Outstanding Members Comments on DS407 Version 1

Criticality Safety

CONTENTS

Notes:

1. ISO-France comments related to both DS407 Version 1 and DS407 Version 2.
2. Resolution of comments now shown in DS407 Version 3

TITLE: CRITICALITY SAFETY, DRAFT SAFETY GUIDE DS407

COMMENTS on DS 407 Draft 1

COMMENTS BY REVIEWER Reviewer: French members of ISO TC85/SC5/WG8 Country/Organization: FRANCE Date: June 2010				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	§ 1.1 Lines 2-4	[…] during normal operation, anticipated operational occurrences and also in the case of accident conditions within design basis accidents.	To be consistent with AIEA Glossary, "plant states" entry. Also note that incidents from INES point of view are accident from Safety Standard point of view (see AIEA Glossary, "INES" entry)	Y			
	§ 1.4 Lines 2-3	[…] during normal operation, anticipated operational occurrences and also in the case of accident conditions within design basis accidents.	Consistency with § 1.1	Y			
	§ 2.1 Lines 2-3	[…] for all operational states (normal operation and anticipated operational occurrences) and accident conditions within design basis accidents.	Consistency with § 1.1	Y	Addition of bracketed text not necessary as term "Operational states" already consistent with IAEA safety glossary		
	§ 2.12 Lines 1-2	This § can be deleted, as the sentence is written elsewhere and is not related to "safety criteria and safety		Y			

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		margins" Otherwise, write […] during all operational states (normal operation and anticipated operational occurrences) and accident conditions within design basis accidents.	Consistency with § 1.1 and § 2.1				
	§ 2.17 Lines 3-4	[…] deviations from normal operation and in anticipated operational occurrences or accident conditions within design basis accidents.	Deviations are not from operational states (which includes anticipated operational occurrences) but rather from normal condition. Note that "deviation" is defined in AIEA glossary as "a departure from specified requirements", but in the "plant states" entry, accident conditions are defined as "Deviations from normal operation more severe than anticipated operational occurrences". Maybe another term may be preferred.	Y	Deviations are from the normal operating condition and safety measures are defined where this may lead to an accident condition. Text updated to clarify this.		
	§ 4.17 Lines 4	[…] during operational states (including normal operation and anticipated operational occurrences)	Consistency with § 1.1. Double Contingency Principle should be mentioned.	Y	Cross reference to paras updated		

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		and design basis accidents, in relation with the "single failure" approach or "double contingency principle" (see § 3.13, 3.14 and 3.15).					
2	§ 1.2 Lines 1-5	The subcriticality of a system depends on many parameters related to the fissionable materials, for example mass, moderation, ~~volume, density,~~ concentration, geometry, enrichment or density. It is also affected by parameters related to the other materials, for example by the presence of moderators, absorbers (i.e. neutron poisons) and reflectors.	There is no specific reason to separate the first from the second set of examples, unless it is said that the first set is intended to apply to the fissionable material. It is better to mention moderation (widely used in the document, and let volume be a subset of geometry in this introduction). Density is related to the fissionable material, it is therefore better to group this case with enrichment	Y			
	§ 2.3 Line 3	[…] which are mass, ~~volume,~~ ~~enrichment~~, concentration, moderation, geometry (volume or other geometrical dimensions), for a given fissionable material (defined	Consistency of the document Volume is a subset of the geometrical attributes Density is mentioned in § 1.2. It can be controlled like enrichment. and Pu/U may	Y	Agreed with need for consistency, reference to volume deleted and density added. However, reflection and absorption remain		

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		by its enrichment, density…) and taking into account reflection, interaction and neutron absorption.	also be controlled. It seems the new redaction tries to be exhaustive, but is not. Reflection or absorption is not controlled as such (the presence of reflectors and poisons is controlled)		unaltered as the list describes the parameters rather than how they are controlled.		
	§ 3.12 Lines 1 and following	For the fissionable material (given its isotopic composition, etc.), the hierarchy of safety measures gives preference to passive safety through the use of ~~inherently safe material or~~ (suppress) geometrical constraint. […] such as controlling: - the mass ~~and isotopic composition of fissionable material~~ in the system; - the concentration in solutions; - the moderation for dry or moist fissionable materials; - the amount of neutron moderating and	Inherently material should be exempted (see § 5.2 and 5.12 also). Isotopic composition not only related to mass control. PuO2 powder	Y	Inherently safe material and geometrical constraint are part of passive safety, see para 3.5. Text deleted as requested. Moderation within fissionable materials and present in the system clarified and separated from neutron reflectors present in the system. As isotopic composition etc may		

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		reflecting material ~~associated with the fissionable material~~ present in the system.			not be fixed, i.e. it may be a design variable, this is retained as an option as a safety parameter.		
3	§ 1.3 Line 4	[…] with fissionable material, <u>and on the responses to a criticality accident</u>.	In order to cover Section 6			Y	The document only provides guidance to regulatory bodies and operating organizations. Therefore do not need the proposed modification.
4	§ 2.13	In ensuring criticality safety two types of criteria should be considered: - Safety criteria based on the value of keff (the neutron multiplication factor) for the system under analysis; - Safety criteria based on the critical value of controlled parameters such as ~~which are~~ mass, volume, <u>other geometrical dimensions,</u> ~~enrichment,~~	Same formulation A margin factor is rarely applied to enrichment as such (it is therefore better to avoid mentioning it). Reflection/interaction/neutron absorption are taken into	Y			

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		concentration, moderation ~~geometry~~ , taking into account reflection, interaction and neutron absorption.	account but the margin is usually affected to the other parameter (critical mass with 2.5 or 20cm reflection)				
5	§ 2.15	In defining safety margins for the keff (relative to 1) or for the ~~critical~~ value of a controlled parameter (relative to the critical value), the degree of uncertainty in the estimation of keff (in the first case), or the critical value (in the second case), including any code bias and the sensitivity, with respect to changes in a controlled parameter, should be considered. Note that the relationship between keff and other parameters may be significantly non-linear		Y			
6	§ 2.16 Lines 4,5	~~Implementing the double contingency principle is an example of implementing a criticality safety margin, see 3.13~~. (Suppress)	Not consistent with the definition of the term “margin”.	Y			

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7	§ 2.17 Line 4	As part of that demonstration, operational limits set at values leading to controlled parameters sufficiently below the critical values should be applied	Operational limits are often expressed in terms of process parameters (like temperature, liquid flows, acidity…) for which a "critical value" is not defined.	Y	In addressing this, it was necessary to define operational limits and the safety limit (paras 2.13 & 2.16 as IAEA glossary) and clarify that the operational limits were set such that safety measures can act prior to a safety limit being exceeded. The final sentence of para 2.16 became redundant. New sentence on process parameters added.		
8	§ 2.18 Lines 1-2	Facilities or activities involving material inherently safe are exempted from a full criticality safety assessment. Moreover, in some facilities or activities the amount of fissionable mass may be so low that a full criticality safety assessment would	Materials inherently safe should be exempted and not relevant to "passive safety".			Y	Although some inherently safe materials are exempted, some may require assessment for certain forms, e.g. the same quantity of low enriched material may be inherently safe in powder form whereas in metal form it may not be. This

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		not be justified.					would require some level of justification, see para 3.5 and ISO USA comment No 10.
9	§ 2.19 Lines 1-2	The general principles should be that: 1) Facilities or activities involving uranium with 1% or less of ^{235}U (in mass) are exempted from a full criticality safety assessment: - if the uranium is not in the form of rods in graphite or water (ordinary or heavy) or - if the uranium based fuel has not been burned in a fast-neutron reactor and if no chemical operation can change the isotopic composition of the fissionable material. 2) The maximum amounts of […]	Idem			Y	Different Member States have different criteria for exempting fissionable material. Therefore retain the existing general text.
10	§ 3.2 Lines 4-6	[…] unshielded criticality event can be severe and	Without concern for human intervention, the	Y			

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		even fatal for those in the immediate vicinity, and human intervention in case of a criticality accident can be difficult. Consequently, the primary objective should be to adopt safety measures that prevent a criticality event.	"Consequently" is not a strictly logical argument (shielding would address the other concern).				
11	§ 3.5 Line 2-5	[…] for active engineered ~~or operator based safety~~ measures.~~ This might be achieved for example […] which are geometrically safe~~. (suppress)	Operator may need to check the adequacy Very low or enriched uranium should be exempted. Moreover, in a facility, there will usually be a point from which the geometry is not safe any more.			Y	As comment No 9
12	§ 3.8 Line 2	[…] to ~~less safe~~ unsafe conditions	Failures, perturbations, etc. will always lead to "less safe" conditions", almost by definition (if they are failures of component important for safety criticality).	Y			
13	§ 3.14 Lines 1-2 + last item	According to the Double Contingency Principle, if a criticality accident can occur because of the simultaneous occurrence of	If a criticality accident is postulated to occur, there is no condition.	Y			

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		two events, it should be shown that:[…]					
14	§ 3.15	In § 3.16, the content seems to apply to technical and administrative measures, while the paragraph is under the "technical safety measures". The same applies for the list of controlled parameters (§ 3.16).	Is it intended? Is it consistent with the first sentence of § 3.10. Note that the distinction technical vs administrative safety measures is neither explicitly explained in AIEA glossary nor in specific glossary.	Y	Reference to technical safety measure changed to either engineered safety measure or just safety measure as appropriate to improve clarity.		
15	Before § 3.18	Sub-section title "Factors affecting <u>reactivity</u>" An introductory sentence before this § would clarify its meaning, for instance: "Some factors may particularly affect the reactivity of the system and should be taken into account in the analysis."	The factors have a physical influence on the reactivity. The controlled parameters result from a choice of the analyst. This section may be placed before the "Controlled parameters" sub-section	Y			
16	§ 3.18 Line 5	- the isotopic compositions limits shall be respected	There is no simple order relation between isotopic vectors that can be used to say that a limit is "exceeded".	Y			
17	§ 4.10 Lines 8-10	<u>Use computational codes and check that they are used in conditions where</u>	Criticality assessment and associated calculation are relevant to criticality safety.	Y	"Develop" changed to "use". Verification and validation of		

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		they have been - verified; - validated.	Software development *per se* are not.		codes covered in “Computational models” section.		
18	§ 4.23	Verification of the computational model ~~should be performed prior to its validation and should~~ relates to the process of testing the methods, mathematical or otherwise, used in the model.	While performing verification before validation is usual (and prescribed in ANSI), is it the place in an AIEA criticality safety guide, to formulate this software development recommendation? Users do not have access to this	Y	Reference to prior verification removed.		
19	§ 4.29 Line 4	[…] into the design or operating procedures. The requirements should be treated in accordance with a Quality Assurance program, as described in section 3 (in particular § 3.26, 3.29, 3.31, 3.37 and 3.40).		Y	Para numbers omitted.		
20	§ 5.14	(i.e. MOX fuel fabrication) by the Pu content in the mixture, ~~and~~ by the ^{235}U content in the composition of the uranium, and by the ^{240}Pu content in the composition of the plutonium		Y	Reference to 240Pu included in addition to 239Pu and 241Pu as requested by ISO-USA comment No 37.		
21	§ 5.49	The forms of fissionable materials are diverse and		Y			

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		include: - fuel assemblies; - fuel rods; - uranium and mixed uranium/plutonium oxide; - solutions of uranium and/or plutonium; - fines; - plutonium oxalate; - plutonium oxide - …	When sawing Quoted in § 5.48 Pu oxalate in PUREX				
22	§ 5.50	[…] To accommodate these process conditions and to ensure an adequate safety margin, criticality control should be implemented through a number of controlled parameters, e.g. control of geometry and concentration.	Geometry and concentration is only an example. Note also that fixed poison absorbers (cadmium layers…) are commonly used.	Y			
23	§ 5.61	PUREX is considered standard but not in the glossary; Electrolytic dissolution is mentioned in glossary (Pyroelectric entry) but not in the text		Y	For consistency with the deletion of PUREX previously in para 5.37, (Previous comment USA No 38), reference to PUREX has been deleted.		

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24	Bibliography	Add the following references: - J. Anno, N. Leclaire, V. Rouyer, *Valeurs minimales critiques du nitrate d'uranyle et du nitrate de plutonium utilisant les nouvelles lois de dilution isopiestiques (Minimum Critical Values of Uranyl and Plutonium Nitrate Solutions using the New Isopiestic Nitrate Density Law)*, SEC/T/2003-41 - Reference Values for Nuclear Criticality Safety - Homogeneous and Uniform UO2, "UNH", PuO2 and "PuNH", Moderated and Reflected by H2O. A demonstration study by an Expert Group of the Working party on Nuclear Criticality Safety for the	The references proposed in Regis COUSIN's email (the 6th of January 2010) have not been included in the draft.	Y			

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		OECD/NEA Nuclear Science Committee - X. Knemp, J. Rannou, *Updated rules for mass limitation in nuclear plants*, SEC/T/2004-14, January 2004 - S.Evo, *Critical values for homogeneous mixed plutonium-uranium oxide fuels (MOX) - Cristal V1 results*, SEC/T/2005-299, July 2005					
25	§ 3.19 Lines 6-9		The sentence that has been added (following UK comment No 20 on the version 1 of the draft) could be misleading. One could think that moderators containing neutron poisons should be preferred.	Y			
26	§ 5.34 Lines 9 - 11		Following Belgium No 2 comment on the version 1 of the draft, the last sentence is not consistent with the first sentence ("In some spent fuel storage ponds one component of criticality	Y	Sentence removed. Reference to IAEA safety standard for the storage of spent fuel, which covers the use of soluble		

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			control may be the inclusion of a soluble neutron absorber (e.g. boron) in the storage pond water.”). The use of soluble neutron absorbers in normal operation should not be ruled out.		neutron absorbers, added.		

COMMENTS BY REVIEWER Reviewer: Christopher S. Tripp, Sr. Nuclear Process Engineer (Criticality), USNRC (NMSS/FCSS/TSB) Country/Organization: United States of America Date: April 2010				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.3	Remove "or temperature" from the first sentence.	This is a secondary parameter, not one of the main criticality parameters such as mass, geometry, etc., and so does not belong in this list.	Y			
2	1.5	What is meant by "exempted from the criticality safety regime" should be explained. If what is meant is that a detailed criticality safety analysis is not required based on low mass, then "…in accordance with Sections 2.17 and 2.18" should be added to the end of this sentence.	The criteria under which an exemption may be granted should be explained.			Y	SCOPE section does not need to cross reference out to each section. More detail is provided in the EXEMPTIONS section as noted. No change required.
3	2.1	The terms "operational states" and "design basis accidents" should be defined, or reference should be made to an IAEA document defining them.	Criticality safety traditionally speaks in terms of normal and credible abnormal conditions. Use of other terms should be explained. The term "technical" is not	Y	The terms referred to are defined in the IAEA Safety Glossary. The term		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		Change: "Safety measures, either ~~technical~~ **engineered** or administrative…".	standard in this context.		technical has been changed to engineered where relevant.		
4	2.2	Reference should me made to an IAEA document defining the various levels of defense-in-depth (e.g., 4th or 5th level).	These concepts may not be familiar to practitioners in all countries.	Y			
5	2.3	Change: "a full description would require the use of ~~microscopic parameters~~ **nuclear data (e.g., cross sections)** such as fission, capture, scatter, etc. ~~For these reasons there are many examples of apparently 'anomalous' behavior in fissionable systems where the neutron multiplication factor changes in ways that seem counter-intuitive.~~	The discussion of macroscopic and microscopic parameters is confusing. The so-called "microscopic properties" such as fission, capture, and scatter, are functions of the various macroscopic parameters, and so they do not need to be independently specified. If necessary to refer to them, they should be referred to as nuclear cross sections. The last sentence is also			Y	Narrative is a general introduction and sets out the need for guidance given that some behaviours are indeed counter-intuitive to those not specializing in the topic.

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			confusing. While some behavior of fissionable systems is counter-intuitive, it is not clear how this follows from the text that precedes this sentence.				
6	2.6	Add to 4th bullet: "In particular, it is important that supervisors**,** **operators,** and other personnel involved in activities with fissionable materials…"	It is most important that the operators themselves are knowledgeable in the hazards associated with fissionable materials.	Y	Previous UK comment no 12 also addressed this		
7	3.1	The discussion of defense-in-depth in Section 3.1 through 3.4 should include the concept of control and/or parameter diversity (preference for reliance on two different parameters for criticality control, or different types of controls on the same parameter).	This is an important part of the overall control preference hierarchy (i.e., passive over active, engineered over administrative, geometry over other parameters).	Y	Double contingency as the preferred method for demonstrating fault tolerance has been included in para 3.7 et seq.		
8	3.10	Change: "…sufficient	See Comment 3.	Y			

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		subcriticality can be ensured by ~~technical, including~~ engineered safety measures or administrative safety measures or a combination of both.”					
9	3.10	Change: “~~Active engineered~~ **Administrative** safety measures that need to be manually brought into action in response to the fault.” Remove the bullet in front of “Mitigation safety measures” and make clear that, in addition to following the preventive control hierarchy, mitigation (e.g., shielding, alarms, emergency response) should also be used to the extent practical and/or required.	Features that require human action are generally considered enhanced administrative controls. Having mitigation as a 5th bullet makes it appear that mitigation is an acceptable alternative to prevention. Mitigation of the types mentions can be used, but primary reliance should be based on prevention.	Y	Clarification provided with examples. The bullet referring to the use of mitigation removed and additional text added as requested.		

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10	3.12	Explain what is meant by "inherently safe material."	If this includes only the isotopic ratio then it is readily understandable. If this includes the chemical and physical form, these are attributes that can be changed and should not be considered "inherently safe."	Y	Para 3.5 expanded to include physical and chemical properties as potential factors defining inherently safe material, The change of form to one which may not be inherently safe may be theoretically possible but not credible on plant. E.g. 1%U235 enriched powder and solutions may be considered inherently safe even though they could be unsafe if converted to		

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					moderated metal rods. This would not be possible by accident.		
11	3.12	Remove concentration and reflection from the bullets	Mass, isotopic composition, moderator, and absorbers are all highly reliable means of control. Concentration and reflection are much harder to control and inherently less reliable, and should not be included after geometry among the recommended means of control.			Y	The list is not definitive and no hierarchy is implied. It is acknowledged that some parameters are more difficult to control, however, this does not necessarily make them unsuitable.
12	3.14	"Applying the double contingency principle is ~~a~~ **the preferred** means of demonstrating defense in depth."	Here, and throughout the draft safety guide, double contingency should be emphasized more. This principle is a key cornerstone of criticality safety but is scarcely mentioned.	Y	See response to comment 7		
13	3.15	In the last bullet, remove "para 2.166."	This section does not exist in the current document.	Y			
14	3.17	In the first bullet, change: "Restriction to a certain ~~type~~ **physical form** and	All the examples given involve specific chemical compounds. However, it is	Y	However, this bullet was deleted as a		

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		chemical compound of the fissionable material…”	also often important to control physical form (e.g., solution, solid, sintered pellets, powder), and non-compound mixtures may also be present.		result of previous comment no 15 from Japan.		
15	3.17	In the 3rd bullet, it is not always sufficient to consider double batching. Reference should be made to the conditions under which double batching is the appropriate upset to consider.	Depending on the capacity of the process and/or equipment, it may not be necessary to consider double batching, or it may be necessary to consider greater than double batching.			Y	As written, the text does not require consideration of double batching, only a consideration of a mass limit with safety factor where appropriate . Bullet wording updated.
16	3.17	In the last bullet, “shielding” should be replaced by “neutron absorbers” or “interaction control” as appropriate.	All the other bullets mention specific criticality parameters. The term “shielding” is usually used in the context of mitigating dose.	Y	Shielding replaced by neutron absorbers		
17	3.17	All the standard criticality parameters should be mentioned here. Those not mentioned include volume, density, and heterogeneity.	The section discussing criticality parameters should be complete.	Y	Volume is considered to be part of geometry, therefore not changed. Aligned with ISO France		

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					comment 2 Density is now included in bullets. Heterogeneity has been added to the bullets in 3.20 and a new paragraph 3.27 on heterogeneity consideration has been added.		
18	3.18	Remove this section.	Many combinations of parameters are used to implement double contingency. There is no need to specifically call out mass and moderation to the exclusion of other control strategies.	Y			
19	3.22	Add: "Criticality safety assessments usually consider a light-water reflector of a thickness	12" is the standard for full water reflection. Full reflection may also be provided by 24" of concrete,			Y	There is some variation across Member States and for transport regulations, therefore the text does not specify specific values.

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		sufficient to each the maximum neutron multiplication factor, **generally 12 inches of tight-fitting water,** known as 'total **water** reflection.'"	so it should be clear that this is just for reflection by water.				
20	3.23	Change: "Neutron absorption ~~should~~ **may** be considered."	Neutron absorbers typically reduce the system k_{eff}, so analysts should be free to conservatively omit them.	Y	Neutron absorbing elements should be considered, though the consideration may be to exclude them, however, this should be justified. Text included to state this in para 3.25.		
21	3.28	Change: "Before starting a new system or a new activity with fissionable material the required **engineered and** administrative measures	Configuration control should be implemented for all criticality safety controls, not just administrative.	Y			

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		should be determined…".					
22	3.35	5th bullet change: "(~~It is recommended that~~ The criticality safety staff should conduct regular walk-downs through the plant and inspections of the facilities, systems or activities)".	The safety guide does not distinguish between requirements ("shall") and recommendations ("should") in the same manner as national consensus standards. However, this language appears to soften the recommendation even further. Criticality safety staff observation of plant activities is a very important component of the Nuclear Criticality Safety Program and should at least be a strong recommendation.			Y	This is already listed as a "should" as is appropriate for an IAEA guide. Therefore this is already recommended.
23	3.37	Add bullets: "to ensure that operators are adequately trained on criticality hazards and operating procedures" and "to stop work and report unsafe conditions"	The duties of supervisors as listed are incomplete. While it mentions ensuring compliance, a safety conscious work environment also should incorporate stop work authority.	Y	Part 1 "Training" covered by management systems section. Part 2 "Stop work" included.		
24	3.34	Change: "...usually	See Comment 3.	Y	See comment 3		

COMMENTS BY REVIEWER Reviewer: Christopher S. Tripp, Sr. Nuclear Process Engineer (Criticality), USNRC (NMSS/FCSS/TSB) Country/Organization: United States of America Date: April 2010				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		require the application of combinations of different ~~technical~~ **engineered** and administrative safety measures."			(It is noted that comment 24 actually refers to para 3.40)		
25	4.17	The sentence that ends with "…should consider all single failure faults" should more prominently discuss application of the double contingency principle.	See Comment 12.	Y	Text amended.		
26	4.20	Change: "…should be verified and validated to ensure the ~~quality~~ **accuracy** of their predicted values and to establish their limits of applicability…"	Determination of bias relates to the idea of accuracy. This language is more precise.	Y			
27	4.20	Change: "Verification relates to the process of ~~determining~~ **confirming** that the ~~controlling physical equations within the computational model~~ **computational method**	The sentence as worded is very unclear. Suggested reword is from ANSI/ANS-8.24-2007.	Y	Definition of verification changed to be consistent with that in IAEA Safety Standard GSR Part 4		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		~~have been~~ correctly ~~incorporated~~ **performs numerical calculations**."			"Safety Assessment for Facilities and Acticities".		
28	4.23	Change: "Verification of the computational method should be performed prior to its validation **and periodically thereafter** and should test…."	Verification should be performed on some periodic frequency (e.g., annual) to ensure the continued integrity of the computer code system's configuration.	Y			
29	4.24	The definition of "representativity" should be generalized.	A definition of "representativity" that implies that TSUNAMI (or some other quantitative method) should be used should be avoided. TSUNAMI is an acceptable method for determining benchmark applicability, but it is not the only acceptable method of doing this. The traditional method of comparing benchmarks to design applications in terms of certain key parameters (e.g., enrichment, moderator-to-fuel ratio, average neutron	Y	Specific reference to representativity removed and recommendation for benchmark to be representative generalized.		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			energy) remains valid and should be allowed for within the definition of representativity.				
30	4.25	Change to 2^{nd} bullet: "Benchmark characteristics…should ~~correlate~~ **be similar** to the fissionable material system and its operating parameters…"	Use of the term "correlate to" seems to imply that a method such as TSUNAMI (which explicitly calculates a correlation coefficient) should be used. See comment 29.	Y			
31	4.25	2^{nd} sub-bullet of 3^{rd} bullet: It is unclear whether "molecular compounds, mixtures, alloys, and their chemical formulae" relate only to fissionable materials, or to all mixtures that may be present in the model (e.g., moderators, absorbers, and reflectors)	The material characteristics of all mixtures in the model should be considered in assessing benchmark applicability.	Y	"All materials" now specified in introductory paragraph to 3^{rd} bullet		
32	4.25	5^{th} sub-bullet of 3^{rd} bullet: The term "atom ratio" is unclear. Ratio of what to what?	See Comment 31.	Y	Reference to atom ratio deleted and text clarified.		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		Also, the discussion of moderators refers too specifically to water. While this is the most common moderator in most facility operations, for completeness other hydrogenous moderators should also be mentioned (oil, plastic, etc.). These are much more common than beryllium or magnesium oxide, which are included on the list.					
33	4.25	7th sub-bullet of 3rd bullet: ^{240}Pu and ^{238}U should not be listed as examples of neutron absorbers. Except for cases where these may be present other than in fissionable materials (e.g., depleted uranium), they are included in control of isotopic composition.	The usage of non-fissile isotopes of U and Pu as neutron absorbers is non-standard terminology.	Y	Reference to 240Pu and 238U deleted and reference to iron added.		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
34	4.26	Change: "If no benchmark experiments exist that match the system being evaluated…it may be possible to interpolate **or extrapolate** from other existing benchmark data to that system**, by making use of trends in the bias.** Sensitivity and uncertainty analysis ~~should~~ **may** be used to assess the applicability of benchmark problems to the system being analyzed…"	No mention was made of extrapolating, which may be done as long as the range is not too great. Some guidance on how this may be done should be included (see example guidance from ANSI/ANS-8.1-1998). Sensitivity and uncertainty analysis is one tool that may be used, but not the only tool (see Comment 30).	Y	Text amended as requested and additional text added derived from ANSI/ANS-8.1-1998.		
35	4.27	The discussion of "single failure criterion" and "double contingency principle" should be clarified to make clear the distinction between them. Also, the statement appended to the end of	Defining changes in process conditions solely in terms of changes to a criticality parameter is overly restrictive. It is not part of the definition of double contingency; it is an interpretation.	Y	Note, text had already been amended due to comments from other Member States.		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		the paragraph on double contingency "(e.g., mass, enrichment….etc.)" should be deleted.	Defining changes in process conditions as requiring a change in parameters would imply that reliance on single-parameter control is not permissible for meeting double contingency. While this is the traditional position within the U.S. DOE community, it is not universally followed throughout the criticality safety community. Many NRC licensees have traditionally relied on single-parameter control for meeting double contingency. While two-parameter control should be preferred, it has been NRC's position that single-parameter control is acceptable.				
36	5.7	Change the "i.e." in the first sentence to "e.g."	Incorrect calculation of the amount of fissionable material present is not the only way calculation errors can occur. It is only one example.	Y			

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
37	5.14	Change: "These facilities can be characterized depending on the ^{235}U content for uranium fuel fabrication or for facilities mixing powders of uranium and plutonium…by the Pu content in the mixture**, the ^{239}Pu and ^{241}Pu content in the plutonium,** and by the ^{235}U content in the composition of the uranium."	The isotopic composition of both the plutonium and uranium, as well as the relative proportion of U to Pu, should be specified.	Y	Reference to 239Pu and 241Pu included in addition to 240Pu as requested by ISO-France comment No 20		
38	5.15	Change to the 2nd bullet: "(e.g., control on volumes of materials and types **and densities** of materials to be used such as CO_2, water, graphite, sand, etc.)".	Low-density water foam may be acceptable for fire-fighting activities when full-density liquid water may not be.	Y			
39	5.13 – 5.21	The discussion of controlled parameters in fuel cycle facilities emphasizes the	The inclusion of good practices across different stages of the fuel cycle is a productive exercise.	Y	Additional discussion has been included in 5.21 and 5.22 to		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		importance of moderator control. However, it may be overemphasized if other important parameters are not equally discussed. Discussion should also be included of mass and geometry, at a minimum.	However, this discussion should not overemphasize one type of control to the exclusion of others that may be equally important.		highlight the use of other control parameters and relevant good practice.		
40	5.22	Change: "the isotopic, physical, and chemical composition of the fissionable material will have changed during irradiation in the reactor **and subsequent cooling**"	The isotopic composition will change both during and after irradiation.	Y			
41	5.32	Remove or clarify the 4th bullet: "justification for the treatment of a large number of nuclides in the calculations"	All nuclides being used to provide burnup credit should be appropriately validated. The focus should be on the demonstration that the cross sections of all included nuclides are accurate, not on justifying the number of nuclides.	Y	Bullet removed		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
41	5.38	Many of the items under "Reprocessing," and in particular the bullets under Section 5.38, apply equally well to operations at fuel cycle facilities (especially, but not only, MOX facilities). The criteria that are not solely applicable to reprocessing should be moved to the section on fuel cycle facilities, or else put in a general section on criticality safety.	The physical phenomena applicable to reprocessing activities are not, for the most part, unique to this type of facility.			Y	Items listed are all relevant to reprocessing. Some of these items are already included in the other parts of Section 5. If additional items are to be included in the other parts, please provide the suggested additions.
42	5.40	Move this section to the discussion of fuel cycle facilities.	Most of what's in this paragraph applies equally well to fuel cycle facilities (see Comment 41).			Y	Parts of this section are specific to reprocessing. If additional text is required in the general section, please specify.
43	5.40	Change: "It is recommended that only in exceptional circumstances should soluble ~~or fixed~~ neutron	Use of fixed neutron absorbers is a very reliable means of control. It is often used in conjunction with geometry control as robust	Y			

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		absorbers be used, and that their use should be fully justified in the criticality safety assessment."	passive strategy in solution processes. This means of control should not be discouraged.				
44	5.45	Add "flow rates" and "amounts of reagents" to the list of process parameters that can affect criticality.	These are among the means used to ensure that criticality parameters remain within analyzed bounds.	Y			
45	5.51	Add "passive filtration" as a 5th bullet.	Among all the measures used to ensure the complete dissolution of fuel, passive features (such as filters) may be the most reliable. It should be included in the list.	Y			
46	5.57 – 5.60	Add a discussion of waste acceptance criteria and possible re-concentration phenomena.	Nowhere in the discussion of the criticality safety issues associated with waste are these important concepts discussed.	Y	Acceptance criteria is covered by para 5.70. i.e. use of package limits. Para 5.71 added to cover configuration changes in the		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					waste.		
47	5.64	This section discussing validation is very general, and adds little useful guidance. If it cannot be made more specific to the validation issues occurring for waste systems, it should be deleted.	Adds little value as written.	Y			
48	5.65	Add a discussion of release criteria for processes and facilities undergoing decommissioning.	Nowhere in the discussion of the criticality safety issues associated with decommissioning is a statement that criticality control and monitoring should be maintained until the area is released (or fissionable mass reduced below a minimum critical mass).	Y	Agreed. A new paragraph was added from previous comments ENISS No 15, to cover the proposed change, additional text has been added to this para to cover the criticality aspects during decommissioning by including a		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					reference to the IAEA Safety Standards WS-G-2.4 on decommissioning		
49	5.68	Change: "Due to the potential for closer contact with the public, the transport criticality safety assessment is **more** stringent and based on a fully deterministic system, ~~which does not allow risk-informed judgements~~."	While the safety guide is written with the assumption that facilities will adhere to IAEA rules and standards, this may not be the case. The requirements of the individual member countries may vary, so categorical statements such as this should be avoided. It is not entirely true, in the US, that there is no room for risk-informed judgement in regulating transportation. It is true that the regulations are largely deterministic, but this sentence is too strongly worded.	Y			
50	5.73	Clarify whether "out-leakage" applies to water	Needed for clarity.	Y	Text amended to clarity and to be		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		(as in-leakage does) or whether it applies to leaking of fissionable material outside the package, in the first bullet.			consistent with the IAEA requirements in the transport regulations TS-R-1.		
51	5.75	Re-title this section "Research Laboratory."	Operating production facilities often include analytical laboratories. It does not appear that the intent of this section is to include those types of laboratories.			Y	Title remains general to cover the use of analytical laboratories.
52	5.76	Change: "Useful references for determining the properties of **some of** these materials **(i.e., special actinides)** include Refs. [20] and [21]."	The references only apply to special actinides, not all materials discussed in the paragraph above.	Y	Reference to special actinides not included as already covered by Ref. [22].		
53	6.9	Change: "It is acknowledged that in ~~some~~ **most** operations with fissionable materials the risk of a criticality accident, while very	Whenever a sufficient quantity (usually more than a minimum critical mass) of fissionable material is present, there is a non-zero risk of criticality. There will be	Y			

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		small, cannot be eliminated."	very few processes where there are no credible scenarios leading to criticality. A major contributor to many accidents that have occurred has been the idea that criticality is not credible. As worded, the sentence appears to support this non-safety conscious idea.				
54	6.22	To the 2nd bullet, add "(including quantities)". As an additional bullet, add "feedback and quenching mechanisms (venting, etc.)".	If the intent is to obtain a clear picture of how the excursion was initiated, then the three bullets listed here are probably sufficient. If, however, the intent is to assess how the excursion is likely to evolve, more information is needed (parallel to the information listed in Section 6.3).	Y			
55	6.38	Remove the sentence: "Re-entry should be performed by more than once person."	Unless conditions are such that it is likely a person would be incapacitated while attempting to respond, such as by intense radiation, toxic	Y	Recommendation for more than one deleted.		

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			chemicals, etc., ALARA seems to suggest that the minimum number of individuals needed to perform recovery activities should be exposed. The only justification for requiring more than one responder would be to prevent a single incapacitated individual from receiving a lethal dose or from being subjected to other facility hazards.				
56	6.39	Clarify the statement "…if radiological surveys indicate that the radiation levels are acceptable."	This is vague. Some indication of what constitutes an acceptable radiation level for reentry should be specified, or else references should be provided to other IAEA documents.			Y	Recommendation is that re-entry should be assessed against a radiological limit. However, the limit will depend on the circumstances and the national regulatory requirements.
57	6.49	Change to 2nd bullet: "…or where the provision of criticality accident alarm systems offers no	The purpose of a criticality accident alarm system is to reduce the risk of plant personnel to the	Y			

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		reduction **in the risk from a criticality accident, or results in an increase** in total risk, i.e., the overall risk to personnel from all hazards, including industrial is ~~not reduced~~ **increased**."	consequences of a criticality. The default position should be that criticality alarms are required, unless (1) they provide no reduction in the risk of criticality, or (2) they result in an increase in overall risk. As written, the position is that alarms are *not* required unless they can be demonstrated to result in a reduction to overall risk. The problem with this idea is that risk is hard to quantify, and so it will not be clear in many cases how to compare industrial risks with reduced risk from criticality. (Not just likelihood but also consequences have to be compared.) In most cases, the best that can be done is a qualitative judgement, but only if the increase or				

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			decrease in risk is substantial. Thus, alarms should conservatively be installed unless there is a compelling risk argument why they should not.				
58	6.50 – 6.51	These paragraphs do not belong in the section on criticality alarms. They should be moved.	Permanently installed criticality alarms are not relevant to transportation.	Y	Deleted		
59	6.66	Change: "The location and spacing of detectors should be chosen to ~~avoid~~ **minimize** the effect of shielding by equipment or materials."	Entirely avoiding intervening shielding will not usually be feasible. In most processing plants, it is not possible to definitively pinpoint where criticality will occur; there may be a large number of vessels or pieces of equipment in any given area where there are credible criticality hazards. Thus, the best that can be done is to locate alarms so they can have the widest practical coverage.	Y			
60	6.67	Clarify or remove the phrase "and kept under	It is not clear what this has to do with determining the alarm			Y	The alarm testing period will be determined during design

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		review."	testing period.				substantiation, however, on-plant conditions willl provide data that should feed back to confirm an adequate testing regime is maintained throughout life.
61	6.71	Add a statement to the effect that compensatory measures will be established, or fissionable material will not be moved or processed, during periods when required coverage is lost.	Nowhere in the section on criticality alarms does it discuss what to do in the event alarm coverage is lost.	Y	Additional text was added in 6.69 as a result of comment No 58 from France.		
62	7	Comments apply to definitions in the Glossary: Depletion: This definition is too generic. Everywhere it occurs in the safety guide, it refers to isotopic depletion as a result of irradiation. ISOCS: This definition is too specific. Many	Specificity of terminology is needed to ensure meaning is understood. It is the understanding of the reviewer that the Glossary will not be included in the final safety guide. Reviewer believes that a list of definitions in some format should be provided to aid clarity.	Y	Isotopic change added to definition. ISOCS retained and this is correct in context and is provided as an example only. Pyroelectric … deleted		

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		facilities use other systems for performing similar functions. Pyroelectric, etc.: This definition is too specific, as many facilities use other processing technologies. Also, these terms are not used in the current version of the safety guide. Suggest removing them. Representativity (ck): This definition is too narrow, and too specific to the TSUNAMI method. (See Comment 30.)			Representativity (ck): deleted		
63	References & Bibliography	These sections are weighted heavily in favor of documents applicable to or written by the U.S. DOE. There are very few NRC documents or documents from other	This standard is intended to apply to a wide range of fuel facilities worldwide.	Y	Please provide any references that you feel should be included.		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		countries. A wider literature search to identify important documents should be conducted.					
64	Bibliography	NRC Regulations (10 CFR 60, 61, 70, 71, and 72) are listed under "Government standards," while DOE Regulations (10 CFR 830) are listed under "Handbooks & Guides." Suggest a separate category for regulations (including IAEA).	This will ensure these documents are properly characterized.			Y	Bibliography focus is on standards and guidance, therefore reference to regulations has been deleted.
65	Bibliography	The list of "Computational Methods" excludes MONK.	This is a significant code package that should be included along with SCALE, MCNP, VIM, and COG.	Y	Reference to MONK added.		

Japan NUSSC comments on Draft Safety Guide Criticality Safety (DS407) Draft 1

COMMENTS BY REVIEWER Reviewer: H. Tezuka, T. Nakata, K. Nakajima, H. Tamaki, T. Oshima Country Organization; JNES, Kyoto University, NISA/ Japan Date 30/04/2010				RESOLUTION			
Comment No.	Para./Line No.	Comments/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modif./rejection
13	3.17	The explanation on the use of safety factor for "k_{eff}"should be described as well as that for "Controlled parameters."	The method to determine the safety criteria based on k_{eff} should be described.	Y	Additional text added to 3.17 acknowledging the use of k_{eff} to demonstrate sub-criticality. Text covering the issues for determining keff such as bias, uncertainty and sensitivity are already covered in 2.12 to 2.16 and code validation, verification and the use of benchmarking are already covered in 4.20 to 4.27.		

COMMENTS BY REVIEWER Reviewer: U.S. NRC (NUSSC/RASSC/TRANSSC/WASSC) (Contact: Boby Eid) Country/Organization: United States of America Date: May 5, 2010				RESOLUTION			
Comment No.	Para/Line No.	Comment/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
10	3.7	“The sensitivity of the system to potential faults should be minimized.” This requirement is too vague. What does success look like? Is there a threshold or reference that can be used to describe the expectation?	Clarity	Y	Additional text that was added to the original paragraphs 3.7 and 3.8 in Version 2 (now paras 3.9 & 3.10 in Version 3) in response to previous comments from Finland (7 & 10) and Japan (27) provides clarity on the characteristics of systems that minimize sensitivity to faults		
12	NEW Paragraph after 3.8	We recommend adding a new Para to provide some guidance as when a design cannot be both passively safe	Completeness, Clarity: Considering rare, but actual reported accident where	Y	Additional text added to original		

COMMENTS BY REVIEWER Reviewer: U.S. NRC (NUSSC/RASSC/TRANSSC/WASSC) (Contact: Boby Eid) Country/Organization: United States of America Date: May 5, 2010				RESOLUTION			
Comment No.	Para/Line No.	Comment/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		and fault tolerant.	neither passive safety nor fault tolerance features were available; we suggest providing guidance on what should be done when a system is neither passively safe nor fault tolerant.		paragraph 3.8 (now para 3.10 in Version 3) recommending the addition of safety measures where fault tolerance criteria are not met.		
15	3.17 / 3rd, 4th, & 5th Bullets	Add the basis for the 0.45, 0.90, and 0.80 failure criterion.	Clarity/Completeness: Provides supporting information and adds clarity	Y	Values now deleted following Japan's request. Specifying values may lead to mis-use due to safety factors being dependent on their application.		
17	3.42	"Implementation of the safety measures includes inspections, periodic surveillances, continuous or quasi-continuous measurement. Accordingly,	Clarity/Completeness	Y			

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Comment No.	Para/Line No.	Comment/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		quality assurance measures should be developed and implemented to maintain the reliability of the safety measures. Other factors, which influence the selection of safety measures, should be considered. These factors include:" The guidance document would benefit by explaining what is being inspected, surveilled, and/or measured.					