			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			between §1.11 and §1.13 on what is understood by operational phase. In any case, the shutdown phase as described in §1.13 (c) should be included in §1.11 as part of the lifecycle.				
4	P3 §1.14	This Safety Guides also addresses the site evaluation for multiple nuclear installations and eventual coupled facilities (if any) on the same site or on adjacent sites.	Especially for HIEE it is important to mention also the specific aspect of coupled facilities, e.g. for hydrogen production. This is valid for SMRs but also for large NPPs.	X			
5	P3 §1.16	Section ~~0~~ 11 provides recommendations on applying a graded approach	Mistake	X			This error occurred during conversion of the document from MS Word version to PDF version. It is corrected.
6	P6 §2.8	~~As different from natural external hazards,~~ New sources of HIEEs can evolve. Therefore, …	§2.8: some natural hazards can also evolve. Difference with natural hazards is rather the degree of administrative control to keep the situation acceptable.		X First sentence already modified by considering MSs comments		
7	P6-7 § 2.11	In general, there are three types of protection against HIEE for a nuclear installation: (i) protection through a robust design of the ~~safety related~~ structures, systems and components important to safety, (ii) protection through the provision of site protection measures such as sufficient distance and barriers, (iii) protection through administrative measures such as 'no-fly zones.	"important to safety" instead of "safety related" is the correct IAEA terminology. Same comment regarding administrative measures : e.g. if there is an exclusion zone for giving permits for hazardous facilities around the nuclear facility, than it is rather the one to prefer (= inherent safety). Missing : the kind of measures you would take for your own hazardous facilities on site, because there you would prefer a sufficient distance to SSCs important	X			

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		It should be kept in mind that administrative measures are generally the least reliable means of protection and they should be considered as complementing the first two.	to safety. The sentence is generally true, not always !				
8	P6 Footnote	~~For example, in the safety review of the plant, the potential for a fire of small extent and with no direct effect on the plant was found. Examination of the power supply to the offsite emergency system showed that the power lines should be put underground to protect them against fire in order to prevent any impairment of safety related systems important to safety.~~		X			
9	P7 §2.12	~~Unless~~ A satisfactory engineering solution ~~can~~ should be achieved for protection against those HIEE hazards which have not otherwise been excluded from further consideration through the screening process. ~~either the site should be deemed unsuitable during the siting stage, or~~ Appropriate administrative actions should be taken in the case of an existing plant where satisfactory engineering solutions are not considered reasonably practicable, keeping in mind the recommendation provided in Paragraph 2.11.	§2.12: HIE are not considered as exclusionary criteria in SSG-35 > The way it is written now is problematic for existing sites where new NI would be build. Besides, protection against HIE may differ significantly between different standard designs (e.g. Aircraft crash protection) > satisfactory engineering solutions can be different according to the considered design (not always known at the stage of the site selection) and even be the driving force for the selection of the standard design.	X			
10	P7 §3.3	To initiate the evaluation process, the source regions centered on nuclear installation site should be identified based on Generic Screening Distance Values (SDVg) given in Table II, Appendix for	The SDVg is not very clear. One would expect it to be a generic value e.g. characterised by the maximum effect (for a building with no specific protection) of the inventory release of			X	The intent of generic SDV is to start the process with a conservative value as a wide

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		different Event Categories (see box 1 in Fig. 1). SDVg's are typical values used by some Member States. ~~for large nuclear power plants with standardized designs. Since large nuclear power plants are more robust, these values should be checked for other nuclear installations.~~ They should ~~also~~ be checked if the nuclear ~~power plant~~ installation design and layout present any potential weakness to HIEE hazards.	the largest known reservoir used as a first rule to identify hazard sources. Throughout the document, it appears that larger inventories could occur and that standard nuclear design provisions are considered. This unnecessary complicates the procedure. It would be beneficial to clearly define one single bounding SDVg based on the 'naked risk' (building with no specific protection). The values in Table II already seem to be sufficiently conservative to be in accordance ith this remark.				variety of NIs, designs and site conditions are encountered. It is important that no potential source misses out in the first step. Subsequently, refinement is done as more and more data/information is available.
11	P8 §3.7	Specific Screening Distance Value (SDVs) for each hazard of an HIEE (stationary and mobile) should be determined by simple calculations using source specific data, considering local site conditions. The determination of the SDVs should consider the severity and extent of the event including relevant uncertainties. ~~as well as the expected characteristics of the nuclear installation to be located at the site. These characteristics may be assumed for the early stages of siting process to be those corresponding to the standard nuclear installation design.~~	Same remark as for §3.3. How is defined a "standard nuclear design"? Also, there should be still ad ifference with the analysis under §3.14.			X	There are different standard nuclear installation designs provided by vendors. Different set of generic site parameters are used in the design of each of them. The type, design, # of NI units are considered before starting the siting and site characterization studies. The proposed deletion is therefore not agreed.
12	P11 §4.3	The data and information collection process recommended in this guide is set out in Requirement 14 of Ref [1]. It should	As HIE-site evaluation is part of a complete 'site-evaluation', it is suggested to add the link/interface			X	SSR-1 requirement is referred. Suggested text is

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		be noticed that there are interfaces with other topics of the overall site-evaluation, e.g. geology. The following is a list of the most salient and important data and information collection resources: …	with other topics (e.g. geological surveys related to subsidence related to mines, land use as collected for emergency planning issue…).				not necessary.
13	P13 §4.12	The following information for stationery sources should be collected, but the necessary level of detail could vary according to the specific site evaluation stage: …	The level of detail is dependent on the specific stage : At first site evaluation stages location and type of activity may be sufficient.	X			
14	P16 §5.1	… - Flammable gases, liquids and vapours that can form explosive clouds and can enter ventilation system intakes and burn or explode, - Asphyxiant and toxic gases and liquids which can threaten human life and impair safety functions, …	liquids should also be mentioned, because evaporation can cause vapours	X			
15	P17 §5.11	… The drifting cloud may adversely affect the safe operation of the nuclear installation. …	to include risk for operator	X			
16	P19 §5.21	… As explained at 5.11, these liquids are not likely to reach a NI except via the water-intake, but gases emanating from these liquids are extremely important and should be considered.	liquid spills can reach NI (e.g. via water intake > addressed in chapter 9, but it would be good to highlight this here too)		Already modified with MSs comments		
17	P22 §6.4	… - Deflagration in case of liquid pool fires or similar ~~Unintended exothermic chemical reactions~~, - Accidents with explosives	What about fabrication and storage of explosives, fireworks, ammonium nitrate ? in what category do they fit in ? Also, unintended exotherm reaction are not hydrocarbon pool fires, but rather run away reactions, e.g. Toulouse (2001) or Beirut (2020) explosions of Ammonium Nitrate.	X			

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18	P23 §6.6	BLEVEs can occur to all sorts of contained substances, but generally occur when pressurised Liquid Petroleum Gas (LPG) or propane tanks fail catastrophically. .... The mechanical overpressure effects of the burst itself may be sufficient to cause a BLEVE, but if the ~~LNG~~ vapour ignites, this adds …	Liquified Petroleum Gas = LPG; Liquified Natural Gas = LNG		Already corrected		
19	P23 §6.7	~~Unintended exothermic reactions are typically~~ In case of hydrocarbon liquid pool fires or similar, ~~where~~ the hydrocarbon has escaped his containment and ignited. …	unintended exotherm reaction are not hydrocarbon pool fires, but rather run away reaction (e.g. Toulouse (2001) or Beirut (2020) explosion)	X			
20	P23 §6.12	A significant factor affecting the propagation of blast waves is the presence of obstacles between source and nuclear site and inside the vapour cloud; local topography may also play a role and both effects should be considered.	The presence of obstacles inside the vapour cloud is important (cfr 'multi-energy model')	X			
21	P25 §6.23	… TNT equivalents are commonly used as first approach to estimate safe distances for given amounts of explosive chemicals and for …	TNT equivalent method is a good first approach, but for sure not the best to estimate effects related to gas explosions.	X			
22	P29 §8.3	~~In some nuclear power plants, specific protection is provided against malicious aircraft crash; such protection measures are generally sufficient to envelope the risk from accidental aircraft crash hazard significantly, such that it can be screened out~~	Malicious aircraft crash is not considered in this Safety Guide however some of the methods recommended herein, may also be applicable to malicious aircraft crash.		X Already modified by considering MSs comments.		
23	P30 §8.5	it is important to consider all the potential effects of the aircraft crash event on the nuclear installation if any aircraft crash is not screen out	In some cases, the configuration leads to not considering all the mentioned effects	X			
24	P30 §8.9	Please add references for the definitions of Type 1, 2 and 3 (e.g. in footnote)	o General aviation is normally understood as the class of aircrafts		X Word aviation is		

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			with MTOW below 5,7 tonnes. General aviation in type I refers to general aviation but seems to address also military and commercial aviation (as indicated in §8.10 and §8.12). o It is not clear why type I is not covered by type II and III. While small aircraft can generally use the entire airspace, military and commercial aviation is much more delimited. Hence, I would expect that type II & III would cover type I activities. How is double counting avoided? It is proposed to add references for definitions of type 1, 2 and 3 in a footnote		already deleted from Type-1. There is no change in the three types (1, 2, 3) used in NS-G-3.1. Adopted the same types as the MSs especially embarking countries were seen comfortable in using these types.		
25	§10.9	Add a new sentence: Particular attention should be provided to jamming facilities that may be used by the on-site security organization or by national security authorities' transmitters (airborne, seaborne or ground-located on- or off-site), as the actual power and antenna amplification of these transmissions might not be public, and the radiation power of the transmissions may be increased significantly with little or no warning. When information on these cannot obtained by the operator, the regulator should be asked to estimate the significance of these hazards.	The increase of anti-drone measures and increased use of electronic warfare in air defence systems has increased the likelihood of powerful jamming systems being operated near nuclear power plants.	X			
26	§10.24	Add a new point: geomagnetic field strengths in the region (especially in polar areas)	Geomagnetic phenomena are an important source of eddy currents in areas near the poles.			X	Section on Eddy currents removed as it cannot be a strong external

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							source to affect NI equipment.
27	§10.26	Add a footnote to the second sentence: e.g. if there exist undisclosed national security locations (e.g. permanent underwater minefields, electronic warfare installations or concealed munitions depots) near the site that might cause a hazard for the plant, the plant or the regulator should make their best efforts to contact the responsible authorities to determine and minimize the hazard caused to the plant.	In addition to the public locations, the operator and the regulator should attempt to verify that there are no hazardous classified national security facilities near the site.	X			
28	P43 §11	11. ~~EVALUATION OF EXTERNAL HUMAN INDUCED HAZARDS FOR NUCLEAR INSTALLATIONS OTHER THAN NUCLEAR POWER PLANTS~~ Graded approach to assessment of external human induced hazards for nuclear installations	In order to have a more inclusive general title, and to represent better the contents of the chapter			X	There will be guidance on graded approach in Section 11. On the other hand, to be consistent with safety guides on site evaluation for nuclear installations, it is better to keep title of section as it is.
29	P43 §11.1	For the purpose of adopting a graded approach with respect to HIEE ~~hazard assessment~~, nuclear installations should be graded on the basis of their complexity and in accordance with the potential radiological consequences of accidents ~~potential radiological hazards and hazards due to other materials present~~. Protection against HIEE in design and operation of the nuclear installation ~~hazard assessment~~ should be performed in accordance with this grading. This grading may be applied	It is correct that you can grade installations also with respect to consequences other than radiological, but then you have to elaborate on this consistently throughout this guide; e.g. §1.10 only "in accordance with the potential radiological consequences of accidents" is specified. It would be better to exclude this from the scope. The text proposal brings it in line with §1.10.		X The proposal in the first sentence does not improve the guidance. Proposal in the second sentence changes the meaning as design is out of scope of this hazard safety guide.		

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		for each HIEE separately.	Also it is important to allow for grading for each HIEE separately. Also, proposal for the text of this § to be more clear in general.		Last sentence is acceptable.		
30	P43 §11.3	If the results of the conservative screening process show that the potential consequences of such releases would be 'significant', a HIEE hazard ~~assessment and a~~ and safety evaluation of the nuclear installation should be carried out, in accordance with the procedure indicated in para.11.5-14.	the text of this § should be written more clearly			X	The sentence is clear with approved text
31	P44 §11.4	… (k) The potential for on-site and off-site contamination resulting from the ~~volcanic~~ event.	text seems mistake		Already modified		
32	P46 §12.3	The project scope should prescribe to identify all the hazards generated by HIEEs from the various sources that are relevant for the safety of the nuclear installation and that will be investigated within the framework of the project. If some HIEE hazards are not included within scope, an explanation should be provided as to why this is the case, so it is clear that the project has not covered all aspects of the HIEE hazard analysis.	"The project scope should identify all the hazards generated by HIEEs from the various sources that are relevant for the safety of the nuclear installation and that will be investigated within the framework of the project." : One would expect that this will be addressed during the project, but not at the moment of the scope definition (it seems part of the source identification, screening and evaluation).	X			
33	P52 tab I	Generic ~~Source~~ Screening Distance Value (SDVg)	mistake; to be corrected in all Appendices	X			
34	P52 tab I	?	(1) - (4) for (e) meaning (1) (2) (3) (4) ?	X			
35	P52 tab I	… These can arise from road and rail vehicles, pipelines, river barges and sea vessels. Hazards from this category normally arise directly from crash events,	(e) text is incomplete	X			

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		which in turn can lead to consequential toxic gas, fire and explosion events.					
36	P52 tab I	NA and (6)	(f) last column to be completed	X			
37	P54 tab II line 2	For « Sources of hazardous clouds, vapours, gases etc » change from "8-10 km" to "5-10 km" for SDVg	France, one of the "member states", uses this range of SDVg, which includes the previous one			X	Vapour clouds can travel longer distances. During a IAEA PSAR review of a NPP, the safe distance for toxic vapour cloud analysis from a mobile source was calculated as 7.5 km. Stationary sources are much bigger in sizes. We believe that a conservative value should be given as example.
38	P67 tab IV footnote d	See Table V ~~VI~~ for an explanation of the numerals	mistake		Already corrected		
39	P68 tab V	Impaired habitability of control room Disruption of systems or components Damage to structures Ignition of combustibles	text seems incomplete for (3)	X			