DS407 Version 6

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSILE MATERIAL

RESOLUTION OF MEMBER STATES COMMENTS

on

DS407 Version 4

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DS407 Version 6

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COMMENTS BY REVIEWER Reviewer: C. Kennes, Th. Maldague Country/Organization: Belgium / FANC (Federal Agency for nuclear Control) + Bel V (TSO of FANC) Date: 2011-05-04				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejecti on
1	General comment	Although the text is meaningful, several editorial issues (wording, terminology, uniformity, clarity, simplicity of the text ...) are still remaining.			Noted		
2	General comment 1.4 2.2 2.12 3.39	*Keep uniform terminology* : ensuring sub-criticality	"ensuring criticality safety" « controlling criticality » "maintaining subcriticality"		Document reviewed		
3	General	Check uniformity & coherency: Licensee, operators, personnel, staff, employees, management; "senior" management …)	appears in different § sometimes with different meanings (operator for example)		Terminology made consistent with IAEA Safety Glossary and therefore structured as follows: Operator (i.e. operating organization), management, personnel, operating personnel.		
4	General	Other terminology Issues :	IAEA 2007 glossary	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
	comment	- Operational Limits and Conditions (Iaea 2007 glossary) - "events" or "postulated initiating events" in place of "faults" - "Controls" in place of "checks" - Remove "Note (that).". - Criticality safety (assessment)	Appears several times in : 2.1, 2.12, 3.40, 4.11, 4.18, 5.4, 5.40,… IAEA 2007 glossary To be checked for coherency & uniformity (According the context)				
5	General	"safe geometry" used several times need to be defined.			Changed to "favourable geometry" and definition added.		
6	1.1	Nuclear installations ~~materials~~ containing fissionable radionuclides are required to be managed in such a way as to ensure sub-criticality during normal operation, anticipated operational occurrences and also ~~in the case of accident conditions~~	"normal *operation*" ; or "*operational occurrences*" does not apply to *materials* Accident conditions within		Reference to facilities and activities used instead of installations		

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		~~within~~ during design basis accidents Ref. [1]. This applies to large commercial facilities, e.g. nuclear installations, that deal with the supply of fresh fuel, with ~~and~~ the management of spent fuel ~~and~~ or with radioactive waste containing fissionable material, including handling, processing, use, storage and disposal ~~(operation and postoperation).~~ This also applies to ~~prototype~~ research and development facilities and ~~to~~ activities, and to ~~such as~~ the transport of packages containing fissionable materials.	design basis accident are design basis accidents Meaning of operation and post-operation not clear “ prototype research and a development facility” meaningless				
7	1.2	The sub-criticality of a system depends on many parameters related to fissionable materials, for example, mass, concentration, geometry, enrichment or density. It is also affected by ~~parameters related to~~ the presence of other materials, for example, moderators, absorbers (i.e. neutron	More clear	X			

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		poisons) and reflectors. Criticality safety may be realised through the control of an individual parameter or a combination of parameters, e.g. by limiting mass or by limiting both mass and moderation. The means for controlling these parameters is ensured either by engineered features ~~of the design~~ ~~and~~ and/or by administrative measures	Simplification ("of the design" not needed")				
8	1.3	The objective of this Safety Guide is to provide guidance and recommendations on how to meet the relevant requirements for ensuring sub-criticality when dealing with fissionable material and for planning the responses to criticality accidents. The guidance and recommendations are applicable to both regulatory bodies and operating organizations ~~who are dealing with fissionable material~~. This Safety Guide presents guidance and recommendations on how to fulfil the sub-criticality related requirements established in the	Repetition (of sentence above)	X			

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		following IAEA Safety Requirements publications:	See above				
9	1.4	This Safety Guide ~~makes recommendations on how to ensure sub-criticality in systems involving fissionable materials during normal operation, anticipated operational occurrences and also in the case of accident conditions within design basis accidents from initial design, commissioning, through operation and decommissioning and disposal. It~~ encompasses all types of facilities and activities, except ~~facilities~~ systems that are designed to be intentionally critical, e.g. a reactor core at a nuclear reactor, or a critical assembly, and systems ~~that have been exempted from complying with the~~ subject to other criticality safety requirements, e.g. transport regulations Ref. [6] and does not cover any activities on defence related facilities. ~~If applicable the recommendations of this guide should be applied to operations that should remain~~	Already in 1.1 & 1.3 A *facility* is never critical Transport is not "*exempted*" from complying with criticality safety repetition	X			

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		~~sub-critical~~ Recommendations encompass approaches to and criteria for ensuring criticality safety, conducting criticality safety assessments, including the use of data, identifying measures to ensure sub-criticality, as well as the planned response to criticality accidents.					
10		Section 3 addresses the safety measures for ensuring sub-criticality, especially the Importance of implementing adequate measures ~~adequately implementing the measures~~, the factors affecting these measures, the roles and responsibilities for those involved in implementing the safety measures, as well as the implementation and reliability of the safety measures.	Editorial	X			
11	2.1	~~Criticality safety should be ensured for all operational states and accident conditions within design basis accidents.~~ Safety measures, either engineered or administrative, should be identified, implemented, maintained and periodically reviewed to ensure that the	Already in 1.1	X			

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		activity is conducted within specified operational limits and conditions that ensure ~~the activity remains sub-critical~~ sub-criticality (i.e. within a defined safety limit, see Para 2.13).	Terminology (see comment n° 2)				
12	2.2	The criticality safety assessment should also determine whether adequate defence in depth is provided, bearing in mind that the consequences of an ~~unshielded~~ criticality accident can be severe and even fatal for those in the immediate vicinity.	No reason to specify /limit to "*unshielded*" accidents		Agreed. However, para deleted by Canada-AECL comment no 7		
13	2.3.	The ~~processes~~ physical phenomena which affect the neutron multiplication factor (Keff) are often complex, non-linear and contain competing effects.	Better wording		Agreed. However, sentence deleted by Canada-AECL comment no 10		
14	2.5	Human error and related failures of supervisory/management systems contributed ~~have been a contributory cause~~ in nearly all criticality accidents experienced to date.	wording		"Have been a feature" used instead		
15	2.6	Management1 should establish a comprehensive criticality safety programme ~~for maintaining sub-criticality~~ to ensure that measures for all aspects of criticality safety are identified,	Redundancy	X			

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		implemented, monitored, audited and documented throughout the entire lifetime of the facility or activity. Management should ensure that any corrective action plan is set up, ~~updated and~~ implemented and updated when necessary.	Consistency and chronology				
16	2.6	~~To ensure~~ For the correct implementation of operating procedures ~~for~~ ensuring sub-criticality, management should ensure that personnel involved in handling fissionable materials are involved in ~~writing~~ developing them;	3 times “ensure” in one sentence	X			
17	2.6	Management should clearly define and identify ~~document~~ staff and his ~~personnel~~ responsibilities for ensuring criticality safety;		X			
18	2.6	Management should provide suitably qualified and experienced criticality safety staff ~~to serve as advisors to operators, to supervisors and to the plant management~~;	Task of experienced staff not limited to serve as advisor & supervisor	X			
19	2.8	Management should ensure that ~~the~~ criticality safety assessments and analyses are ~~produced~~ established and	Editorial	X			

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		periodically reviewed..					
20	2.7	Personnel handling fissionable materials should inform their supervisors in case of ~~difficulties~~ any (suspicion of) abnormality .	meaning of "difficulties" not clear		Agreed. However using wording proposed in UK comment no 12		
21	2.12	~~In ensuring criticality safety two types of criteria should be considered~~: Operational safety limits should be derived according two types of criteria: • 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 mass, volume, concentration, geometry, moderation, taking into account reflection, interaction and neutron absorption. The critical value is that value of a controlled	Same wording as 2.12 Link 2.12 with 2.13 to 2.16: Safety criteria <-> safety limits	X			
22	2.14.	In ~~determining~~ applying safety margins to keff (relative to 1) or to ~~the value of~~ a controlled parameter (relative to the critical value), the ~~degree of~~ uncertainty	Same wording as 2.13 : "safety margins should be *applied*" Simplify wording	X			

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		in the estimation of keff (in the first case), or the critical value (in the second case), including any code bias and sensitivity with respect to changes in a controlled parameter, should be considered.					
23	2.15.	All margins adopted in setting safety limits ~~in criticality safety assessments~~ should be justified	According 2.13, margins apply to set the safety limits, not to safety assessments	X			
24	3.1	The ~~criticality safety~~ measures that should be taken for ensuring ~~sufficient~~ sub-criticality of systems processing, handling, transporting or storing fissionable materials should be based on the defence in depth concept	Terminology, simplification “sufficient” undetermined	X			
25	3.2	The facility and activity should be designed and operated such that defence in depth against incidents or accidents is achieved by provision of different levels of protection with the objective of preventing failures, or if prevention fails, ensuring detection and limiting the consequences. ~~The consequences of an unshielded criticality event can be severe and even fatal for~~		X			

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		~~those in the immediate vicinity, and human intervention in case of a criticality can be difficult. Consequently~~, The primary objective should be to adopt safety measures that prevent a criticality event. However, in line with the defence in depth principle, measures should also be taken to mitigate the consequences of such an event. Application of the defence in depth concept should be aimed:	Repetition of 2.2, no added value				
26	3.5	The passive safety ~~design~~ of the facility or activity is such that the system will remain subcritical without the need for active engineered or operator based safety measures (other than verifying that the fissile material properties are covered by the design). ~~This might be achieved by using inherently safe material, e.g. by using only very low enriched or natural uranium in specific chemical or physical forms. Alternatively~~, For example the facility or activity might be designed such that fissionable material is always restricted to containers with safe	"passive design" meaningless Coherency with 3.12 The chosen example of using only very low enriched or natural uranium is not appropriate and should be removed. It is not an example of passive safety, but an example of a system which is not critical Terminology: "geometrically subcritical configuration" meaningless	X			

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		geometry. ~~have geometrically sub-critical configurations.~~					
27	3.7	The double contingency principle is the preferred mean~~s~~ of demonstrating fault tolerance for criticality safety				X	Grammatically ok
28	3.9	~~The sensitivity of the system to potential faults should be minimized. To achieve this~~, The system design should follow the fail safe principle and the safety measures should fulfill the single failure criterion. Any single failure or fault such as a component failure; a function control failure or a human error (e.g. instruction not followed); should not result in a criticality accident.	"*sensitivity of the system"* not defined/explained	X			
29	3.15.	The hierarchy of safety measures gives preference to safe ~~passive~~ geometry.	Passive geometry has no meaning (what is an active geometry?), terminology coherency with 5.22, 5.23, …		Agreed. However using wording proposed in UK comment no 33		
30	3.15, 3.16	Delete 3.15 & 3.16 ("passive" geometry already discussed in 3.5)	3.17 contains information of 3.15 & 3.16		Text in 3.15 retained and amended as suggested in comment no 29.		

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					However, bullet listing and 3.16 deleted.		
31	3.17	The sub-criticality of the system can be demonstrated by calculating the neutron multiplication (keff) and/or controlled by limiting one or more parameters. Safety measures that may be considered ~~Parameters that may be controlled~~ for ensuring criticality safety are as follows, but not limited to: • Limitation ….	A *limitation* is not a *parameter*			X	To be consistent with the previous para, that implies a listing of controlled parametersr
32	3.17, 3.19	Limitation ~~of~~ on the isotopic composition of the …	The isotopic composition itself is not a parameter that can be limited.	X			
33	3.19	the compound to be used cannot be changed to a more reactive compound; comment: "*changed*" should be explained : Chemical/physical change (decay for example), substitution, by another compound?			Text modified.		
34	3.20	~~The minimum critical mass for a system~~	Similar to 1st sentence of 3.20	X			

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		~~may be dependent on the presence of moderating material and usually changes when the system is changed.~~	(redundancy)				
35	3.21	The presence of neutron reflecting material should be considered. Material that ~~has less neutron absorbing properties and~~ surrounds the fissionable material system will act as a neutron reflector and potentially increase the neutron multiplication factor of the system.	Even materials with neutron absorbing properties can act as reflectors		Agreed. However using wording proposed in UK comment no 44		
36	3.21	~~The amount of increase will depend on the type, thickness, number and location of the reflecting material~~	Not relevant in 3.21	X			
37	3.27	When administrative safety measures are employed, particularly procedural controls, ~~the operator~~ it should demonstrated that potential deviations from ..	Consistency of terminology. (comment n° 3)	X			
38	3.38	~~Revised~~ Procedures should be reviewed according to the management system. As appropriate, it should include review by the supervisors and the criticality safety staff and	? (original procedures too)	X			
39	3.40.	~~The application of the~~ Criticality safety considerations ~~measures~~ should be used	Simplification	X			

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		to determine: • the design and arrangement of ~~safety measures~~ devices (?) such as apparatuses, casks and other components; • the need ~~for measurement devices~~ for instrumentation ensuring that the operational limits and conditions ~~conditions and operating limits~~ are adequately monitored and controlled (e.g. the measurement of moisture in the fissionable material dioxide powder); • the need for additional administrative measures for ensuring that ~~the system conditions and operating limits~~ the operational limits and conditions are adequately controlled.	Comment: the text under this bullet is not clear : A cask is not a safety measure IAEA 2007 Glossary: "operational limits and conditions" Reference to fuel cycle IAEA 2007 glossary				
40	3.41	~~Implementation of the~~ Safety measures should include the requirement for quality assured examination, in-service inspection and testing, and maintenance to demonstrate that the safety functions and reliabilities of the SSCs are met. ~~In-service functional testing of systems, structures and~~	Simplification, See 3.40 : "application" of … ?? Sentence deleted because not clear : "prove the functionality",	X			

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		~~components important to safety should prove the functionality of the complete system and the safety function of each component.~~	"prove the safety function" meaningless SSCs already in 1st sentence				
41	4.1, 4.2 , 4.3	Use criticality safety assessments In place of "criticality assessment" (see 4.5 to 4.11)	Coherency, title of section 4	X			
42	4.7	Design basis accident	See comment #3	X			
43	4.9	In the criticality safety assessment the criticality safety staff should consider the possibility of inappropriate (and unexpected) operator responses to incidents (i.e. off-normal conditions). For example, operators may ~~automatically~~ respond to leaks of fissionable solutions by catching the material in geometrically unsafe vessels.	Avoid confusion : Usually, an "automatic" action is opposed to an operator's actions	X			
44	4.11.	The ~~limits and extent~~ operational limits and conditions of the activity involving fissionable	IAEA glossary 2007	X			
45	4.14	Replace "fault "by "initiating event"	IAEA glossary 2007 - A natural phenomena is not a fault	X			
46	4.15	Estimates of the normal range of		X			

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		operating parameters including conservative/bounding estimates of any anticipated variations in those parameters should be determined, justified, documented ~~and shown to be sub-critical.~~	Estimates of parameters are not sub-critical. End of sentence not needed (evidence)				
47	4.16	The next step in the assessment should be to identify all credible ~~faults~~ initiating events (i.e. faults, incidents and accidents leading to anticipated operational occurrences and design basis accidents). These should then be analysed and documented. The following should be considered when performing the fault analysis:	-IAEA 2007 glossary - Coherency with § 5.6	X			
48	4.18	The criticality safety assessment should describe the methodology or methodologies used to establish the operational limits and conditions for the activity being evaluated. Methods that may be used for the establishment of these limits include, but may not be limited to: • Reference to national and international consensus standards;	IAEA 2007 glossary	X			

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			Not limited to national				
49	4.20	~~There is a need to identify limits and conditions necessary to control criticality risks.~~	Repetition	X			
50	4.21	Calculation methods, such as computer codes and nuclear data, used in the criticality safety analysis should be verified and their limits of applicability, bias and level of uncertainty should be determined, to ensure the accuracy of their predicted values. Comment : Last sentence of 4.21 : "Validation ... quantify any calculation bias" is OK; although bias can le linked to the calculations methods (incl. modeling), but also to the (nuclear) data used in calculation	Validation don't *establish* bias.	X			
51	4.24	Verification of the calculation method should be periodically performed ~~and periodically checked~~ and should test the methods, mathematical or otherwise, used in the model	*Verification .. should be periodically checked* meaningless	X			

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52	4.26 Third bullet	Benchmarks should be reviewed to ensure that their neutronic, geometric, physical and chemical characteristics encompass the ~~operational states~~ characteristics of the fissionable material system to be evaluated.	Coherency	X			
53	4.26 Second bullet	To be deleted	Repetition, redundancy	X			
54	4.26	Geometric arrangements and compositions of the fissionable materials relative to non-fissionable material such as neutron reflectors and scatterers but including materials ~~that are effective for parasitic~~ contributing to absorption of neutrons	"*effective for parasitic*" Meaningless	X			
55	4.27	If no benchmark experiments exist that ~~match~~ encompass the system being evaluated	Coherency with 4.26	X			
56	4.29	Any unique or special safety measures resulting from the criticality safety analysis and assessment should be specifically highlighted ~~to ensure their visibility and~~ to ensure that they are complied with.	Delete because no meaning		Agreed. However, Para deleted by UK comment 86		
57	5.2	and controls which are used to prevent			Agreed. However,		

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		the accumulation of fissionable materials in unforeseen locations. ~~in areas which are not included within the installations (equipment) design parameters.~~	Not clear : in unforeseen locations ?		Para deleted by UK comment no 89		
58	5.4	.. operational limits and conditions	IAEA 2007 glossary		Agreed. However, Para deleted by UK comment no 88		
59	5.5	This paragraph should be deleted or should be put somewhere else (for instance in chapter 2 “Management system”.	Stating that the effects of production pressures should not be allowed to override criticality safety considerations, is not a specific safety measure. Imposing that production must not override safety, (whatever the domain and the facility) is a general safety principle.	X			
60	5.10.	The impact of ~~design~~ ~~changes~~ modifications to the installation on criticality safety, made at any part of the life cycle, should be assessed.	clarification		Agreed. However, Para deleted by UK comment no 91		
61	5.15	… or for facilities mixing powders of uranium and plutonium (i.e. MOX fuel fabrication) by the Pu content in the mixture and its isotopic composition (principally, 239Pu, 240Pu and 241Pu),	clarification	X			

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		and by the 235U content in the ~~composition of the~~ uranium.					
62	5.25	~~On completion of manufacture of the fresh fuel assemblies, a fresh nuclear fuel~~ An handling programme for the manufactured fuel assemblies should be established with the objective of preventing ~~a~~ criticality when the fresh fuel is handled, stored or transported.	Deleted because not clear		Agreed. However, Para deleted by UK comment no 99		
63	5.26	The purposes of this programme should be to delineate locations where ~~physical boundaries within which~~ the fresh nuclear fuel is ~~to be~~ stored and which are subject to practices for material control and constraints ~~on the criticality configuration.~~	To be clarified: what is for example “criticality configuration” ? “location” more coherent with 5.40&5.41 (misloading)		Agreed. However, Para deleted by UK comment no 99		
64	5.27	It should be verified that the fuel’s enrichment ~~is commensurate~~ comply with the design limitations of the storage area.		X			
65	5.29	Drains in dry storage areas for fresh fuel should be properly kept clear for the efficient removal of any water that may enter ~~and~~ so that they should not constitute a		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
		possible cause of flooding.					
66	5.30	The need for remote handling and the presence of heavy shielding necessary for radiation protection, introduce a set of design basis accident s ~~conditions~~ with the potential to damage fuel elements	IAEA Glossary	X			
67	§ 5.35 Line 1	…handling operations…	Misprint "…handing operations…"	X			
68	5.36	For stored fuel there is sometimes a requirement to remove fuel pins/rods for postirradiation examination work which can change the moderation ratio ~~state~~ of the fuel element potentially increasing its reactivity	Usual terminology	X			
69	5.38	~~Due to its highly radioactive condition~~ Spent fuel is often stored in pond facilities for several years following discharge from the reactor core	Weak explanation without added value	X			
70	5.40	design) or otherwise administrative controls and verification of the fuel assembly marking. ~~checks on fuel identity~~	clarification	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSILE MATERIAL

COMMENTS BY REVIEWER Reviewer: C. Kennes, Th. Maldague Country/Organization: Belgium / FANC (Federal Agency for nuclear Control) + Bel V (TSO of FANC) Date: 2011-05-04				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
71	5.40, 5.41	Change "the wrong storage location to "a wrong storage location"		X			
72	5.42	~~It has often been the practice to base criticality safety assessments of spent fuel operations on a conservative assumption using fresh fuel compositions~~ Usually, fresh fuel composition is assumed in criticality safety assessments of operations involving spent fuel	Simplification, reformulation for clarity	X			
73	5.45	Spatial variations in the spent fuel composition ~~(resulting from variations in conditions in the reactor during burnup)~~ should be taken into account in ~~accounted for in~~ calculating keff for the relevant spent fuel configuration. The increase in complexity presents several challenges ~~to the production of a suitable~~ for the criticality safety assessment. In ~~demonstrating the adequacy of~~ a criticality safety assessment based on burnup credit, the following should be	Weak "explanation" without added value Simplification	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSILE MATERIAL

COMMENTS BY REVIEWER Reviewer: C. Kennes, Th. Maldague Country/Organization: Belgium / FANC (Federal Agency for nuclear Control) + Bel V (TSO of FANC) Date: 2011-05-04				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		addressed:					
74	5.45	~~Note, the irradiation of fuel with burnable poisons will typically result in increased reactivity early in its life.~~ For fuel assemblies with burnable poisons, the burnup credit analysis should take account of the depletion of the burnable poison and consider the possibility that the most reactive condition may not be for the fresh fuel;	Simplification	X			
75	5.46	Generally, the operational limits and conditions…	IAEA 2007 glossary	X			
76	5.46	In such circumstances, the criticality safety assessment should determine the ~~include consideration of what~~ operational measures ~~are~~ necessary to ensure compliance	Simplification	X			
77	5.48	Replace treat by process			Agreed. However, sentenced modified by Sweden comment no 46		
78	5.54	Many of the fissionable materials are in ~~a mobile~~ liquid form and due to the existence..	Liquid are always “mobiles” “*Solutions*” preferable to *“liquid forms*” ?	X			
79	5.55	The possibility of ~~operational personnel employing ad hoc~~ external connections	Deleted because no particular meaning	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSILE MATERIAL

COMMENTS BY REVIEWER Reviewer: C. Kennes, Th. Maldague Country/Organization: Belgium / FANC (Federal Agency for nuclear Control) + Bel V (TSO of FANC) Date: 2011-05-04				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		to approved pipework and vessels should also be considered.					
80	5.72	It should be noted that wastes are commonly wrapped with vinyl, more ~~moderated~~ moderating than water.	Plastics & water are moderators	X			
81	5.80	~~Note that in this context the consequences of criticality are the resulting increases in doses to the public through any increased release of radioactive material from the disposal facility to the surface environment~~.	*Partial* explanation of a *possible* consequence; Even in case of degradation of an engineered barrier it is not certain that contaminants will reach the surface and will result in an increase of dose. Suggested to be removed	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Staff …….. Country/Organization: Canada/Canadian Nuclear Safety Commission Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.1/3	- to ensure sub-criticality *in normal operations, for anticipated operational occurrences and for design basis accident conditions* ***(or the equivalent)*** OR - to ensure sub-criticality *under all normal and credible abnormal conditions*	Change wording to what's in IAEA NS-R-5, Ref [1]. Without addition of words marked in bold, the text of DS407 is not consistent with what Canada agreed during development of IAEA NS-R-5. OR Use equivalent wording, which is consistent with terminology in national and international standards and regulatory documents, which are specific to criticality safety, such as ISO-1709, ANSI/ANS-8.1, Canadian standards CSA N292.2, N292.3 and Canadian Regulatory documents RD-327, RD-337, GD-327.		Adopted IAEA NS-R-5		
2	1.4/2	*… credible abnormal conditions*. OR - to ensure sub-criticality *in normal operations, for anticipated operational occurrences and for design basis accident conditions* ***(or the equivalent)***	"Operational occurrences" is not consistent with criticality safety terminology established in existing international and national standards. See additional justification above, in comment No. 1. Furthermore, prevention of accidents "in the case of accident conditions within design basis accidents" sounds self-contradictive. This terminology seems to be borrowed from nuclear reactors. OR Change wording to what's in IAEA NS-R-5, Ref [1]. Without addition of words marked in bold, the text of DS407 is not consistent with what Canada agreed during development of IAEA NS-R-5.		Agreed. However, sentence deleted by Belgium comment no 9		
3	2.1/1	*Criticality prevention* should be…	Criticality safety includes both prevention and mitigation of accidents. As written, the DS407 text refers only to the prevention. Mitigation of accidents needs to cover a wide range of			X	DS407 includes mitigation concepts in various places,

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Staff …….. Country/Organization: Canada/Canadian Nuclear Safety Commission Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			conditions.				e.g., shielding, 6.12, and criticality alarm systems,6.49
4	2.1/1-2	- to ensure sub-criticality *under all normal and credible abnormal conditions* OR - to ensure sub-criticality *in normal operations, for anticipated operational occurrences and for design basis accident conditions* ***(or the equivalent)***	Change wording to what's in IAEA NS-R-5, Ref [1]. Without addition of words marked in bold, the text of DS407 is not consistent with what Canada agreed during development of IAEA NS-R-5. See further justification in comments No. 1 and 2.		Agreed. However, sentence deleted by Belgium comment no 11		
5	2.2/2	…preventing criticality.	Term "Controlling criticality" is more relevant to nuclear reactor. This is not consistent with established criticality safety terminology.		Agreed. However, para deleted by Canada-AECL comment no 7		
6	2.15/3	When appropriate, justification should be by reference to national regulations or *national and* international standards,	There are no reasons to exclude national standards from the list.	X			
7	2.18/3	- to ensure sub-criticality *under all normal and credible abnormal conditions* OR - to ensure sub-criticality *in normal operations, for anticipated operational occurrences and for design basis accident conditions* ***(or the equivalent)***	Change wording to what's in IAEA NS-R-5, Ref [1]. Without addition of words marked in bold, the text of DS407 is not consistent with what Canada agreed during development of IAEA NS-R-5. See further justification in comments No. 1 and 2.	X			
8	3.1/3	on the defence in depth concept, Refs. [1].	Remove reference [13] to Power Reactors. Criticality Safety is completely different - sometimes opposite - compared to Power	X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Staff …….. Country/Organization: Canada/Canadian Nuclear Safety Commission Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			Reactors in terms of prevention and mitigation of accidents.				
9	3.2/7	Replace “criticality event” by “criticality accident”.	Inconsistent terminology is used throughout the document. It appears that event is not meant to be an accident.	X			
10	3.2/2	Change ‘incidents’ to “abnormal conditions”– also in bullet 3	Inconsistent terminology.		Wording used changed to “anticipated operational occurrences” to be consistent with the terminology in NS-R-5 Para2.4.		
11	3.3/2	Remove reference [13] to Power Reactors.	Remove reference [13] to Power Reactors. Criticality Safety is completely different - sometimes opposite - compared to Power Reactors in terms of prevention and mitigation of accidents.	X			
12	3.4	Delete	Remove reference [13] and information related to Power Reactors. Criticality Safety is completely different - sometimes opposite - compared to Power Reactors in terms of prevention and mitigation of accidents.		Reference [13] deleted and information related to Power Reactors modified.		
13	3.9/2-3	the system design should follow the fail safe principle and, *as a minimum*, the safety measures should fulfill the single failure criterion	Higher safety level should not be prohibited or discouraged – directly or indirectly - by DS407.	X			
14	3.10/last	which prevent the fault developing into a criticality *accident*	Inconsistent terminology.	X			
15	3.11/4	safety arising from *credible abnormal conditions*	Inconsistent terminology. Prevention of accidents “arising from incidents and accidents” sounds	X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Staff …….. Country/Organization: Canada/Canadian Nuclear Safety Commission Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			self-contradictive.				
16	3.17/3	may be controlled for ensuring *sub-criticality* are as follows, but not limited to:	Inaccurate terminology. Criticality safety includes both prevention and mitigation of accidents, whereas only prevention was meant in the DS407	X			
17	3.17/last bullet	*Minimum separation* between separate criticality safe systems.	Suggested wording provides more clarity.	X			
18	3.20/5	Replace/remove "sometimes known as "special moderators"	It is not established criticality safety terminology			X	Some countries acknowledge these materials as "special moderators"
19	3.22/2	Delete "and/or energy"	Confusing.		Modified text retains reference to energy		
20	Administrative Safety Measures		Why are administrative measures in separate section? There is no separate section for Engineered Safety Measures	X	New section added on Engineered Safety Measures		
21	3.28/bul. 12		Term anticipated operational occurrences need to be replaced; this is not criticality safety terminology.			X	This is generic IAEA terminology
22	3.39/3,4	Replace term "*engineered features*" by "*engineered safety measures*", "*administrative controls*" by "*administrative safety measures*"	Inconsistent terminology: multiple terms are used instead of one.		2nd sentence deleted and proposed terminology applied.		
23	3.39/6	…, reliance may be placed on *safety measures* already present…	Inconsistent terminology: multiple terms are used instead of one	X			
24	4.7/4	criticality safety in all operational states….occurrences and accident conditions within design bases accidents	Change wording to what's in IAEA NS-R-5, Ref [1]. Without addition of words marked in bold, the text of DS407 is not consistent with what	X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Staff …….. Country/Organization: Canada/Canadian Nuclear Safety Commission Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		[***or equivalent***].	Canada agreed during development of IAEA NS-R-5.				
25	4.9	possibility of inappropriate (and unexpected) operator responses *to abnormal conditions.*	Inconsistent terminology: multiple terms are used instead of one. Term needs to be replaced; this is not criticality safety terminology.	X			
26	4.16/1	The next step in the assessment should be to identify all credible faults *(credible abnormal conditions)* OR The next step in the assessment should be to identify all credible faults *(anticipated operational occurrences and for design basis accident conditions* ***(or the equivalent)***	Change wording to what's in IAEA NS-R-5, Ref [1]. Without addition of words marked in bold, the text of DS407 is not consistent with what Canada agreed during development of IAEA NS-R-5. See further justification in comments No. 1 and 2.	X			
27	4.17/2-3	… demonstrates sub-criticality *for all normal and credible abnormal conditions* OR … demonstrates sub-criticality *in normal operations, for anticipated operational occurrences and for design basis accident conditions* ***(or the equivalent)***	Change wording to what's in IAEA NS-R-5, Ref [1]. Without addition of words marked in bold, the text of DS407 is not consistent with what Canada agreed during development of IAEA NS-R-5. See further justification in comments No. 1 and 2.		"Or the equivalent" added and reference to "operational states" retained as it is consistent with the IAEA Safety Glossary.		
28	4.20/1-2	The criticality safety analysis should demonstrate that operations are sub-critical under *all normal and credible abnormal conditions* OR	Change wording to what's in IAEA NS-R-5, Ref [1]. Without addition of words marked in bold, the text of DS407 is not consistent with what Canada agreed during development of IAEA NS-R-5. See further justification in comments No. 1 and		Agreed. However, para deleted due to japan comment no 24		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Staff …….. Country/Organization: Canada/Canadian Nuclear Safety Commission Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		The criticality safety analysis should demonstrate that operations are sub-critical under *normal operations, for anticipated operational occurrences and for design basis accident conditions* ***(or the equivalent)***	2.				
29	6.8/2-3	should have an emergency response plan, programme, and capabilities to respond to *potential* criticality accidents	Inconsistent terminology: in section 6.21 and in its title, term "potential" is used for the same purpose as here in 6.8. Term "credible accident" cannot be used in 6.8 because the same term was used before, in 4.16, to characterize range of conditions, for which accident should be prevented.		6.21 changed to "credible" and added a "definition"		
30	6.22/1	Replace 'an unplanned criticality incident' with *a criticality accident*	Inconsistent terminology: multiple terms are used instead of one. Incident" seems to be used in the DS407 to identify a non-accident condition.	X			
31	6.22/ bul. 1-3	Replace 'incident' with *a criticality accident*	Inconsistent terminology: multiple terms are used instead of one. Incident" seems to be used in the DS407 to identify a non-accident condition.	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.1/7	This also applies to research and development facilities *that use fissionable material* and to activities…	The term prototype isn't necessary and the rest clarifies that is only for those facilities with FM.	X			
2	1.4/2	… abnormal events.	"operational occurrences" is not consistent with industry terminology			X	Terminology consistent with IAEA terminology
3	1.4/4-5	It encompasses all facilities and activities *that have or use fissionable material*…	Need to be more specific that it is for those areas that have fissionable material especially when using the word 'all'.	X			
4	1.4/9	…operations that *must* remain…	Should indicates an option but in this case it isn't; operations need to remain sub-critical.			X	use of should is consistent with the IAEA terminology requirements for a Safety Guide
5	1.9	General comment: remove Section 5	General comment: Section 5 doesn't seem necessary as many of the practices listed can be found in Sections 2, 3 and 4. Do not see the purpose of this section.			X	This section is consistent with the IAEA's DPP for the Safety Guide
6	2.1/2	… either engineered or administrative *(operator-based)*…	Section 3 uses the term operator-based(Para. 3.5)	X			
7	2.2	Move entire paragraph to Section 4 or at least consider moving lines 1-5	This applies to the safety assessment.		2.2 deleted as content is covered in Section 4		
8	2.2/2	…preventing criticality.	"Controlling criticality" sounds more like what is done in a reactor when control rods are manipulated". This is not referring to a reactor.		Para deleted		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
9	2.2/7	… getting close to a criticality accident.	"Cliff edge" is an unusual term that not everyone may understand		Para deleted		
10	2.3/1	Delete.	Does not add value.	X			
11	2.3/3	…control of a set of parameters… (delete words: limited, macroscopic)	Either choose simpler words or delete as this is not common industry language (re: isotopic vector)			X	Reference to macroscopic retained to differentiate between microscopic properties at the nucleus level.
12	2.3/5-10	Delete or modify as follows: A description of the neutron multiplication of a system based on these parameters alone is incomplete, and a full description would require the use of properties such as fission, capture or scatter. For these reasons there are many examples of apparently 'anomalous' behavior in fissionable systems where the neutron multiplication factor (k_{eff}) changes in ways that seem counter-intuitive.	Extra information that is not needed.		Agreed, but retained reference to microscopic properties.		
13	2.4	Add some description as to what is to be learned from the reference.	There is no context. What does this mean?	X			
14	Management Systems	Move to the end of Section 2.	Safety Criteria and Margins are the first when ensuring criticality safety, after which are Management Systems.	X			
15	2.5/1	… management oversight…	Making reference to "system" sounds more like a software program.	X			
16	2.6/bul. 2	…are involved in writing *the operating procedures*…	clarifies 'them'	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
17	2.7/2-4	Remove "to operators" Remove "Personnel handling…ease of difficulties."	It may not be obvious to anyone working in the area, not just operators. The second sentence does not add value to a safety guide.		Retained reference to "personnel handling…." As it was modified by UK comment no 12		
18	2.8/1	Most *past* criticality accidents have had multiple causes and often faults *could have been* identified by operators and supervisors and unsafe conditions corrected before the criticality *accident*.	Hard to read. Simplified the wording.	X			
19	2.10	Add some description as to what is to be learned from the reference.	There is no context. What does this mean?	X			
20	2.13/1	Remove "In applying the criteria" Line 3: remove 'somewhat'	Should be stated as a fact and the value of k_{eff} is to be less than 1, somewhat is ambiguous.	X			
21	2.13/4	… ensures that k_{eff} remains less than one.	"remains on the safe-side" is not specific and is subjective.			X	Current text retained to cover the possibility of a controlled parameter having to be either more than or less than its critical value to ensure criticality safety.
22	2.14/2	… in the *calculation* of k_{eff}…	We always say calculated k_{eff} (not estimated).	X			
23	2.15	Move to Section 4.	This applies to criticality safety assessments.	X			
24	2.16	Sufficient and appropriate safety measures *must be* in place to …limit is exceeded or design features *must be* in place which effectively avoid any criticality. *This*	Modified to fit in this section. Otherwise should be moved to section on criticality safety assessments. Note that		Reference to *"This should also be demonstrated in the criticality safety*		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		should also be demonstrated in the criticality safety assessment.	operational limit		*assessment"* not included		
25	2.18	Delete	While this would be nice, suspect that this is only practical for very small operations so as such has limited value. Really does not add anything to the document.			X	Still worth mentioning even if it is not practical for all parts of the fuel cycle.
26	3.1/3		Not clear what "fault tolerance" is. Simpler, more common terms should be used to make this easier to follow.		Definition of fault tolerance added		
27	3.2/3+	Delete everything after "failures" down to Application".	The title of this section is "Measures for Ensuring Sub-criticality". The deleted words refer to accidents which by definition are not sub-critical and as such do not belong.			X	Reinforces the various levels of defence in depth.
28	3.2/2	Change 'incidents' to 'events' – also in bullet 3	The rest of the paragraph goes on to use criticality "event"			X	Incident refers to precursors to accidents
29	3.2/bul. 2	… adequate *safety* margins…	Safety margins is the term used in Section 2.		Agreed. However bullet list deleted by UK comment no 16		
30	3.2/bul. 4	Delete	Again, this refers to what to do in the event of an accident which is not in agreement with the title of the section.			X	Title of section changed to Criticality Safety
31	3.3	Should reference Table 1 in this paragraph		X			
32	3.3/5, 6	Define the term, "extremely unlikely"			Sentence deleted.		
33	3.3/6, 7, 8	Delete	Again, this refers to what to do in the event of an accident			X	Title of section changed to Criticality Safety

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			which is not in agreement with the title of the section.				
34	3.4/2	The *aim* for each level…	grammar	X			
35	3.5/1	…should be…	Replace "is" as you want it to have that function.	X			
36	3.8/bul. 2	Need to define "acceptably low"	This is a subjective term that requires guidance on what should be used.			X	Different Member States have different values and therefore not possible to provide a definitive value. Note that NS-R-5 requires that criteria for the level of safety shall be established.
37	3.10/2, 3	Consider removing.	How would one select a key parameter as there is likely no way to depend on it deviating slowly? Can't reasonably expect that this will be achieved.			X	Retained para. Modification by UK comment no 29 removed reference to slowly and is now more general.
38	3.12/3	remove "(both engineered and administrative)"	Redundant; applies to all safety measures		Sentence deleted by UK comment no 32		
39	3.12/bul. 1	Passive *engineered* safety measures…	To be consistent (use active engineered later on in sentence)	X			
40	3.15	Add "controlled parameters" at end of paragraph. Delete all bullets	All these bullets are described under controlled parameters	X			
41	3.17/bul.	7th bullet: …the *fissionable* materials…	wording of sentence		Retained wording for		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		9th bullet: *Including* the presence of neutron absorbers in the system…			bullet 9		
42	3.19/3	…effective safety measures…	Measures listed may not be essential when an operation involves materials with these characteristics.	X			
43	3.20/5	remove "sometimes known as "special moderators"	not industry terminology	X			
44	3.21/1-2	Delete, "has less neutron absorbing properties and"	Since all neutrons that escape are lost, having any material, irrespective of its absorbing properties, will increase k-effective	X			
45	3.21/5	…material. A light water reflector of a thickness […] factor, is known as "total reflection". The availability of reflector materials…	This section is not about criticality safety assessments.			X	Agreed. However, useful to introduce the idea of total reflection
46	3.22/2 & elsewhere	Delete "and/or energy"	Confusing. Doesn't add anything	X			
47	3.23	Separate paragraph after second sentence	Two separate topics	X			
48	3.25/7	Not sure what a "space frame" is. Please add words to describe or use a different term.	Not clear what is meant.		Term deleted		
49	3.26		Consider adding 'heterogeneity' and 'homogeneity' to definitions.			X	Not considered necessary
50	3.26/1	Explain "swarf"	Not sure what this term means	X			
51	Administrati	Comment: why are these separated out?			Section on		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
	ve Safety Measures	Why isn't there a separate section for Engineered Safety Measures?			engineered safety measures added		
52	3.28/bul. 6	*Procedural controls for record keeping systems (accounting).*	There are no other systems besides computer-based and paper-based	X			
53	3.28/bul.5, 7 & 8	Use "movement" instead of transfer in all three cases	Consistent terminology	X			
54	3.28/bul. 7	Remove "using different controlled parameters"	Not needed.			X	Adds required clarification.
55	3.28/bul. 10, 12-18	Comment: These can be covered under one bullet to develop appropriate procedures and possibly give examples.				X	Preference
56	3.28/19	Remove	Does not need to be considered as an administrative safety measure			X	Bullet listing is considering the use of administrative measures which would include ensuring that they are understood
57	3.29/1	Remove "the required"	This safety guide should not contain requirements	X			
58	3.30/1	Remove "Senior", remove 'the' before overseeing	sentence structure	X			
59	3.31/1	Replace 'These senior persons' with "Management"	sentence structure	X			
60	3.31/3	Delete last sentence.	Not necessary as the intent is covered by the first sentence.	X			
61	3.35/bul. 3	Comment: For us, it is operations that does the implementing, not criticality safety staff.		X			
62	3.35/bul. 4	This too is something that operations will		X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		do, not CS staff					
63	3.35/bul. 10	This need not always be CS staff doing this. Recommend changing to ensure that the training is provided	Add the flexibility to enable others to do training	X			
64	3.36/1	Replace 'tasks' with "responsibilities"	consistency with rest of document	X			
65	3.36	Comment: What about responsibilities for operations and facility/area employees?		X			
66	Operating procedures	Place this section after General Considerations	Needs to be before responsibilities.	X			
67	3.37/bul. 7	*be written in the* language understood by the facility.	consistent grammar with other bullets.		Bullet was deleted by France comment no 18 and UK comment no 63		
68	3.40	Remove	Do not see relevance. How can apply safety measures determine their own design (bullet 1) – circular argument			X	Text modified by Belgium comment no 39, proposed change no longer applies.
69	Section 4	General Comment: I do not like the use of the word "risk" in this section			Noted		
70	4.1/1	Criticality *safety* assessments *can be* based on…	Title uses term criticality safety assessment. Don't need to say the history. Just facts.	X			
71	4.1/9	… risk *of* criticality… Remove last sentence.	risk <u>from</u> a criticality is always high		Last sentence deleted, but "from" retained as it refers to both occurrence and consequence.		
72	4.2/1	*It is also* common to complement *a*		X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		deterministic approach to criticality *safety* assessment with *a* probabilistic *approach*					
73	4.2/2	Is 'Probabilistic studies' the correct term?		X			
74	4.2/2	Remove 'usually'		X			
75	4.2/3	This is saying that the probabilistic approach isn't conservative – why would we use this then?			4.3 explains what the probabilistic approach can be used for.		
76	4.2/4	Use term "deterministic *approach*"		X			
77	4.2/5	*The* probabilistic approach *provides* estimates …		X			
78	4.2/5	*a* deviation		X			
79	4.2/7	'These' – what?		X			
80	4.2/8	'combining it' – how? (physically, mathematically)			Reference to "combining" deleted		
81	4.2/9	what is meant by criticality risk?	Seems to be confusion over (a) risk <u>from</u> criticality (high) and (b) risk <u>of</u> criticality (needs to be low)		Criticality risk covers initiating frequency (i.e. the chance that a criticality will occur) with the consequences of the criticality, (.i.e. may be high for an unshielded criticality if someone is present or low if it occurs in a shielded facility designed for a criticality). In general terms, risk is the		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					chance that someone is adversely affected by a hazard		
82	4.3	Remove	Do not see relevance			X	Explains use of the probabilistic approach
83	4.4/1	Remove first sentence.	Extra information not needed in SG	X			
84	4.4/11	Use "probabilistic *approach"* not 'probabilistic assessment'	consistent with term 'deterministic approach'	X			
85	4.6/4	Delete "as defined by… regulatory body"	Not needed; doesn't have to be defined by just these areas. What about defined in international standards?	X			
86	4.7	…analysis which *evaluates* criticality safety in all operational states….occurrences and accident conditions within design bases accidents, *identifies* hazards, both internal and external, fault scenarios and their consequences.	sentence structure			X	Important to retain the use of the word "should"
87		Add words to the effect that the assessment needs to be done in consultation with operations	Need to ensure that operations is part of the process.		Text added to para 4.8		
88	4.9	Remove 'the criticality safety staff'	the assessment needs to document this, not the staff.	X			
89	4.10	Remove. Consider replacing with "All calculations for criticality analysis need verification and code validation."	Simplifies.			X	Retain text as it provides the structure for the remaining part of this section
90	4.13	Remove "as well as references to any related criticality safety assessments"	Not relevant; no impact on safety.	X			
91	4.14	Move first sentence to Section 3,	It is a responsibility that	X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		responsibilities for criticality safety staff (3.35)	should be listed with other responsibilities				
92	4.14	The assessment needs to be verified in consultation with operations	Operations should be part of the process.		Text added earlier to include operator input.		
93	4.15	Delete first sentence. Second sentence: The *controlled parameters* (e.g. mass…interaction) *used to determine safety criteria* should be identified. The normal range of *these* parameters including conservative/bounding estimates *for* any anticipated variations in those parameters should be determined and documented.	Parameters (and characteristics) can't be shown to be sub-critical – they ensure that the system remains sub-critical.		1st sentence retained. Reference to characteristics retained in preference to parameters		
94	4.15/3&4	Comment: what is meant by 'degree of' fissionable material or fission product	'degree' is unclear		Deleted, see also Sweden comment no 26		
95	4.16/4	Change fault analysis to *probabilistic approach*	Probabilistic analysis (*approach*) is term used in para. 4.2			X	This is part of the deterministic design basis analysis
96	4.16 (1)	Replace fault with *event* (and in 4.16)	Consistency with para. 4.2 and from para. 3.7 which considers failures, faults, errors, incidents and accidents as "events"	X			
97	4.17/5	Remove: 'including any administrative safety measures'	Does not need to be explicitly stated, all safety measures should be identified.	X			
98	4.17/6	…their safety functions *including* their		X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		reliability, …separation *and* system and equipment…					
99	4.18 & 4.19	Consider moving to Criticality safety analysis section.	These are methods that you would generally find in a CS analysis, not a CS assessment.		Noted		
100	4.20/3&4	Add *i.e. DCP* after 'fault tolerance of the system' Last sentence: There is a need to identify *the safety margins* (limits and conditions) *established* to control criticality risks.	So one does not have to refer back to Section 3.7-3.10 to remember.		Agreed. However. 4.20 deleted by Japan comment no 24.		
101	4.21/2	…safety analysis *to calculate* k_{eff} should be…	The methods used to calculate k_{eff} are the ones that require verification and validation.	X			
102	4.22	Is it the calculation method or the computer code that needs QA?	A method can be verified but do not know how it is validated. Codes can be validated.		Para 4.21 explains what the computer method is, that is a computer code, nuclear data, and so 4.22 is still relevant		
103	4.23	Is it really necessary to document the hardware used? Thought software was enough.			Yes. We are advised that changing hardware can have an effect.		
104	5	General Comment: I do not see the purpose of this section. These 'best practices' could easily be incorporated into the other sections.			Section is required as defined in the documents DPP.		
105	5.1 & 5.2	Remove	Does not provide any different guidance or recommendation.			X	This is general introductory text only, setting the overall issues of criticality

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COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
							through-out the fuel cycle
106	5.3/1	…considered *for* criticality safety	This isn't only for CS assessments.	X			
107	5.4	Remove 'For both types of'. … the approved *safety margins* (limits and conditions) identified…	Term safety margin is used in para. 2.12-2.15.	X			
108	5.5	Remove 'For both types of'		X			
109	5.6	Delete first sentence.		X			
110	5.7	Remove 'For both types of'	This paragraph would fit better in the safety assessment Section 4.	X			
111	5.8	Remove.	How is this different from para. 4.5?	X			
112	5.9	Reword para. to: *Plant ageing* should be monitored and *its* impact on criticality safety should be assessed *periodically*. Periodic testing of material relied upon to maintain sub-criticality should be performed to ensure the criticality safety analysis remains valid *and for* any actual or potential material degradation.	Two separate things to test for (1) analysis remains valid and (2) actual or potential material degradation.		Para deleted by UK comment no 91		
113	5.10	Remove.	How is this different from para. 4.5?	X			
114	5.11	Move to Section 4.	Period review of assessments should be guidance found in Sec. 4.		Para deleted by UK comment no 88		
115	5.16	Reword: *A* typical control parameter *looked at for* fuel fabrication *facilities is*	No need to include geometry if not going to discuss.	X			

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COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		moderation. Where moderator control is…					
116	5.16	Comment: Why not include this in Sec. 4?	Wouldn't these apply to all areas/facilities that have moderation control? Why segregate for fuel fabrication?			X	This section is highlighting control parameters that were judged to be important to this part of the fuel cycle and therefore there is likely to be some repetition.
117	5.16/bul. 1&2	Move to Sec. 6	Seem to fit more into emergency preparedness guidelines.			X	Appropriate to also highlight it in this section as well
118	5.17	Make sub-bullet of 3.16		X			
119	5.19/2	...materials *in the waste* remain…	Not every area will use waste containers.	X			
120	5.22		I do not believe this to be best practice. It may be necessary to use coolants for safety reasons. Perhaps limiting the amount of coolant is better terminology.		Reference to safety reasons added		
121	5.23 & 5.24	Remove.	Not needed. Information can be found in 5.16 and Sec. 2-4.	X			
122	Handling and storage of fresh fuel	Unirradiated	In some places, "fresh" means just out of the reactor. Unirradiated is a more precise term.			X	Definition of fresh fuel in IAEA Safety Glossary covers unirradiated fuel
123	5.26	Don't need to specify 'nuclear' fuel – fresh fuel is fine. Should be fresh fuel *and storage*			Para deleted by UK comment no 99		

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		programme that includes *movement control* as well. Administrative *processes* may be a better word.					
124	5.28	Remove and add as example to para. 5.9 (material degradation).				X	Para 9 deleted by UK comment no 91
125	5.29	Move to para. 5.16	Deals with moderator controlled areas			X	Specific issue to be highlighted for dry storage area
126	5.30	Move to Sec. 6	May fit better with emergency preparedness.			X	Appropriate to also highlight it in this section as well
127	5.30/3, 4	Either expand the discussion or remove words that do not pertain to fire fighting (last sentence)	Paragraph makes reference to controlling the movement of moderator which is not related to fire fighting. In addition, there is more than just water to worry about as a moderator (e.g. graphite, oils, etc.) so consider adding words to expand the discussion on moderator.		Last sentence deleted		
128	5.32	Add a bullet that discusses the role that shielding plays in providing reflection.	No mention made of possible reflecting done by shielding contained in flask.			X	Bullet listing is only referring to the characteristics of the irradiated fuel
129	5.33	Move to Section 4.	This para. indicates that these para. might be better suited in Section 4 on criticality safety assessments.		Para deleted		
130	5.35	…storage and *handling*…	spelling mistake	X			

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COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
131	5.38	These types of measures (1st sentence) or these types of events (2nd sentence) – which is it? When discussing boron, is that just an example or is this para. specific to just boron use?	Be specific and clear.			X	The para is referring to both soluble and fixed neutron absorbers
132	5.39/5.40	Need to add something on possible accidents involving fuel movements (e.g. flask being dropped onto storage array)	Need to consider all possibilities	X			
133	5.41/last	Add :"assessment" at the end	Word missing	X			
134	5.42	Move to just before 5.44 (part of Burnup credit subsection) Remove 1st sentence.	Talks about burnup credit. This section should not be specific to criticality safety assessments.			X	Prefer current layout, it introduces the concept of burnup credit
135	5.43	Move to below 5.41 (part of misleading accidents subsection). Remove 1st sentence.	One will consider this entire safety guide.		Retained para position as it closes the section on spent fuel operations		
136	5.47	Remove 1st sentence. Replace 'above' with *for burnup credit*	One will consider this entire safety guide.	X			
137	5.49	"supplementary criticality precautions"	This is a new term. Please describe.		Reworded and reference to supplementary criticality precautions removed		
138	5.50	Remove.	No added value for criticality safety.	X			
139	5.52	*could* include		X			
140	5.53	Remove.	This is a repeat of what was said at the beginning of this section. Not sure that it is	X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			needed here or provides any added value.				
141	5.54-5.57	State at start of subsection: *The criticality safety assessment should consider that:* Consider moving subsection to Section 4.	All should be considered in CS assessments and Section 4 is on CS assessments.			X	These aspects are dealt with in a general manner in Section 4, this section is highlighting those issues important to reprocessing
142	5.58 (&5.60)	*chemistry* control	Chemistry control not chemical control	X			
143	Hold-up and accumulation	Need to provide references to this paragraph as there are other places in the document where this is mentioned	To provide other paragraphs with additional information			X	No proposed text provided. Hold-up mentioned twice in the document, both in the section on reprocessing.
144	5.62/1	Add, "fuel fabrication facility or any other operation where items containing fissionable material are cut, separated or otherwise processed" after "reprocessing facility".	For completeness as there are many operations that could result in hold-up and accumulation.			X	Text is intended to be specific to reprocessing as it is in the reprocessing section
145	5.62/5, 6	Delete last two sentences.	Not needed.	X			
146	5.64	Delete 1st sentence	Not needed.			X	Retain as the text introduces the remaining sentences
147	5.67	Please reference paragraph number.	I do not see where 'monitored sumps to detect such leaks have been discussed above'	X			
148	5.69	Delete 1st sentence.	One will consider this entire safety guide.	X			
149	5.70/5	"fissile material" is used. Previously "fuel"	Consistency in terminology	X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		was used. It was suggested that a more appropriate general term such as "fissionable material" may be more appropriate.					
150	5.72/1	Don't believe that wrapping wastes with vinyl is common. Recommend using "plastic". In addition, it says "more moderated than water". Assume this means that this is a more effective moderator than water? Not sure this is true unless you add, "may be a more effective moderator".	Use more common terminology as well as clarify statement regarding moderator effectiveness.	X			
151	5.72	*legacy* wastes Comment: clarify the meaning of "repartition of the fissionable material is heterogeneous"	Assuming this is referring to legacy wastes and this practice is not a current one.		Sentence deleted		
152	5.74	*Fissionable*	Have not used fissile in this document.	X			
153	5.76/3	...criticality *safety are:…*	These should be considered for criticality safety not just the assessment.	X			
154	5.77	Remove.	Not needed.	X			
155	5.78		What is the meaning of 'global risk approach'?		Text changed to integrated risk approach		
156	5.78	What about adding guidance or information on verification of materials/packages or of inventory records?				X	The paragraph is addressing the issue of not being able to verify the material
157	5.79	Instead of 'may occur', suggest *is possible* Delete last part of last sentence: which are	Subjective.	X			

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COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		subject…					
158	5.80/3	…the*re will be a large criticality safety margin*…	safety margin isn't usually high it is large		Sentence deleted by UK comment no 118		
159	5.80/11	Remove 'i.e. the risk'	Consequences are not the same thing as risk [of criticality]			X	As stated the risk is a combination of likelihood and consequence
160	5.82	Move last sentence to 5th line, after 'operations'. Separate out the two methods that could be used into two bullets (1) and (2). Remove 'that the work stations remain'. Simply want to ensure subcriticality.			Two methods not bulleted		
161	5.84	Remove.	One will consider this entire safety guide.	X			
162	During transport	Should be noted that transport takes place not just on public highways but on roads between areas within a site. Need to add some words to help describe the challenges involved in this type of activity	For completeness in the document	X			
163	Access to a wide range of fissionable and non-fissionable	"Fissionable" is used here. As noted earlier, this is a more broad term that should replace "fuel", "fissile"	Consistent terminology		Noted		
164	5.91/6, 7	Need to separate and provide an accurate list for fissionable, non-fissionable, and special fissionable materials as what is described here is not consistent within the industry	Clear terminology			X	General list only

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COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
165	5.92	Remove.	This is simply repeating what is described in 5.91.	X			
166	5.93	Move to Section 4.	Describes what should be in the CS assessment.			X	These aspects are dealt with in a general manner in Section 4, this section is highlighting those relating to laboratories
167	5.94	Consider adding para. references for management system and criticality controlled area	Will help the reader.			X	Not necessary if reader considers the whole document.
168	5.95	~~Fissionable material~~ operation Delete last part of last sentence: prior to….laboratory area.	Not always just FM operations. Last sentence doesn't fit.	X			
169	5.96 & 5.97	Remove.	These apply to all areas and are found in other sections.			X	Contain useful recommendations
170	5.97	Could consider adding radiation/ benchmark section to para. 4.25.	If do not want to remove this para.			X	
171	6.4	First sentence should be separate paragraph.	Separate guidance/requirement.	X			
172	6.8+	Consider re-ordering the paragraphs. The plan information belongs at the back for instance and the criteria at the front. In addition, you should consider moving the criticality alarms system paragraphs ahead of the response paragraphs as the response will be to the alarm presumably.				X	Prefer to retain current structure
173	6.9	Experience shows that the main risk *during a criticality accident* is to…	Better wording	X			
174	6.13/bul. 2	'locations' should be singular	<u>the</u> accident location	X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		…the *expected or possible* accident characteristics…					
175	6.13/bul. 5	And the availability of that medical care should also be considered.	May or may not be readily available.	X			
176	6.15	Replace 'provided' with *available during an emergency*	Expertise needs to be available	X			
177	6.31	Remove	Very similar to 6.33	X			
178	6.42	Remove.	Or combine with 6.37	X			
179	6.51 or elsewhere in the general area	Add a paragraph pointing out that gamma sensitive equipment is appropriate for signaling the need to evacuate; however neutron detectors are needed to definitely differentiate a criticality accident from another type of radiation accident. Therefore, emergency response personnel should have access to portable neutron detectors	Believe that the initial assumption at the Tokaimura accident was that it was a radiation contamination accident. It wasn't known for some time that the accident was a criticality accident and that it was still in progress (i.e. critical). Although the accident occurred around 10:35, neutron measurements were not made until 19:09 (indicated by table in Appendix 7 of "Materials for Briefing", Science and Technology Agency October 1999) or after 17:00 (Section 3.1, "Report on the preliminary fact finding mission following the accident at the nuclear fuel processing facility in Tokaimura, Japan", IAEA, 1999). A neutron detector would have been	X			

COMMENTS BY REVIEWER Reviewer: Nuclear Criticality Safety Program Country/Organization: Canada/Atomic Energy of Canada Date: 2011/05/19				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			useful to definitively identify the accident as a criticality accident which would have helped shape the response to the accident at an earlier stage.				
180	6.65	Remove.	How is this different from 6.64?	X			
181	Definitions	There are a great many terms used in the document that are not defined and should be as there is some variation in the industry on what these terms mean. For example, you should consider adding *criticality controlled area*, *homogeneous*, *heterogeneous*	Clarify what is meant		Definition of criticality controlled area added		
182	References	Reference 36 is in preparation. Either ensure that it is complete when this document is published or delete it	Only published references should be included		Noted		
183	General	At the end, it contains a great many references to various documents. It would help if some information on how to gain access to these documents was included	Make it easier to find the documents		Noted		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: Country/Organization: China			Date:	RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	Para5.16	In order to prevent water leakage and unexpected changes of Critical control conditions, it is recommended to use hot air rather than hot water for heating some special facilities for fissile material storage; if not available, limitation to the leakage amount of hot water should be considered.		X			
2	Add a new paragraph after Para.5.71	Some safety measures should be taken to avoid fissile material accumulation from high-level liquid waste to reach criticality	The fissile material is likely to aggregate by organic solvent (TBP kerosene) extraction or by uneven precipitation, and the mass will accumulate slowly, which will be a risk for the criticality safety of the storage facilities.	X	Commenter reason re-worded and added as a bullet to 5.64		
3	Add a new Paragraph after Para.6.59	The performance of the detectors monitoring criticality safety must be considered carefully to avoid omission or overload of signals.	The excursion duration is very short, and the dose rate (fission rate) is tremendous, so the detectors should be chosen carefully, otherwise they will be overloaded with the dose rate (fission rate).	X			
4		In addition to the existing definitions, it is better to provide definitions of more terms.		X	Additional definitions provided		
5	Para.3.17	Limitation of the rate of changes in the system's variable conditions	Since some of the system's conditions might change, additional limitations should also be considered, such as the rate of change in those conditions.			X	See paragraph 3.18

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COMMENTS BY REVIEWER Reviewer: Country/Organization: Finland Date: 20 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
General		The issue of spent fuel criticality safety is important and would benefit of an international SOAR in near future. Also, further guidance for using burn-up credit, would be highly welcomed.		X	Reference to ISO Burnup credit added		
1	2.7/1	2.7 Personnel handling fissionable materials should inform their supervisors in case of difficulties. The nature of the criticality hazard is such that deviations towards a less safe condition may not be intuitively obvious to operators and there will be no obvious indication that neutron multiplication is increasing. 2.X Inspection of existing facilities and activities as well as the proper control of changes in facilities and activities are particularly important for ensuring criticality safety and should be carried out regularly and the results reviewed. There is a danger that conditions may 'creep' with time in response to factors such as ageing of the plant or due to increased production pressures, for example.	Two quite different requirements have been stated in the same paragraph. It is suggested that the paragraph is divided in two and the order of sentences is changed so that the requirement is stated first and this is followed with the explanation.	X			
2	2.8/3	This highlights the importance of analysis and sharing of operating experience, operator training and independent inspections...	The sentence could be clearer.			X	No alternate text proposed
3	2.13/1	In applying the criteria, safety margins	The phrase "within which the	X			

COMMENTS BY REVIEWER Reviewer: Country/Organization: Finland Date: 20 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		should be applied to set the safety limits. This implies a value of k-eff...	facilities and activities are demonstrated to be safe" proposed to be removed. This safety margin is arbitrary by definition and intended to cover unknown uncertainties not taken into account in the analysis. So, one can't *demonstrate* that the safety margin is safe, since it covers unknown uncertainties.				

4	4.10./2	• Define the activity involving fissionable material;
		• Define the methodology for criticality safety assessment;
		• Validation and verification of the calculation methods and nuclear data;
		• Criticality safety analyses;
		  o Use of validated codes and nuclear data;
		  o Area of applicability;
		  o Quality assurance of results;
		• Identify unique or special safety measures;
			The validation and verification of codes and nuclear data is not a part of the criticality safety analysis. Therefore it is given an own bullet. In the criticality safety analysis it should be ensured that validation covers the application in question. Otherwise, the validation may need to be revised or extrapolation of the validation results may be considered.
			
			4.21, 4.22, 4.24, 4.25, 4.26 proposed to be moved under Validation and verification of the calculation methods. 4.20, 4.23, 4.27 and 4.28 proposed to be moved under Criticality safety analysis.
				X			

COMMENTS BY REVIEWER Reviewer: Country/Organization: Finland Date: 20 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		4.X The quality check of the input data and the calculation results is an important part of criticality safety analysis. This includes for example ensuring that Monte Carlo calculations have properly converged.	Additional paragraph under Criticality safety analysis could stress the importance of the quality assurance of the computed results (e.g. proper convergence of Monte Carlo calculations).				
5	5./0	CRITICALITY SAFETY SPECIFIC PRACTICES	It is proposed that the chapter title be changed. Chapter 3 "MEASURES FOR ENSURING SUB-CRITICALITY" deals with safety measures. Also paragraph 1.9 states that chapter 5 identifies a number of criticality safety practices.	X			
6	5.36./3	Controls should be identified and implemented to ensure that a criticality safety assessment is performed to analyse the potential impact of such changes.	The idea of this change is to clarify that such changes need to be analysed but this can be done in a separate criticality safety assessment. Also assembly repair effects may need to be analysed in a criticality safety assessment.		Text modified as "Criticality safety assessments should be performed to consider the impact of those operations."		
7	5.45./last bullet	Bullet to be removed.	This is not a burnup credit specific requirement but a general one. It has been	X			

COMMENTS BY REVIEWER Reviewer: Country/Organization: Finland Date: 20 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			proposed in Comment 4 that this requirement be stated in Chapter 4, under Criticality safety analyses.				
8	5.85./0	Transport	Paragraph title "During transport" to be changed to "Transport", which better covers all stages related to transport of fissile material.	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: FRANCE Country/Organization: FRANCE			Date: 6 May 2011	RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
1	1.4/6-8	…or a critical assembly, and systems that have been exempted from complying with the criticality safety requirements, ~~e.g. transport~~ and does not cover **transport which are performed according to transport regulations Ref. [6] and** any activities on defence related facilities.	In transport, there are also criticality safety requirements in Ref. [6].		Logic or argument accepted and text modified as follows: "…or a critical assembly, and systems that have been exempted from complying with the criticality safety requirements or are covered by other regulations, e.g. transport which is performed according to transport regulations Ref. [6] and does not cover any activities on defence related facilities.		
2	1.4/10	…in nuclear power plants, e.g. storage and ~~transportation~~ **handling** of fresh and spent fuel. Recommendations encompass…	"Handling" is more generic than "transportation"	X			
3	2.3/1	k_{eff} instead of K_{eff}	Consistency with § 2.12-14		Agreed. However, sentence deleted by Canada-AECL comment no 10		
4	2.3/3-4	"… such as mass, isotopic vector, enrichment, concentration, moderation, geometry, density, reflection, interaction and neutron absorption." ⇨ (order) "…mass, concentration, moderation,	In order to group material properties (i.e. isotopic vector/enrichment and density), which allow to determine the number of atoms per cubic centimeter used in a calculation	X			

COMMENTS BY REVIEWER Reviewer: FRANCE Country/Organization: FRANCE Date: 6 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
		geometry, <u>isotopic vector, enrichment,</u> density, reflection, interaction and neutron absorption."	code.				
5	2.6	End item #1, #7, and #8 with semi-colons instead of dots.		X			
6	2.6	Item #8: "produced and periodically reviewed" => "produced, documented and periodically reviewed"	To be consistent with 1st item.	X			
7	2.13	This implies **<u>in particular</u>** a value of keff somewhat less than unity and/or a controlled parameter value below its critical value.	Safety margins rely not only on keff values or critical values			X	Additional words do not increase clarity.
8	2.14	In determining safety margins for keff (relative to 1) **and**/or for the value…	To be consistent with §2.13	X			
9	2.17	In some facilities or activities the amount of fissionable material may be so low or the isotopic composition may be such, ~~e.g. 235U/U < or = 1%,~~ that a full criticality safety assessment would not be justified.	In particular circumstances (heterogeneity or fertile blanket irradiated in fast reactor) the relationship given in the example is not sufficient	X			
10	3.1/2	…handling, ~~transporting~~ or storing fissionable materials should be based on the defense in depth concept, Refs. [1] and [13]….demonstrating fault tolerance, Ref. [1]**<u>]. For transportation the Ref. [6] applies.</u>**	Transport has its own regulation.		Scope clarified in 1.4		
11	3.7	"(Note; two…" => "(Note: two…" colon instead of semi-colon		X			
12	3.12	…Administrative safety measures; o Operator manually initiates an active engineered safety measure (e.g. operator initiates an automatic shutdown system in response to an indicator or alarm),	The examples give the impression that administrative safety measures are only related to "shutdown procedures" and concerns the second level of defence in depth.		Text modified as follows: "Operator provides the safety measure (e.g. operator closes a shutdown valve in		

COMMENTS BY REVIEWER Reviewer: FRANCE Country/Organization: FRANCE Date: 6 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
		Or o Operator provides the safety measure (e.g. operator closes a shutdown valve in response to an indicator or alarm).	An example which concerns the first level of defence in depth should be also provided.		response to an indicator or alarm or brings the system into normal operational limits by adjusting controls).”		
13	3.17	Delete item #4 (“Safe limits…”)	Redundant with § 2.12 (where information should be).		Text moved to 3.18		
14	3.17	Move item #1 (“Limitation of the isotopic…”) between item #6 “Limitation of the amount…” and item #7 (“Limitation of the density…”)	See Comment #2	X			
15	3.22	Neutron absorption should be considered. Neutron absorbers are mainly effective for thermal neutron ~~and/or energy~~ systems.	Simplification proposed. Note this simplification should also concern § 3.23	X			
16	3.28	Item #7 (“Transfer and control of fissionable…) “Using different controlled parameters” => “Using different <u>fissionable materials and/or</u> controlled parameters”	Consistency with definition of item #2 of § 3.28	X			
17	3.28	Item #12 (“Procedures in case of…) Delete “unforeseen”	Not necessary and may be confusing since it is about “anticipated operational occurrences”	X			
18	3.37	Group item #5 and item #7 (reformulate if necessary)	Both express the same idea	X			
19	3.40	Item #5: “The ability” => “the ability”		X			
20	4.10	Perform criticality safety analyses **<u>including notably</u>**; o Calculation method o Verification o Validation	Criticality safety analysis not include only this bullets		Text modified		
21	4.15	“mass, isotopic vector, volume,	Enrichment is in fact a special	X			

COMMENTS BY REVIEWER Reviewer: FRANCE Country/Organization: FRANCE Date: 6 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
		enrichment…" => "mass, volume, moderation, isotopic vector, enrichment…"	case of isotopic vector (for fresh uranium), so it is better to group both terms. Moderation is an important parameter. Note that concentration (for homogeneous liquids) may also be added, but can be deduced from mass/volume (while moderation cannot, at least for solids).				
22	4.26	Item #3. Sub-item #5 "Effective moderators… an effective moderator" => "Considerations about moderators can be found in Para 3.20 and 3.24." And add missing information in Para 3.20 if necessary	Avoid duplication of information in 2 different §. Para 4.26 gives the list of characteristics. Para 3.20 discusses their peculiarities.	X	Content transferred to 3.20 however duplication kept in 4.26 for validation consideration		
23	5.2	…fresh fuel storage ~~(and transport)~~, spent fuel storage ~~(and transport~~), reprocessing…	Transport has its own regulation.	X			
24	5.16	Typical control parameters => Typical control**led** parameters.		X			
25	5.25	…fuel is handled **or** stored ~~or transported~~.	Transport has its own regulation.	X			
26	5.37	As noted before, recommendations about soluble poison as a criticality controlled mode are not clear.	It is namely recommended to avoid it for normal operation, and to allow "limited" credit for accident conditions. But in Para 5.38 it is used for criticality control.		Please note the original text stated that the use of a soluble neutron absorber should not be credited for		

COMMENTS BY REVIEWER Reviewer: FRANCE Country/Organization: FRANCE Date: 6 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
					normal operation. However, text modified to emphasize credit for soluble neutron absorbers only in certain accident conditions.		
27	5.37 Last sentence	Delete "in view of the double contingency principle"	Or is it "to comply with the double contingency principle"? This does not add much, as it applies to a lot of paragraphs.	X			
28	5.45	Item #3. The remark "The BUC analysis should take account of the depletion of the burnable poison and consider the possibility that the most reactive condition may not be for the fresh fuel" should be "The analysis should take account of the depletion of the burnable poison and consider the possibility that the most reactive condition may not be for the fresh fuel." and be moved in Para 5.42.	This remark does not apply only for BUC analysis, but also for the "classical" analyses, which consider "fresh fuel" (and would not be bounding in this case).		Assessment used instead of analysis as it is a more general term encompassing analysis and also to maintain consistence with bullet introductory text in 5.37.		
29	5.49	"Reprocessing operations could also include the treatment of fresh fuel" => "Reprocessing operations can also…"	This is already the case (e.g. in French facilities)	X			
30	5.58	"include; two…" => "include: two…" [colon instead of semi-colon]		X			
31	5.89	Item #3: Delete space before semi-colon Last item: end with a dot.		X			
32	5.97	"of the materials cited in Para 5.91 => "of unusual materials, like some of those cited	Not all materials cited in 5.91 are "challenging" (Pu with less	X			

COMMENTS BY REVIEWER Reviewer: FRANCE Country/Organization: FRANCE Date: 6 May 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
		in Para 5.91" Add "exotic" materials in Para 5.91 if needed (Cm 243 or Cm 245 for instance)	that 5% of Pu 240, graphite, boron… are not especially challenging for instance).				
33	6.8	**An analysis should be conducted to determine whether an installation** should have an emergency response plan, programme, and capabilities to respond to credible criticality accidents.	The analysis should not be limited to installations which have criticality alarm systems		Agreed. The following text was added at the end of the para: "In some circumstances where a criticality alarm system is not installed (e.g. shielded facilities), analyses should still be conducted to determine if the installation needs an emergency response plan"		
34	6.13	Item #4: clarify requirement	Not understood.	X			
35	6.55	Item #4: void (to delete)		X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer : Team of National Nuclear Energy Agency of Indonesia Country/Organization : Indonesia/BATAN Date : 26/04/2011				RESOLUTION			
Comment No.	Para/ Line No.	Proposed New Text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
1	2.5/2	… contributory cause in nearly all criticality accidents experienced to date. Optimal collaboration between human and machine in the system control management should be considered as well.	the additional sentence is needed to emphasize that collaboration between human and machine is more safe than only using human supervisor		Modified text added: "The interface between human and engineered systems should be considered as well."		
2	2.6/28	… licensee/organization. The inspection data should be documented for safety prognosis management program and preventive maintenance inspection scheduling.	to emphasize that the advantage of inspection data		Modified text added: "The inspection data should be documented and submitted for management review and action."		
3	2.6/29	Management should ensure that the safety assessment and analysis document are produced and …	safety assessment and analysis is more convenient performed in a document to meet safety management & quality control procedure	X			
4	2.6/ additional point	• Management should ensure that a sustainable improvement safety culture is implemented consistently in the operating organization and staff	Implementation safety culture is very important in a critical installation		Modified text added: "Management should ensure that an effective safety culture is implemented, see Ref [1]."		
5	2.9/3	… should be performed to analyze the causes of the deviation and to identify corrective actions as lesson learned to prevent re-occurrences	As a procedure, all the experiences should be documented as lesson learned		Modified text added: "The investigation should be performed to analyze the causes of the deviation,		

COMMENTS BY REVIEWER Reviewer : Team of National Nuclear Energy Agency of Indonesia Country/Organization : Indonesia/BATAN Date : 26/04/2011				RESOLUTION			
Comment No.	Para/ Line No.	Proposed New Text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
					lessons learned and to identify corrective actions to prevent re-occurrences."		
6	2.11/2	Operating experience and incidents and accidents to ensure the sustainable improvement of …	The improvement should be sustained and not only continuous			X	"Continual" is more common usage
7	2.12/5	… volume, concentration, geometry, moderation, taking into account neutron production, leakage, scattering, reflection, interaction and absorption. …	A more elaborative parameters to account rate of change in number of neutrons	X			
8	2.14/4	… should be considered. In practices, uncertainties in measurement, instrument and sensor delay time should be considered. Note that …	Measurement uncertainties should be considered to determine the safety margin except computation uncertainties	X			
9	3.5/4	… achieved by using inherently safe material (e.g. by using very low enriched or natural Uranium in specific chemical or physical forms) or using passive driven actuated system (e.g. scram system using gravitational force). Alternatively, …	A passive driven system should be set as a complement to the inherently safe material			X	Scram systems are not passive as they need actuation
10	3.12/7	• Automatically initiated active or passive engineered safety measures …	the engineered safety measures can be automatically initiated by active or passive action			X	Initiation by passive action is still an active engineer safety measure
11	3.28/ additonal point	• Room and facility lay out design which support to the emergency preparedness includes utilization of yellow light lamp; • Procedures for emergency arrangement	safety in the emergency case			X	These points relate to emergency preparedness (section 6) not to safety measures
12	3.33/6	the organizational means for establishing a periodical	the training is intended	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer : Team of National Nuclear Energy Agency of Indonesia Country/Organization : Indonesia/BATAN Date : 26/04/2011				RESOLUTION			
Comment No.	Para/ Line No.	Proposed New Text	Reason	Accepted	Accepted but modified as follows	Rejected	Reason for modification/rejection
		criticality safety training to improve the safety awareness and behavior for the management …	to deepen the safety culture				
13	3.35/ additional point	• to provide a periodic review of safety assessment and safety analysis document	to emphasize that periodical document review is important		Added the following text bullet to 3.33: "The organizational means to undertake periodic reviews of criticality safety assessments."		
14	4.2/3	… based on realistic assumptions regarding to operational condition experiences, rather than …	to emphasize that the probabilistic quantity is determined from experiences	X			
15	4.2/6	… from normal conditions in a certain time range and the probability …	the frequency is calculated by number of events in a certain time range			X	The concept of "time range" is implicit with "frequency"
16	4.16/10	• "What-If" or cause-consequence methods;	to be more elaborative statement	X			
17	4.16/ additional point	• Bayesian Networks;	Bayesian networks can also represent the fault scenario	X			
18	5.7/6	… sampling), or measurement error.	measurement error should be taking into account		Agree. However, para deleted by UK comment no 88		
19	6.4/ additional point	• temperature	temperature feedback reactivity should be considered as well	X			

COMMENTS BY REVIEWER Reviewer: NISA, JNES Country/Organization: Japan/ Date: 2011.5.16 Note: **Underlined means insertion of word(s) and ~~delete~~ means deletion.**				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification./rejection
1	General	The wording "Fissionable material" should be clearly defined in this draft. If, "Fissionable material" means the same as "fissile material", only "fissile material", which is used in the upward document NS-R-5, should be used.	"Fissionable material" is undefined word in the IAEA safety glossary 2007 edition. This word is not used in the upward document NS-R-5;" Safety of Nuclear Fuel Cycle Facilities".		Fissile material now used.		
2	General.	In case that "Fissionable material" is not the same as 'fissile material', it should be clear the usage of "Fissionable material" and 'fissile material' in order to distinguish the difference of the application. The application method of these two wordings should be clearly defined in this document.	"Fissionable material" is undefined word in the IAEA safety glossary 2007 edition. And this word is not used in the upward document of NS-R-5"Safety of Nuclear Fuel Cycle Facilities".		Definition of fissionable material added to document and definition of fissile material already defined in IAEA Safety Glossary.		
3	3.15and 3.16	Delete all bullets of 3.15 and combine 3.15 and 3.16 as follows; The hierarchy of safety measures gives preference to passive geometry. ~~If sub-criticality cannot be ensured through this means, further safety measures should be considered such as limiting:~~ The safety measures used should be related to the application of controlled parameters and their combinations. ~~Examples of the controlled parameters~~	All bullets part of 3.15 are described in 3.17, so it is redundant. 3.16 refers 3.17.	X			

COMMENTS BY REVIEWER Reviewer: NISA, JNES Country/Organization: Japan/ Date: 2011.5.16 Note: **Underlined means insertion of word(s) and ~~delete~~ means deletion.**				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification./rejection
		~~are given below.~~ They are given in 3.17.					
4	3.17/4th bullet	move 4th bullet sentence after the last bullet and change as follows. •Parameter limitations exemplified above bullet ~~Safe limits such as safe mass, safe geometry~~ can be evaluated either by multiplying the critical value determined by the system conditions with a safety factor or by calculation of the value which meets sub-critical keff criteria;	4th bullet sentence is valid not only for mass, geometry, but also for other parameters described in other bullet sentences.	X			
5	3.26/4	Therefore, selection of the heterogeneity or homogeneity ~~assumed~~ should be considered in the criticality assessment as a factor affecting the reactivity and the selection should be justified. …	Clarification		Some clarification added		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: NISA, JNES Country/Organization: Japan/ Date: 2011.5.16 Note: **Underlined means insertion of word(s) and ~~delete~~ means deletion.**				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification./rejection
6	3.28/8th bullet	Insert the following bullet just before the 8th bullet. •Transfer and control of materials from criticality controlled areas to areas without criticality safety control ;	As explained in Japanese Nuclear Safety Handbook, version 2 (JAERI-Review 2001-028) 2.2.2, the facilities or devices which have a chance to fuel materials flowing into should also need to be considered.		Added text to clarify 8th bullet		
7	4.24	Verification of the calculation method should be performed ~~and periodically checked~~ and should test the methods, mathematical or otherwise, used in the model.	Verification is not conducted periodically.			X	Verification should be conducted periodically to ensure correct function of the system used for validation
8	4.26/4th bullet	・Neutron-energy spectra (e.g. in liquid system, in metallic system) throughout the individual benchmarks relative to the neutron-energy spectra throughout the fissionable material system that is the subject of the safety analysis;	Although “Neutron-energy spectra” is mentioned as review item, few benchmarks are reviewed including “Neutron-energy spectra”.		Bullet deleted		
9	5.9	Changes due to plant ageing should be considered. The ageing effects should be monitored and their impact on criticality safety should be assessed. Periodic testing of ~~material~~ function of instrument, equipment, etc. relied upon to maintain sub-criticality should be performed to ensure the criticality safety analysis remains valid for any actual or potential ~~material~~	What is to be ensured during plant life is “function for criticality safety”. The wording “material” sounds like “structural material” and seems that “safe-geometry equipment” should be geometrically checked during plant life. Such “safe-geometry equipment” is designed and manufactured in consideration for corrosion effect and		“Items” used instead of equipment, as this is a defined term in the IAEA Safety Glossary.		

COMMENTS BY REVIEWER Reviewer: NISA, JNES Country/Organization: Japan/ Date: 2011.5.16 Note: **Underlined means insertion of word(s) and ~~delete~~ means deletion.**				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification./rejection
		degradation.	actually it is often impossible to measure the dimension of safe-geometry equipment in high radiation environment.				
10	5.49/2	Consideration should be given to supplementary criticality precautions for the control of the dissolution phase as these materials can be more difficult to dissolve. In addition, MOX fuels tend to be more difficult to be dissolved than UO_2 fuels.	MOX fuel can be added as materials difficult to dissolve.	X			
11	5.53/6	Periodic testing of function of instrument, equipment, etc. ~~material~~ relied upon to maintain sub-criticality should be performed to ensure the criticality safety analysis remains valid for any actual or potential material degradation.	To avoid a misunderstanding. Same reason as above No.17.		Agreed, However, para deleted by Canada-AECL comment no 140		
12	5.64/3rd bullet	・post dissolution gamma monitoring (e.g. to detect residual ~~fission products~~ undissolved fuel on ~~in~~ hulls);	For clarity of meaning and applied process.		Agreed, however, para/text deleted due to UK comment 118		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: NISA, JNES Country/Organization: Japan/ Date: 2011.5.16 Note: **Underlined means insertion of word(s) and ~~delete~~ means deletion.**							
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification./rejection
13	5.80/1	If the criticality safety design of packages containing fissile material (e.g. spent fuel disposal packages) ~~disposal waste packages~~ is based on the assumption that the empty spaces of the package will eventually be filled with groundwater and no burnup credit is adopted, the safety margin to criticality will be high.	Clarity and completeness.		Text modified		
14	6.7/3	the majority being due to increase in concentration, movement of fissionable material~~/reflector~~ by gravity or flow through pipework.	Is there any criticality accident caused by movement of reflector by gravity or flow through pipework? If it means "Fat man effect", it can be considered as minority.	X			
Editorial comments							
15	2.12/1th bullet	In ensuring criticality safety two types of criteria should be considered: • Safety criteria based on the value of keff (effective ~~the~~ neutron multiplication factor) for the system under analysis;	For exact definition.	X			
16	2.14/2-3	keff (in the first criteria ~~case~~ of 2.12), or the critical value (in the second criteria ~~case~~ of 2.12), including any code bias and sensitivity	For clarity.	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: NISA, JNES Country/Organization: Japan/ Date: 2011.5.16 Note: **Underlined means insertion of word(s) and ~~delete~~ means deletion.**				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification./rejection
17	2.17/1	In some facilities……may be such, e.g. 235U/U <u><</u> ~~< or =~~ 1%, that a full criticality safety assessment would not be justified.	Editorial		Agreed, but text deleted due to France comment no 9		
18	3.14/2	Safety should be ensured by design features and characteristics of the system which are as near as possible to the top of the list ~~above~~ <u>specified in 3.12,</u>	for clarity	X			
19	3.15/1	The hierarchy of safety measures gives preference to passive geometry.	Clarification Explain the wording ‘passive geometry’ otherwise replace it with more familiar words.		The term “passive safety” is used, see also correction due to UK comment no 33		
20	3.20/6-8	Delete this sentence. ~~The minimum critical mass for a system may be dependent on the presence of moderating material and usually changes when the system is changed.~~	Duplicate meaning as a first sentence.	X			
21	3.22/2	Neutron absorbers are mainly effective for thermal ~~neutron and/or~~ energy systems.	Editorial. Originally proposed 2 sample expressions.	X			
22	3.23/4 and 6	in a thermal ~~neutron and/or~~ energy system	Editorial. Originally proposed 2 sample expressions.	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: NISA, JNES Country/Organization: Japan/ Date: 2011.5.16 Note: **Underlined means insertion of word(s) and ~~delete~~ means deletion.**				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification./rejection
23	4.2/8	(~~often~~ sometimes assumed to be a single fatality per criticality accident for unshielded operations),	Such assumption is not popular with us.	X			
24	4.20	Delete this paragraph 4.20	All contents of 4.20 are described in 4.17, so it is redundant.	X			
25	4.29/2	Any unique or special safety measures resulting from the criticality safety analysis and assessment should be specifically highlighted ~~. to ensure their ***visibility***~~ and to ensure that they are complied with.	Unclear what mean by "visibility". Please add supplementary explanation or delete these words.		Agreed. However, para deleted due to UK comment no 86		
26	5.2/4	fresh fuel storage ~~(~~and transport~~)~~, spent fuel storage ~~(~~and transport~~)~~,	Editorial.	X			
27	5.6/1	For both types of facility the ***different*** possible errors and/or failures should be taken into account.	Unclear what mean by "different". Clarification is needed.		Agreed. However, para deleted due to UK comment no 88		
28	5.32/4th bullet	In determining the criticality safety measures, the following factors should be noted: ・・・ •the fuel assemblies will have undergone physical changes during irradiation ~~and those changes should be accounted for in the criticality safety analysis~~.	This item is the factor that should be noted in determining the criticality safety measures.	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: NISA, JNES Country/Organization: Japan/ Date: 2011.5.16 Note: **Underlined means insertion of word(s) and ~~delete~~ means deletion.**				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification./rejection
29	5.37/13-14	For certain accident conditions such as a drop of a fuel assembly, limited credit for a soluble neutron absorber ~~soluble boron~~ may be allowed in view of the double contingency principle.	For generalization. In line 2 and 11, "a soluble neutron absorber" was used.	X			
30	5.52/8	plutonium oxalate or mixed uranium and ~~/~~plutonium oxalate;	Editorial.	X			
31	5.54/4	Misdirection can lead to uncontrolled chemical phenomena (e.g. concentration or precipitation of plutonium or dilution of neutron absorbers in solution) or ***to a change in the safe geometry***.	Unclear what mean by "to a change in the safe geometry". Please add supplementary explanation or delete these words.		Reworded to improve clarity		
32	5.91/7-8	Examples of special fissionable and non-fissionable materials sometimes encountered include 233U, 237Np, ^{242}Pu, ^{241}Am, ^{242m}Am,	See Ref. [21] and [22]. Not ^{242}Am but ^{242m}Am is correct.	X			
33	6.8/1	Each installation where criticality alarm systems (see Paras 6.49 ~~6.48~~ & 6.50 ~~6.49~~) are installed should have an emergency response plan, programme, and capabilities to respond to credible criticality accidents.	correction of reference paragraph No.		Cross referencing deleted, see also UK comment no 124		
34	6.10/3	Criticality alarm systems (see paras ~~6.48 & 6.49~~ 6.49 & 6.50)	mistake of reference para.No.		Cross referencing deleted, see also UK comment no 124		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: A. U. Anikin, A. V. Kuryndin, A.A. Stoganov Country/Organization: Russia, SEC NRS			Date: 05.04.2011				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	5.13	Conversion facilities refine natural uranium ores to a purified uranyl nitrate which is then typically converted to uranium hexafluoride in preparation for enrichment. Because of the isotopic composition of natural uranium (i.e. approx. 0.7 atom U^{235}) in the homogenous processes of conversion, no criticality safety hazards are encountered. It should be noted that conversion facilities can also be used for enrichment of regenerated uranium, which usually has higher enrichment than natural uranium and in some conditions can lead to criticality. Anyway, enrichment facilities have the potential for criticality accidents and should be protected from criticality hazards through the application of the criticality measures that have been discussed in the previous sections. Further guidance on criticality safety for conversion and enrichment facilities is provided in Ref. [14].	Nowadays conversion facilities sometimes are used for enrichment of regenerated uranium, which has higher enrichment than natural uranium. So it's not absolutely correct to state that criticality safety hazards cannot be encountered during conversion process.		Agreed. Text also modified to be consistent with IAEA fuel cycle safety standard use of conversion, i.e. converting U3O8 into UO2 or UF6		

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.1 Before 1st paragraph	Nuclear criticality can theoretically be caused by most fissionable nuclides belonging to the actinide elements. Some of those nuclides are also fissile, meaning that they can be critical in a "slow" neutron energy neutron flux. Accidental criticality outside equipment designed to be critical, without presence of fissile nuclides, is not (yet) credible. If it becomes credible, criticality safety will be handled very differently and simpler than for fissile nuclides. This Guide thus refers to criticality safety of fissile materials but also covers mixtures of fissile and other fissionable nuclides.	Fissionable and fissile nuclides and materials are defined in the IAEA Safety Glossary. Criticality with nuclides that are not fissile and where fissile nuclides are not present is not (yet?) a realistic hazard. Nuclides such as ^{238}Pu and ^{237}Np are examples. The criticality safety assessment of such nuclides, separate from fissile nuclides, will be very different, and so much simpler, than for fissile nuclides. TS-R-1 (IAEA transport regulations) is a demonstration.		Added, but 4th & 5th sentence omitted		
2	General	Replace "fissionable" with "fissile" throughout the Guide (including the title), except where "fissionable" is intended (see below).	See previous comment. The only use of fissionable that is appropriate appears to be in 5.91, as modified below.	X			
3	1.1 After Paragraph proposed above	A material in this Guide refers to an idealized safety design material (e.g. a 100 % pure nuclide at theoretical density, neglecting radioactive decay) or to a real material that "can be seen". This applies also to a fissile material. An example is a waste material containing fissile nuclides. The fissile nuclides are not fissile material; they are constituents of the fissile material (the waste). The mass of the fissile material is the mass of the waste material. If the mass of the fissile nuclides is intended, this must be explicitly expressed. If other constituents of the fissile material is intended, e.g. elements or compounds, this must also be explicitly expressed.	The Guide refers to fissionable material as if it was clear what is intended but it is not. Sometimes it is the bulk material, e.g. a reprocessing solution or a waste material, sometimes it is a fissile nuclide and sometimes some compound or other constituent of a mixed material. Safety documents, including the Guide, need to be more precise than that. The history of the IAEA transport regulations [6] gives evidence of the confusion that can occur when "material" is used with different meanings in different paragraphs (e.g.			X	Text reviewed to address comment no 4 to distinguish between nuclide and bulk material, also addition of definitions for fissile nuclide and fissile material.

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			escape of fissile material meaning escape of ^{235}U from ^{238}U, a perfect enrichment process).				
4	General	Change many references to "material" to "nuclide" or constituent of a material. The mass of fissile nuclides is often intended when the text actually refers to the mass of the bulk material, the fissile material.	Each reference to fissionable/fissile material needs to be checked for actual intention.	X			
5	1.1.	"Materials containing fissile nuclides are required …"	"Nuclear" is not needed. "radio" (nuclides) is not needed	X			
6	1.4.	and systems that have been exempted as criticality hazards ~~from complying with the criticality safety requirements, e.g. transport regulations Ref. [6]~~	The fissile exemptions (exception provisions) in Ref. [6] are not exempted from criticality safety requirements. The systems (packages consisting of fissile material and packagings) have been shown to be sufficiently safe under specific conditions and assumptions that need to be verified regularly. The fissile exceptions have been misunderstood and this Guide should avoid contributing to such misunderstanding.		The text, now modified as a result of Belgium comment no 9 and France comment no 1, addresses the issue raised.		
7	1.6. end	"… exemptions to **specific** criticality safety **measures**"	Criticality safety is always required. There are no exemptions from that.	X			
8	General	Explain, early in the Guide, the difference between "measure" and "control".	"Measure" is frequently used in contexts where "control" is more common in other texts. "Control measure" is used in one sentence. The intent appears to be that control is more restricted to active features of a system, and often refers to parameters. However, passive features such as			X	Measure, as used in "Safety measure" is a broad term covering the application of both engineered and administrative features, and its concept and application is covered

COMMENTS BY REVIEWER Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems Date: 2011-04-26				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			material properties and geometry are also safety controls and need to be controlled.				in Section 4. Control is more specific and normally related to a specific item or activity. The reference to "control measure" has been deleted.
9.	1.9.	~~, the application of burnup credit,~~	This structure appears to be flawed. Burnup credit is a criticality safety practice and it is here confused with fuel cycle activities. Burnup credit is relevant as a practice under spent fuel operations, reprocessing, waste management, transport and laboratories.	X			
10	2.2	~~A criticality is only detected when it has occurred~~	This is very true but does this not apply to any observation? The intention is probably to express that the neutron multiplication can increase extremely fast, from essentially zero to lethal levels. Measurement of the approach to criticality is too complicated for practical use in most operations involving fissile material handling. This is new text resulting from French comments on draft 3.		Agreed. However, para deleted by Canada-AECL comment no 7		
11	2.3	isotopic vector **(e.g.** enrichment**)**	Enrichment is a type of isotopic vector.		Agreed. However, reference to isotopic vector deleted by		

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
					France comment no 4		
12	2.12 end	"… no longer being **reliably known to be** sub-critical"	The uncertainties need to be considered when a system is considered to be critical. The best-estimate critical value is not sufficient. This is clear from para. 2.14.	X			
13	2.17	A useful starting point is the exception criteria applied to **fissile classification of** transport packages, Ref. [6]**~~, which represents a conservative approach.~~**	The criteria for exception from classification as fissile are not intended to be a conservative approach. It has even turned out that some of the exception criteria are not considered safe anymore and will be changed in the next revision of [6].	X			
14	2.18	The primary approach ~~principle~~ should be to demonstrate that the fissile material itself has sufficiently inherent sub-criticality features, while the secondary approach is to demonstrate that the maximum amounts of fissile nuclides involved are so far below critical values that no specific safety measures are necessary to ensure sub-criticality for operational states and design basis accidents.	The amounts of fissionable material are often irrelevant.	X			
15	3.1	For criticality safety the concept of the double contingency principle is ~~the preferred~~a method of demonstrating fault tolerance, Ref. [1].	The DCP has been demonstrated to be a useful approach. Other approaches may be better. Combination of the DCP with other approaches is common and often needed. Performance based criteria account for the site-specific experience in predicting contingencies. A new type			X	Safety Guide has to remain consistent with the Safety Requirements NS-R-5, specifically Para 6.45, which states that the DCP SHALL be the preferred approach.

COMMENTS BY REVIEWER Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems Date: 2011-04-26				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			of facility with complicated operations may justify a slightly more ambitious approach such as not accepting criticality after two unlikely concurrent contingencies. This could also be referred to as a DCP but it is different.				
16	3.3	... the protection of the confinement system(1) to limit radiological releases (1) confinement system in [6] has a different meaning	The transport regulations [6] have a definition of the "confinement system" that is different to the meaning of the words and to other uses of the concept. A footnote helps to avoid confusion.	X			
17	3.5	When this is not feasible, ~~Alternatively~~ the facility or activity might be designed such that fissionable material is always restricted to containers which have geometrically sub-critical configurations. Special care is needed to avoid intentional transfer to unsafe geometry under abnormal operating conditions.		X			
18	3.7	The double contingency principle ~~is the preferred~~provides means of	There may be more suitable approaches and a general preference should not be given.			X	Safety Guide has to remain consistent with the Safety Requirements NS-R-5, specifically Para 6.45, which states that the DCP SHALL be the preferred approach.
19	3.15	The hierarchy of safety measures gives preference to ~~passive geometry~~use of inherently subcritical fissile materials and to activities that avoid moderation and makes near optimum moderation unlikely also under abnormal	Safe geometry is good but not the best approach. A transfer to unsafe geometry by mistake, leak, etc. could quickly lead to criticality. Experience shows that such events happen.		General term used, i.e. passive safety, see also UK		

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Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		conditions.	Avoiding solutions and near optimum moderation is a practical way of reducing the risk even when the deterministic design criteria don't allow this to be accounted for in licensing. The risk will usually be reduced by many orders of magnitude. Further, the likelihood of being alerted to the threat to stop it or at least to evacuate the location before criticality is usually large. An activity with large quantities of near optimum moderated fissile material will always be a significant threat even if only safe geometry is used. Dry and wet chemical processes for conversion of UF_6 to UO_2 may be an example of such a choice.		comment no 33		
20	3.15 Bullets	• the geometry to safe dimensions • … • applying burnup credit for irradiated fissile material	Burnup credit is a way of accounting for inherent material features. If they can be verified and assessed properly, burnup credit can be a reliable, passive safety measure.		Agreed. However, bullets in para deleted by Japan comment no 3		
21	3.15	the isotopic composition(s) of the fissi~~onab~~le ~~material~~ element(s) present in the system;	Isotopes must be linked with a specific element. Isotopes of a fissionable material such as a solution or waste material don't make sense. Isotopic composition, vector or distribution should mean the same thing. Only one of them should be used in the Guide		Bullet deleted by Japan comment no 3		

COMMENTS BY REVIEWER Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems Date: 2011-04-26				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			for consistency. If the element or nuclide compositions are intended, that must be clarified. Here it is one or more fissile elements (e.g. U and Pu) that are intended.				
22	3.15, 3.17, 3.19 (twice), 3.28, 5.45, Definition of depletion	Similar to the previous point. Isotope or isotopic should be linked to a specific fissile element. Depletion is not "an isotopic change of the concentration of a nuclide". The isotopic composition of many of the associated elements may change but the nuclide densities also change.	Use isotopes consistently and with the clear relation with elements that is appropriate.		3.15 – para deleted by Japan comment no 3. 3.17, 3.19, 3.28 text corrected. 5.45, no reference to isotopic composition. Definition deleted by UK comment 131		
23	3.17.	Limitation of the concentration of fissi~~onab~~le ~~material~~ nuclides within a solution;	The solution is the fissionable material. If the intention is to limit the concentration of fissile nuclides or elements, that needs to be correctly specified. Sometimes the concentration of the solution could be intended, in combination with other limitations. Here it appears clearer to refer to fissile nuclides.	X			
24	3.36 Last	• to stop work and report if unsafe conditions are	Intended to clarify. Both stopping of	X			

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
	bullet	possible in the event of a deviation from normal operations.	work and reporting are related to unsafe conditions. The current text could be read as stopping work even when there are clearly safe deviations.				
25.	4.10.	• Define the fissile materials, their constituents, chemical and physical forms, nuclear and chemical properties, etc.	The first bullet in the list should be to define the fissile material with its physics, chemical and other properties. The material is not an activity	X			
26	4.15	The fissi~~onab~~le material characteristics ~~(e.g. mass, isotopic vector, volume, enrichment, degree~~ result of ~~fissionable material and burnable~~ absorber depletion, degree of fission product production/in-growth and interactionirradiation transmutation of fissile material constituents, result of radioactive decay)	Transmutation is a wider and more appropriate concept than depletion. It covers production of plutonium, fission products, etc. Constituents include both fissile nuclides, non-fission but fissionable nuclides, burnable absorbers, etc. Radioactive decay is a separate characteristic.		Additional items added to list, mass, volume, enrichment and isotopic composition retained.		
27	4.26	• Degree of homogeneity or heterogeneity, as well as uniformity non-uniformity, including gradients of fissi~~onab~~le and non-fissi~~onab~~le material constituents	Heterogeneity is often defined as particles or components larger than a specific dimension. A solution with a strong gradient in one material constituent (e.g. boron or ^{235}U) is not a good example. Uniformity is a complementary concept that applies both to homogeneous and heterogeneous mixtures,	X			
28	5.7.	For both types of facility ~~computational errors should be taken into account.~~	Calculation errors, analytical errors and sampling errors are all covered. They are not represented by "computational". The first sentence of 5.7 is almost exactly the same as the first sentence in 5.6. Repetition is not helping.		Text deleted by UK comment no 88		

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
29	5.13 or 5.14	Conversion of enriched uranium in the form of UF_6 to UO_2 does not appear to be covered under these activities. It should be added to the section that corresponds to the associated IAEA safety standard ([14] or [15])	It is a very important process and can involve complicated criticality safety issues (in particular for "wet" processes).	X			
30	5.14.	uranium and/or plutonium which may have variable content in either fissile ~~material~~ nuclides (e.g. in ^{235}U enrichment) or in absorber ~~material~~ nuclides or elements (e.g. Gd ^{240}~~Pu~~).	Note, the text correctly refers to fissile (not fissionable) material here. Avoid calling the fissionable nuclide ^{240}Pu an absorber material. Both ^{235}U and ^{240}Pu are constituents of the same fissile material. They both absorb neutrons (all nuclides do).		The term fissionable used as consistent with definition		
31	5.32.	subsequent ~~cooling~~radioactive decay	Radioactive decay also leads to depletion and buildup of nuclides. "Cooling" is used with the same meaning but is not as descriptive.	X			
32	1.3, 1.6, 2.2, 3.25, 3.28, 4.1, 4.2, 4.3, 4.4, 5.17, 5.26, 5.32, 5.37, 5.38, 5.40, 5.45, 5.47, 5.51, 5.53, 5.58, 5.59, 5.73, 5.76, 5.92, 5.93, 5.94	… criticality safety control (specialist, assessment, analysis, precautions, etc.)	"Safety" is missing together with "criticality" in several locations (usually with control but also in other contexts). Sometimes confusion is possible, e.g. use of burnable absorber for criticality control. It can be used both for criticality control and for criticality safety control. There may be more than one missing "safety" in the referenced paragraphs and there appears to be many corrections but "criticality safety" is correct in most cases, probably more than 90 % of the time.	X			
33	5.42	It has often been the practice to base criticality safety assessments of spent PWR fuel operations	Fresh fuel for PWR fuel is a special case of the more general "peak		General reference		

COMMENTS BY REVIEWER Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems Date: 2011-04-26				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		on a conservative assumption using fresh fuel compositions. This is the irradiation point where the peak k_{eff} value, as a function of irradiation, is found for PWR fuel systems. For BWR fuel systems, the peak k_{eff} value is found after some irradiation, typically about one reactor operation cycle. This is due to the presence of burnable absorber nuclides as a constituent of the fuel. An extremely conservative alternative for BWR fuel is to neglect the burnable absorber and then to assume fresh fuel, as for PWR.	reactivity" approach. This also applies to some other reactor types and fuels for which the reactivity may increase with some irradiation. It needs to be stressed that it is the k_{eff} of the actual system or scenario that is relevant, not the reactivity of the fuel on its own.		made to fresh fuel as a result of Belgium comment no 72. Emphasis remains on k_{eff}.		
34	5.42	Alternatively, it may be possible to account for ~~changes~~ reductions in system k_{eff} as a result of changes in the spent fuel composition due to irradiation.	Burnup credit only applies to reliable reductions in k_{eff} at the considered irradiation levels. It is an option.	X			
35	5.42	This approach is commonly known as "burnup credit". It is an option, as opposed to the peak k_{eff} approach, for which an assessment is required whenever k_{eff} may increase due to irradiation.	Accounting for irradiation in peak k_{eff} determination is a requirement, not an option, whenever an increase in k_{eff} can be expected.	X			
36	Subtitle before 5.44	**Burnup credit***Burnup credit*	Burnup credit is not an activity in the fuel cycle; it is a safety measure/control. It can be discussed here under the fuel cycle activity "Spent fuel operations etc.". Later activities (transport, reprocessing, etc.) can have references to this discussion.		Agreed. However the title of the section has changed to criticality safety practices and not the fuel cycle.		
37	5.44	The changes in the spent fuel composition during irradiation ~~normally~~ eventually result in a reduction in spent fuel k_{eff} relative to ~~fresh~~	Use of burnable absorbers lead to requirements for accounting for irradiation for BWR fuel. Increased	X			

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		~~fuel~~the peak k_{eff} for most reactor and fuel types.	needs for higher enrichments may lead to increased dependence on burnable absorbers also for other reactor types. The proposed modification makes the guidance more general.				
38	5.44	• The extra safety margin obtained from burnup credit may be used to simplify the administrative requirements for sites where many fuel types are stored or handled. For BWR fuel, there could be hundreds of different fuel specifications that need to be verified, often requiring additional safety assessments. Burnup credit could reduce the number of needed fuel specifications to a few,	Simplification of administrative requirements has been pointed out by the Swedish operator of CLAB (central spent fuel storage) to be an incentive for burnup credit.		Reference to simplified administrative requirements added		
39	5.44	• In some applications the verified properties of the irradiated fuel, properly assessed, result in an inherently subcritical material.		X			
40	5.45	On the other hand the application of burnup credit may significantly increase~~s~~ the complexity, uncertainty and difficulty in demonstrating an adequate criticality safety margin.	The alternatives sometimes require considerably more resources while leading to less reliable safety. Replacement of storage racks to introduce additional neutron absorbers is not a trivial project. Experience with BFP neutron absorbers show that also other approaches than burnup credit can be complicated. In some cases, some burnup credit is relatively simple to implement and the result is reliable.	X			
41	5.45	The criticality safety analysis and supporting calculations now need to determine a reliable system k_{eff} influence of the changes to the fuel	Determination of the fuel composition is an optional approach but not required. The need is to determine a	X			

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		~~composition~~ properties during irradiation and ~~cooling time~~radioactive decay after irradiation	reliable negative reactivity due to the changed fuel properties. The fuel properties can be represented by "lumped materials", e.g. fission products. It is also the integral effect of all nuclides that needs to be accounted for, not individual effects of each nuclide. Cancelling errors of nuclide concentrations and of nuclear cross section data can be accounted for.				
42	5.45	~~Note, the irradiation of fuel with burnable poisons will typically result in increased reactivity early in its life. The burnup credit analysis should take account of the depletion of the burnable poison and consider the~~ possibility that the most reactive condition may not be for the fresh fuel;	This is not burnup credit. It is not an option as burnup credit is. It is a requirement to account for burnable absorbers. It is covered in comment above and in the previous subsection (Taking account of changes in spent fuel …)		Agreed. Text modified by Belgium comment no 74 and reference made to assessment and not burnup credit.		
43	5.45	… ensuring that Monte Carlo calculations of spent fuel configurations are properly converged. This is a general requirement for all Monte Carlo calculations but it is appropriate to point it out here since the challenges for conversion may be quite extreme.	Convergence in Monte Carlo calculations has always been a factor requiring consideration. Even so, the studies of realistic burnup credit showed unexpected complications in convergence. A warning is justified. A separate subsection on Monte Carlo source convergence in section 4 may be useful.		Bullet deleted by Finland comment no 7, reference to convergence added to Section 4		
44	5.46	Generally, the limits and conditions for ensuring	The conservative assumptions may be	X			

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Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
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		criticality safety based on a burnup credit assessment have been based on a conservative combination of initial enrichment and fuel irradiation and decay history (in which burnup is an important parameter).	related to burnup but also to other parameters, here summarized as "irradiation and decay history".				
45	5.46.	The criticality safety assessment should also consider the potential for misloading of fuel from outside the limits and conditions specified in the safe loading curve.	This is a general issue that is covered specifically in a previous sub-section.		Noted, text is consistent with proposed new text		
46	5.48	Spent fuel reprocessing involves operations to separate specific irradiated fuel constituents from each other and to treat the reprocessed materials. The fuel constituents may have existed before irradiation or may have been formed during the irradiation of the fuel. The fuel irradiation may have occurred in nuclear power reactors ~~and~~or in research reactors.	The separation covers constituents such as uranium and sometimes plutonium that existed before the irradiation. They are not all formed during the irradiation. Many nuclides are formed after the irradiation, during radioactive decay. The proposed text avoids referring to material constituents as full materials until they are actually separated.		General reference to the objective of reprocessing added. That is, the recovery of uranium and plutonium isotopes. This would cover whether they were there originally, due to the fuel being irradiated or due to radioactive decay.		

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Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
47	5.52	The forms of fissi~~onab~~le materials are diverse and include: • materials containing other ~~compositions~~ irradiated fuel constituents (e.g. materials containing high concentrations of minor actinides).	Here it is clear that fissile materials can be whole fuel assemblies and complete solutions, thus not only fissile nuclides, elements or compounds.		Reference to other materials containing minor actinides added		
48	5.58	• increased concentration of fissi~~onab~~le ~~material~~ nuclides (by precipitation/ colloid formation/extraction);	Since the fissile material is the solution itself, its concentration is 100 %. The fissile nuclides (or other fissile constituents of the fissile material from which the fissile nuclides can be indirectly determined) are intended.	X			
49	5.59	• monitoring of a fissi~~onab~~le material constituent (nuclide, element, compound) concentration	A fissile nuclide, element or other fissile constituent may be monitored.	X			
50	5.86	Due to the potential for closer contact with the public, and lack of many safety measures required at establishments (e.g. identification of actual safety threats, criticality detection and alarm systems, dose badges, access to criticality safety specialists and trained operators, etc.) the transport criticality safety assessment is more stringent and based on a solely deterministic system.	There are many reasons for the more stringent safety assessment of transport.		Agreed. However, proposed text too detailed. Text modified to imply proximity of public not the only reason.		
51	5.87	The state of ~~the~~ a representative transport package before, during and after the tests specified in Ref. [6] (e.g. water spray and immersion, drops and thermal tests), together	The tests are important but not the full basis for the assessment. Sometimes the worst condition may be before a test (e.g. fire) than during or after. It is		Text amended as proposed but less detailed		

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Dennis Mennerdahl Country/Organization: Sweden, E Mennerdahl Systems			Date: 2011-04-26				
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		with other considerations such as water in- or outleakage (independent of the test results) and accumulation of packages (different quantities for normal and accident conditions), provides the basis for the criticality safety assessment and analysis of the design. Additional safety assessment is required for the actual transport, see 5.89.	important to understand that the actual transport is normally not formally assessed.		added.		
52	5.89	The package design assessment referred to above in 5.87 provides a safety basis but the final safety assessment can only be made at the time of transport, accounting for real fissile materials, real packagings, real loading, labeling, etc. and real transport conditions. It is stated in the IAEA transport regulations Ref [6], that "Fissile material shall be transported so as to maintain sub-criticality during normal and accident conditions of transport; in particular, the following contingencies shall be considered:	The design and the actual transport are two different aspects of the safety assessment required to avoid criticality in transport. The design specifications can't cover all possible variations (in particular the human factor) and some alertness is required by the organizations responsible for the transport.	X			

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Country/Organisation: UK Member States Comments			Date: 19 May 2011				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	General		The guidance and recommendations provided in this draft safety standard are very relevant and useful. The scope is appropriate and the areas covered by the document are wide-ranging and comprehensive. There is not a lot on disposal nor on waste management, at least not when it comes to specifics (see Section 5). The quality and clarity of the document is generally good and it is well written. We have some concerns relating to Sections 3, 5 and 6 (addressed in later comments); in particular Comments 106, 108, and 127 could cause potential issues if the current wording is not changed. The document might benefit from the addition of some figures as the document is quite long and contains a lot of text.			X	No specific proposal offered
2	General		The document contains a lot of useful information, in a			X	Structure flow is subjective and other

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			difficult technical area, from a number of IAEA and other documents. The structure and presentation of the document is not however in a form to assist the reader to easily find, understand and utilise relevant information. Further consideration should be given to this aspect of the document before it is published. For example: The structure of Sections 2-4 should be revisited. The aims, objectives and general process of a criticality safety assessment are currently presented in Section 4 after the more detailed information in Sections 2 and 3, which is illogical. The generation of a schematic diagram would assist in generating a more logical structure and helping users navigate around it. In Section 3 "Factors affecting Reactivity" appears after "Controlled parameters", which is after "Safety measures". The reverse order would make much more sense; you need to know what affects reactivity in order to determine				member states have not commented upon this

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			which parameters to control and the most effective means of doing this. Much of Section 5 is extracted from various other IAEA documents. This leads to a degree of repetition on some basic aspects of criticality safety.				
3	General		In several parts of the document, it is stated that use of the double contingency principle is the preferred means of demonstrating criticality safety. Other methods of demonstrating criticality safety, e.g. Design Basis Analysis, should also be mentioned. What is important is that there is an appropriate number of independent, preferably passive, safety measures to prevent a criticality incident.			X	IAEA NS-R-5 specifies that the preferred method is the double contingency and is therefore retained for consistence
4	General	Consider including some guidance on acceptable values of sub-critical margins.	Although sub-critical margins are mentioned, there is no guidance on acceptable values. Guidance would be in order to judge the sensitivity of the system to changes in parameter values.			X	Different member states have different guidance values. Please note that recommended values were included in the original document (Version 1). However

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							after debate and many Member States comments, the values were removed.
5	General		This document largely avoids discussion of safety assessment criteria (rather than sub-critical criteria). The fundamental safety requirement is to ensure that the frequency at which a significant consequence can occur is sufficiently low (Ref NS-R-5, Para 2.1 and Figure 2). The relevant safety criteria (concept of credibility/frequency) applicable to criticality safety should be reflected and explained in this guidance.			X	The setting of criteria, specifically the acceptable/tolerable combinations of frequency and consequence, is, as stated in GSR Part 1, a matter for each Regulatory Body and varies between Member States. The concept/principle is well explained in NS-R-5 and it would be inappropriate for the IAEA to expand on this with recommendations for acceptable combinations.
6	General		The document title, and where appropriate in the text, should refer to “fissile” material and not “fissionable” material. An example of where the use of the word “fissionable” is inappropriate is that it would bring a plant handling depleted uranium only, which is predominantly ^{238}U	Y			

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			(fissionable but not fissile), within the scope of the safety guide. Such a plant should not need to consider criticality safety. The IAEA Safety Glossary [Reference 9] defines "fissile material", but does not define "fissionable material". The same glossary does distinguish between "fissionable" (four word definition) and "fissile" (adding five more words to give a nine word definition). It would be helpful if a definition of "fissionable material" were included in this safety guide.				
7	Section 1		The term "ensure sub-criticality" may not be appropriate to all applications – it is inconsistent with the concept of "minimise the likelihood…."		Reference to reasonable practicability added to 1.1 as follows: "Nuclear materials containing fissionable radionuclides are required to be managed in such a way as to ensure sub-criticality, so far as is reasonably practicable,…."		
8	Para 1.4, 2nd	Modify to read:	Whilst the guidance may not	X			

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	sentence	"….and does not **specifically** cover any activities on defence related facilities, **although many aspects will be directly applicable.**"	specifically be written to cover defence related operations, many operations are similar and the principles would be equally valid, should a Member State wish to apply them.				
9	Para 2.3, 1st sentence	Replace "K_{eff}" with "k_{eff}"	Correction.		Agreed. However, sentence deleted by Canada-AECL comment no 10		
10	Para 2.3, 2nd sentence	Replace "isotopic vector" with "isotopic composition"	To be consistent with industry practice and with many other occurrences in the document.	X			
11	Para 2.3, 3rd sentence	Modify to read: "….such as fission, capture or scatter **cross-sections** taking …"	The phrase is incomplete without mentioning "cross-section".	X			
12	Para 2.7, 2nd sentence	Replace "difficulties" with "unexpected operational deviations"	The meaning of "in case of difficulties" is unclear. What kind of difficulties? Consider modifying as suggested to improve clarity.	X			
13	Para 2.7, 3rd sentence	Delete ", for example" to read: "…due to increased production pressures."	Using "such as" earlier in the sentence negates the need for deleted text "for example".	X			
14	Para 2.12		It is not clear if both of or one of these criteria should be considered. The use of the term "and/or" in Para 2.13 does not clarify this. Clarification is needed.			X	Adequate description. The options can be "and" or "or" in different circumstances
15	Para 2.16, 2nd sentence	Consider adding additional examples: "…e.g. temperatures, liquid flows, acidity,	Operating limits would normally be in terms of limits	X			

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		fissile mass and moderator content."	and conditions necessary for criticality safety, e.g. fissile mass, moderator content. The operating limits provided in the text are safety measures, which may be in place to intercept deviations from normal operations. The examples given are therefore perhaps more appropriate to reprocessing plant operations than general operations.				
16	Para 3.2	Consider deleting the bullet points and the 5th sentence "Application of the ……should be aimed:"	This information repeats the information that is presented in Para 3.4 and Table 1.	X			
17	Para 3.3, 1st sentence	Modify to include a reference to Table 1 for an explanation of the defence in depth levels: "….applied in five levels (see Table 1)."	Improve clarity – the five levels have not yet been explained.	X			
18	Table 1		Formatting issue. Ensure this table is not split across pages.		Will check during final editing prior to publication. Repeat header row added for the meantime.		
19	Table 1, Level 2, column 2	Modify to read: "Detect and intercept deviations from normal operation in order to prevent anticipated operational occurrences from escalating to ***accident conditions***."	The Level 2 'Objective' does not align with the level description in NS-R-1.	X			
20	Table 1, Level 2, column 3	Modify to read: "Control, indication and alarm systems, operating procedures to maintain plant within operational state limits."	The Level 2 'Means' does not align with the level description in NS-R-1. "Damage" relates to no reactor damage in NS-R-	X			

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			1 and relates to anticipated operational occurrences leaving the plant within an operational state.				
21	Table 1, Level 4		Formatting error – line omitted.	X			
22	Para 3.4, 1st sentence	Modify to read: "The defence in depth concept ensures that if **a failure occurs**, it will be **detected and** compensated for, or corrected by, **appropriate measures**."	The current wording is unclear, confused and not the same as NS-R-1.	X			
23	Paras 3.5, 3.6 and 3.11	Combine the information contained in these paragraphs with later discussion on the hierarchy of safety.	Passive safety is an important subset of the hierarchy of safety, but this only comes out in Para 3.12. Bringing the discussion on hierarchy of safety forward from the section on safety measures would give it, and the position of passive safety within it, greater prominence.			X	Para 3.1 introduces the need for this important concept in section 3.
24	Para 3.6		The term "fault tolerance" in this context needs to be defined.	X	Definition added. Text moved to fault tolerance section.		
25	Para 3.7, 2nd sentence	Replace "those system's" with "a system's"	Improve grammar – no previous system has been mentioned.	X			
26	Para 3.8, 1st sentence	Consider replacing "can" with "could"	In general, it is unlikely that a criticality accident will occur, even with multiple events.	X			
27	Para 3.8, 2nd bullet		The meaning of "acceptably low" is unclear. It would be useful to suggest criteria for			X	Acceptable depends on relevant regulatory perspective

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			judging this.				
28	Para 3.8, 3rd bullet	Create a separate paragraph using this bullet point.	The double contingency principle (Para II-5 NS-R-5) does not say this. This is a further step in the analysis process.	X			
29	Para 3.10, 1st sentence	Replace "only slowly" with "at a rate" to read: "……parameters deviate at a rate from their normal operating values……"	The word "slowly" is rather subjective; the important point is that the deviation can be detected and action taken within the required timeframe.	X			
30	Section 3 – Safety measures	Consider restructuring the order of this section	The content of this section is illogical. It would be better to discuss the factors/parameters affecting criticality first, then to discuss how these can be controlled rather than vice versa.			X	Subjective not made by any other states
31	Para 3.11		It is unclear what the first three lines of this paragraph are saying about "safety functions". Similarly, it is unclear why the sub-section "Safety Measures" begins with a sub-section on "Safety measures and safety functions".		Subtitle deleted and safety function already defined in IAEA's Safety Glossary		
32	Para 3.12, 1st sentence	Delete this sentence	This sentence is nonsense; it implies that any system can always be demonstrated to be safety sub-critical.	X			
33	Para 3.15, 1st sentence	Replace "passive geometry" with "passive safety"	Should "passive geometry" read "passive safety"?	X			

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			Consider modifying as suggested to improve clarity.				
34	Para 3.15, 2nd bullet	Add semi-colon after "system;"	Typo	X			
35	Para 3.15, 5th bullet	Modify to read: "limitation of the amount and form of moderating material present in the system"	The suggested change reflects the discussion in Para 3.21; it is not purely the quantity of moderating material that matters but also how effective a moderator that material is.		Agreed. However, bullet listing deleted by Japan comment no 3		
36	Para 3.17	Consider adding additional text to state that, as well as double batching, it may sometimes be necessary to consider higher-order over batching faults.	The current text seems to imply that double batching is the only over batching fault that need be considered.		Note added to 2nd bullet		
37	Para 3.17, 2nd bullet		We may define a safe mass as less than a critical mass, e.g. 0.8 of a critical mass, or that corresponding to k_{eff} + 3sigma = 0.95. A lower criticality clearance certificate (CCC) limit is then identified, typically half a safe mass. This represents the operational limit within which the plant would be required to operate. The plant may set even lower limits to ensure that the operational limit in the CCC will not be breached.		Modified text to provide example only		
38	Para 3.17, 3rd bullet	Move this bullet to the top of the list following hierarchy.		X			
39	Para 3.17, 4th bullet	Move this bullet to the end of Para 3.17 as standard text.	Bullet 4 is not a controlled parameter.		Moved text to 3.18, see also France		

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					comment no 13		
40	Factors affecting reactivity		The ability of temperature to affect reactivity should be acknowledged.	X	New para 3.27 added		
41	Para 3.20, 2nd sentence	Modify to read: "Hydrogen and carbon containing materials such as water, oil and graphite are common moderators……."	The modification gives the sentence a more logical and grammatically correct structure, e.g. given that graphite is a form of carbon.	X			
42	Para 3.20, 3rd sentence		The current wording describes beryllium as a "less common but can be a very effective moderator". Beryllium is not always an effective moderator, particularly in metallurgical plant applications, as demonstrated for example in the paper "Dispelling the myth of super-moderators", Monahan *et al*., Trans. Am. Nucl. Soc., November 2010. Clarification is needed.		Text modified to "….<u>can be</u> very effective moderators		
43	Para 3.21, 2nd sentence	Modify to read: "Material present outside the fissionable material……"	**Any** material present outside a fissionable material system has the potential to act as a neutron reflector relative to not having any material present.	X			
44	Para 3.21, 2nd sentence	Delete "has less neutron absorbing properties and"	Neutron absorbers can be very effective reflectors.	X			
45	Para 3.21, 3rd sentence	Consider rewording to read: "The amount of reactivity increase will depend upon the type, thickness, quantity,	Improve clarity.		Agreed. However sentence deleted by Belgium comment no		

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		density and location of the reflecting material."			36		
46	Para 3.21, 4th sentence	Modify to read: "…known as "total **or full** reflection."	In the UK this is normally termed "Full light water reflection".	X			
47	Para 3.22, 3rd sentence	Replace "they" with "this" to read: "…considered as this may result in a ……"	Typo	X			
48	Paras 3.23, 3.24 (and elsewhere – e.g. Para 5.16, 5.72, 5.88)	Delete "it should be noted that"	Superfluous text in nearly all cases (a general point throughout the document).			X	Subjective
49	Para 3.23, last line	Add the following sentence at the end of this paragraph: "Demonstration of the continued presence and effectiveness of neutron absorbers through plant lifetime should be considered."	The current text stops at testing prior to first use. The continued presence is also of key importance.		Text added as follows: "Demonstration of the continued presence and effectiveness of neutron absorbers throughout their operational lifetime should be considered."		
50	Para 3.25, 1st sentence	Replace "the" with "such" to read: "…should be considered as such interaction can ….."	Typo		Text modification as follows: "..should be considered because this interaction can affect….."		
51	Para 3.25, 3rd sentence	Replace "possible" with "practicable" or "reasonably practicable"	Some situations that are "possible" may not necessarily be practicable.	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
52	Para 3.27		The "operator" here seems to be significantly different from the "operator" mentioned in Para 2.6, 4th and 5th bullets. Clarification is needed.		Agreed. However using wording proposed in Belgium comment no 37		
53	Para 3.28, 1st sentence	Modify to read: "….measures should include**, but not be limited to,** consideration of:"	This modification should be applied elsewhere in this document wherever this phrase is used.	X			
54	Para 3.28, 12th bullet	Modify to read: "… operational occurrences (e.g. deviations from operating procedures, potential alterations in process or system conditions)…"	If it can be "anticipated", it cannot be "unforeseen".		"credible" used instead of "potential"		
55	Para 3.28, 20th (last) bullet		The meaning of the text in this bullet is unclear. What does it relate to? Is it Examination, Inspection, Maintenance and Testing related (like Para 3.41)? Clarification is needed.		e.g., this statement is intended to apply to design, procurement, administrative oversight of operations, and maintenance, inspection, examination, and testing		
56	Para 3.32 & 3.33	Replace "periodical" with "periodic" e.g. periodic inspection, etc.	The adjective is periodic rather than periodical. Improve grammar.	X			
57	Para 3.33, 3rd bullet	Delete "a" to read: "…for establishing periodical …."	Typo		Text added as follows: "…for establishing a periodic criticality safety training…"		
58	Para 3.34	Replace "trainings" with "training"	Typo	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
59	Para 3.34	Delete "flagged"	This word is superfluous and colloquial.	X			
60	Para 3.35, 1st bullet	Modify to read: "… documented ***criticality*** safety assessments …"	Criticality safety staff are not responsible for general safety.	X			
61	Para 3.35, 3rd bullet	Modify to read: "to specify and implement the criticality ***limits and conditions and required*** safety measures ***and support their implementation***;"	The criticality staff are not normally responsible for implementation of the safety measures as the facility manager or similar would have that responsibility; they would support him in this task. They are however responsible for defining limits and conditions and relevant safety measures required.	X			
62	Para 3.36		Is "tasks" the correct word to be used here? Is it a task "to stop work and report unsafe conditions"?	X			
63	Para 3.37, 7th bullet	Delete "written operating procedures should"	This text is unnecessary.	X			
64	Para 3.40, 5th bullet	Replace "The" with "the"	Typo	X			
65	Para 3.41, 4th sentence	Consider starting a new paragraph with 4th sentence "Other factors, which……."	This appears to move on to a different set of ideas from the start of the paragraph.	X			
66	Section 4		It is not easy to clearly differentiate between criticality safety "analysis" (paragraphs 4.20 – 4.28) and criticality safety "assessment" (paragraphs 4.5 – 4.19). It			X	The use of the terms assessment and analysis are consistent with their definitions in the IAEA Safety Glossary.

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			would help to have a two-column table to distinguish what is done in criticality safety assessment versus criticality safety analysis; a flowchart would also help.				
67	Para 4.5, 2nd sentence	Replace three instances of "during" to "prior to". Add "prior to" before "construction"	Assessment must be carried out prior to these activities not during. Arguably prior to all these phases except of course design.	X			
68	Para 4.6	Consider deleting "i.e. safety measures" to read: "…to develop appropriate limits and controls to prevent a criticality and to demonstrate…."	This paragraph is confusing to read because of the inclusion of the safety measures sub phrase. This results in a complex sentence. Consider modifying to improve clarity.		Text modified as follows: "….to document the appropriate limits and conditions and safety measures to prevent a criticality."		
69	Para 4.8	Modify to read: "…who are knowledgeable in all **relevant** aspects of criticality safety…."	Criticality staff at a uranium enrichment plant would not require knowledge of criticality issues relating to plutonium for example.	X			
70	Para 4.12, 1st sentence	Delete "assumptions about" to read: "Any assumptions about the operations and any associated systems…."	Text is unnecessary.	X			
71	Para 4.14, 2nd sentence	Modify to read: "….glove box rupture, **ventilation filter material build-up**, rack collapse….."	Consider rewording and reviewing the example list, because it is unclear what it is trying to add. If it is attempting to gain operational feedback on potential initiating events, then the list of		Text in Section 4 re-ordered in accordance with Finland comment no 4. Proposed		

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			examples is a strange mix. Consider adding "ventilation filter material build-up" to the list, as it would be easy to overlook.		modification incorporated into new Para 4.26 and examples deleted from original Para 4.14		
72	Para 4.16, (1), 4th sentence	Delete "Typical" to read: "Techniques available to .. .."	Improve English	X			
73	Para 4.16, (2)	Modify to read: "Input into the fault analysis …".	To distinguish from the criticality safety analysis discussed in Paras 4.20 et seq.		"Assessment" used instead of "analysis"		
74	Para 4.17, 1st sentence	Replace "utilizing" with "using"	Simplification.	X			
75	Para 4.17, 2nd sentence	Replace "in relation with" with "in accordance with"	Improve English.	X			
76	Para 4.17, 3rd sentence	Replace "separation" with "independence" to read: "…. determine their reliability, redundancy, diversity, independence, system…."	It is unclear what is meant by "separation". Consider modification to improve clarity.	X			
77	Para 4.21, 1st sentence	Replace "their predicted" with "the derived"	Computer codes do not make "predictions" they perform calculations.	X			
78	Para 4.21, 3rd sentence	Consider modifying to read: "Validation relates to the process of determining whether the overall calculation method adequately reflects the real system being modeled and enables the quantification of any calculation bias and uncertainty."	Improves readability.	X			
79	Para 4.26, 3rd bullet, 2nd sentence	Modify to read: "…for all materials include, but are not limited to:…."	Typo	X			

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80	Para 4.26, 3rd bullet, 5h bullet, 3rd sentence	Modify to read: "Common materials that can be effective moderators….."	Beryllium and graphite are not always effective moderators (see Comment 42).	X			
81	Para 4.26, 3rd bullet, 6th bullet		What is meant by a gradient of material? Clarification is needed.	X	Text added		
82	Para 4.27, 1st sentence	Delete "not bias" and modify to read: "…by making use of trends in the reactivity"	Correction.			X	Benchmarks are normally critical (i.e., k_{eff} = 1.0) and the trends in biases are being extrapolated.
83	Para 4.27, 2nd sentence	Delete "not bias" and modify to read: "…provide a better estimate of the reactivity"	Correction.			X	Benchmarks are normally critical (i.e., k_{eff} = 1.0) and the trends in biases are being extrapolated.
84	Para 4.27, 4th sentence	Modify to read: "An important aspect of this process is the quality of the basic nuclear data and its uncertainties."	Improve readability.	X			
85	Para 4.28	Transfer this paragraph to Para 4.24	The paragraph relates to "Verification", not "Validation".	X	Moved to new section which covers both verification and validation, see Finland comment no 4.		
86	Para 4.29	Delete this paragraph or explain the concept?	What is a unique or special safety measure? What is unique about them? The concept needs some explanation, or examples to improve clarification.	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
87	Para 4.29, 2nd sentence	Modify to read: "….with these measures should be specified, incorporated **and given prominence** in the design…"	The reader's attention needs to be drawn to such paragraphs.		Comment no longer relevant as the Para was deleted following comment no 86 above		
88	Paras 5.1-5.7	Consider deleting most of these paragraphs.	This section is general and repetitive of previous detail, with Paras 5.3 to 5.7 relating to safety assessment rather than safety measures. Para 5.5 surely does not need to be said in a guide!		General text in 5.3 retained, the rest have been deleted		
89	Para 5.2, 3rd sentence	Consider moving this sentence, ie "The facilities should be operated…." to after Para 5.7 or after Para 5.11 under a new subsection "Generic Issues"	It is too detailed a level to be present in Para 5.2.		Para deleted		
90	Paras 5.4-5.7	Delete "For both types of facility"	Superfluous text. This is already stated in Para 5.3 and does not need to be repeated a further four times.		Comment no longer relevant as Paras 5.4-5.7 deleted following comment 88 above		
91	Paras 5.8-5.11 Life cycle issues	Consider deleting all of Paras 5.8 to 5.11 but include the paragraph on ageing **(ie Para 5.9)** after Para 3.41 under the heading of "Reliability".	The topic again is safety assessment not safety measures.	X			
92	Para 5.15	Delete comma after "principally"	Typo	X			
93	Para 5.16, 2nd bullet	Modify to read: "….such as CO2, **foam, dry powders,** water and sand"	Do not use graphite to put out a fire! Suggest adding foam and dry powder.	X			
94	Para 5.20	Delete	We would expect that criticality controls between production campaigns would mirror the individual campaigns. It is difficult to		This is a generic practice moved to beginning of section 5.4		

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			envisage how fuel rods or assemblies would need extra identification. The paragraph appears to add no value.				
95	Paras 5.21-5.22		General query. Is there a need to mention ductwork minimum flow velocities to reduce the risk of build-up in ducts, so that fissionable material is collected at the ventilation filters, where it can be monitored? These minimum velocities have been used in vent system designs to avoid criticality risks.	X			
96	Para 5.22	Consider modifying to make the following point: If "dry" grinding is to be undertaken, measures should be in place to monitor the build-up of particulates, especially within gloveboxes.	Powders/grits could collect within the glovebox, etc, so special precautions may be necessary.			X	Addressed in 5.21
97	Para 5.23, 1st sentence	Modify to read: "…..however, the implementation of the **hierarchy of safety principles** should lead to consideration of control by other parameters…."	The choice of safety measures/control is not "defence in depth" it is the hierarchy of safety measures as described in Para 3.12.		Agreed. However, para deleted by Canada-AECL comment no 121		
98	Paras 5.24, 5.43, 5.47, etc	Move the 1st sentence "In addition to this guidance….." to Para 5.12.	To avoid continually repeating it.		Deleted offending text		
99	Paras 5.25-5.27	Consider deleting these paragraphs.	Other than the last sentence of Para 5.27, these three paragraphs are fairly common to any criticality assessment and add no value here.		Deleted 5.25 & 5.26 but kept 5.27		

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COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Country/Organisation: UK Member States Comments			Date: 19 May 2011				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
100	Para 5.25 et seq	Replace "fresh fuel" with "unirradiated fuel"	Is the phrase "fresh fuel" internationally recognized terminology? We suggest that "unirradiated" is the more usual and correct term.			X	Fresh fuel defined in IAEA Safety Glossary and includes unirradiated fuel.
101	Para 5.26, 3rd sentence	Modify to read: "….subject to practices for material control and constraints on the ~~criticality~~ configuration to ensure criticality safety."	To improve grammar and readability.	X	Has been deleted by comment 99		
102	Para 5.27, 1st sentence	Modify to read: "The storage area for fresh fuel should meet the ~~**sub-criticality**~~ requirements specified in the design **safety assessment** and should **remain** sub-critical at all times, even in the event of **credible** internal or external flooding or any other event considered **credible** in the design."	Grammar and terminology is inconsistent with the rest of the document. Also, only credible levels of internal flooding would be considered.	X			
103	Para 5.28		Is there a requirement to state that the absorbers are secured in place to maintain effectiveness in the event of geological events? This is mentioned in Para 5.18, but could be repeated here.			X	It is not necessary to restate this
104	Para 5.30, 3rd sentence	Modify to read: "There should be set procedures for controlling the transfer of moderating material into the fresh fuel storage area to ensure that sub-criticality will always be maintained, ~~**even if**~~ **this includes any** fire extinguishing materials ~~**are**~~ used.	Error in grammar, as written, the tow clauses do not follow on. Suggest changing the conjunction from "even if" to "this includes".		Para deleted by Canada-AECL comment no 127		
105	Para 5.35, 1st sentence	Replace "handing" with "handling"	Typo	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
106	Para 5.37, 5th sentence	Delete the sentence "In line with the recommended preference….."	The fact that any safety measure (soluble poison or otherwise) is not engineered, is not a reason to exclude it from the analysis, particularly under normal conditions when by definition it will be present. Adequate discussion is already included in paragraphs 5.37 and 5.38; limited credit may be able to be taken for such a safety measured and particular care should be taken in the fault analysis.	X			
107	Para 5.38, 3rd sentence	Replace "homogenous" with "homogeneous"	Typo	X			
108	Para 5.44, 3rd bullet	Delete the following text: "(e.g. reduction in use of soluble absorbers)"	The use of soluble absorbers is given as an example of a "less favourable" control than burnup credit. This is **not** the case in the UK, where the Regulator considers burnup credit extremely unfavourably.		Deleted entire bullet		
109	Para 5.45	Add a new bullet to cover justification of inclusion or exclusion of specific isotopes, e.g. fission products.	Burnup credit arguments can be based on all isotopes, or restricted to a subset, e.g. just fissile/fissionable isotopes. The approach adopted should be justified.	X			
110	Para 5.57, 5th sentence	Add to end of this paragraph: "It should not be assumed that leaks will be detected in sumps as they may evaporate and form solid accumulations over time.	The consideration of leaks should include slow leaks. It should not be assumed that leaks can be detected by	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
		Consideration should be made for inspection to prevent long-term build-up, especially in unmanned areas."	monitored safe geometry sumps. Possibly include a reference for a classic near-miss criticality example, …Leakage into the B205 Plutonium Evaporator Cell at Sellafield: HSE Investigation into the Leakage of Plutonium Nitrate into the Plutonium Evaporator ... Plant, Sellafield, on 8 September 1992, HSE Books, ISBN 978-0717607211.				
111	Para 5.63		Query. Would leakage of hydraulic fluids (oils, etc) from such shearing/cutting machines contribute to an increased risk of criticality? If so, should it be mentioned here that there is a possibility of criticality due to this fault path.		Cross reference made to Para 3.20.		
112	Para 5.63		As the fuel is usually stored in ponds linked to the shearing facility, should carry-over of water/increased humidity from the pond to the shearing area be an issue for consideration? If so, should it be mentioned here that there is a possibility of criticality due to this path.		Cross reference made to Para 3.20.		
113	Para 5.64, new bullet	Consider adding a new bullet: "Accountancy checks (in versus out)"	For completeness.	X	"Material balance checks" used 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
					consistent with China comment no 2		
114	Para 5.72	Consider modifying to read: "Wastes are commonly wrapped in materials that can act as more effective moderators than water, e.g. polyethylene, PVC. Such wraps are sometimes placed together and stored in arrays so that repartition of the fissionable material is heterogeneous."	Materials other than vinyl may be used. Also this paragraph is difficult to read.	X			
115	Para 5.73, 3rd sentence	Consider replacing "disposal" with "operations at a waste disposal facility".	The wording in this paragraph implies that package fissile limits should be determined by all phases of waste management, including "disposal". We are not sure that this is what is meant, considering the later text. Consider replacing "disposal" as suggested to improve clarity.	X			
116	Para 5.75	Consider adding the following: "Consideration of the consequences of a criticality post-closure is much different to that for say fuel stores or reprocessing plant where immediate deaths may be possible. Disruption of protection barriers and effects on transport mechanisms are likely to be more significant than the immediate effects of direct radiation from a criticality in a disposal facility post-closure."	For completeness.	X	Added as a Note because concept is independent of NCS Practices		
117	Para 5.79	Consider modifying to read: "The fissile inventory of spent fuel mainly	This paragraph is not clear. Consider modifying to	X			

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Country/Organisation: UK Member States Comments			Date: 19 May 2011				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		consists of the remaining ^{235}U and the plutonium isotopes ^{239}Pu and ^{241}Pu. Over the very long timescales considered within a post-closure safety case some reduction in the fissile inventory will occur due to radioactive decay processes. However such safety cases should also take account of the potential for degradation of engineered features of the waste packaging with consequential relocation and accumulation of fissionable and non-fissionable components. A full description of this evolution of package contents requires consideration of the geo-chemical processes involved, which are subject to significant uncertainties."	improve clarity.				
118	Para 5.80		While there is agreement for the last two sentences of this paragraph, we have issues with the earlier part, which talks in terms of an accident scenario (why?) and says that package degradation and relocation of material would not necessarily lead to criticality if the case had been based on water filled void and no burnup credit. What about change of geometry, accumulation with other relocated materials, etc? We would recommend that the last two sentences of this	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
			paragraph are retained with an additional sentence making the point that in the post-closure phase, package degradation will inevitably happen and that the potential for relocation and criticality should be considered.				
119	Para 5.80, 3rd sentence	Modify to read: "…and consequently more sophisticated analysis and controls in waste packaging **may** be required."	It does not necessarily follow that sophisticated analysis and controls will be required. This would be determined by the specific criticality assessment.		Sentenced deleted following comment no 118 above		
120	Paras 5.81 – 5.84 Decommissioning	Consider adding additional text: "The potential for unaccounted for fissile holds ups in potential accumulation sites, e.g. active lathe sumps, needs to be recognised and considered."	For completeness.	X			
121	Para 5.81	Consider deleting the first two sentences.	These sentences have no meaning in the context of this document. They either need to be reworded or deleted.	X			
122	Para 5.86	Add the following sentence to the end of this paragraph: "Where transport of fissile material is solely within a licensed nuclear site, it may be considered in the same manner as other nuclear operations on the site, in line with this guide."	It should be noted that transport within a licensed site is not subject to the transport regulations.		Additional text added for clarification		
123	Para 6.4, 2nd sentence	Modify to read: "Of the 22 world-wide criticality accidents that have been reported; all but one involved fissile materials in solutions or	The present text assertion that "one involved a slurry" is incorrect. At least 2 involved slurries: Electrostal 1965,	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
		slurries."	Novosibirsk 1997 – arguably Mayak 1957 also involved a slurry.				
124	Para 6.8 & 6.10	Replace reference to "Paras 6.48 & 6.49" with "Paras 6.49 and 6.50"	Incorrect paragraph numbers are referenced – they should not be Paras 6.48 and 6.49.		Cross referencing deleted		
125	Para 6.22, 1st sentence		Should the word "dose" read "fission yield". Clarification is needed.			X	The word, "dose", is correct and the determination "fission yield" is implicit to the process of determining dose.
126	Para 6.50, 1st bullet		These criteria differ from those in the Aspinall and Daniels report, which are used extensively in the UK.		No change		
127	Para 6.50, 1st bullet	Replace "foreseeable" with "reasonably foreseeable" OR replace "can initiate" with "can reasonably be expected to initiate"	The current wording is too stringent. It is always possible to "foresee" circumstances that could result in a criticality. However, these predictions may not be reasonable. The wording of the UK SAPS (UK regulatory guidance) explicitly states "reasonably expected". See T/AST/018, 7.2.1.	X	Replaced "foreseeable" with "credible"		
128	Paras 6.52 & 6.53	Move these paragraphs to the start of the section headed "Criticality Detection and Alarm Systems", before Para 6.49.	These two paragraphs relate to the need for a criticality alarm system and therefore belong at the start of the section before Para 6.49. They are not relevant to the performance and testing section.	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: Country/Organisation: UK Member States Comments			Date: 19 May 2011				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
129	Para 6.52, 2nd sentence	Replace "are present" with "may be present"	The presence of moderators or reflectors may be dependent on the event.	X			
130	Para 6.55, 4th bullet	Delete bullet	This bullet is blank – typo?	X			
131	Definitions: Depletion		Is the definition of "depletion" correct? Is there a typo?		Deleted		
132	Definitions: Irradiated Material		This definition is too broad. All material has been exposed to radiation. This must mean a certain amount (and possibly type) of radiation. This definition needs to be improved if included in the final version of safety guide.		Deleted – not used in document		
133	Definitions: k_{eff}		This definition needs to include mention of finite system or leakage otherwise you have defined k_{inf}. This definition needs to be improved if included in the final version of safety guide.		Deleted		
134	Definitions: Legacy Waste		The definition of Legacy Waste is limited to low-level waste and mixed low-level waste. It would be helpful if the term "mixed low-level waste" were defined.		Changed – mixed waste defined in IAEA Glossary		
135	Definitions	Consider including a description of sub-criticality.		X			
136	Hand-books and guides	Include ICSBEP Handbook	The ICSBEP Handbook is a key source of validation data.	X			

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: V Medvedev, S. Kondratyev, V. Khalimonchuck, Yu Kovbasenko Country/Organization: Ukraine/ State Scientific and Technical Center for Nuclear and Radiation Safety Date: April 14, 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	Safety Criteria and Safety Margins" Para 2.12 - 2.16	Add another para: "Based on experience in managing nuclear fissile material, it is expected that the effective neutron multiplication factor (keff + safety margins) should not exceed 0.95 in normal operation, anticipated operational occurrences and design-basis accidents for (fresh and spent) nuclear fuel transportation and storage systems."	Most countries (including Ukraine) request that the neutron multiplication factor keff is lower than 0.95, taking into account safety margins, as the main criterion of nuclear safety. The absence of this criterion in DS407 may further impair the nuclear safety of a number of nuclear fuel management systems			X	Different margins are required for different systems – see balance of text 2.12 – 2.16 (2.14)

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: V Medvedev, S. Kondratyev Country/Organization: Ukraine/ State Scientific and Technical Center for Nuclear and Radiation Safety Date: April 14, 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
	SAFETY CRITERIA AND SAFETY MARGINS Page 9	It is proposed to add "SAFETY PRINCIPLES" to the title of the section and supplement the section with the following" "Nuclear safety principles are to: • Prevent a self-sustained chain fission reaction; • Minimize consequences of a self-sustained chain fission reaction if occurred; • Prevent uncontrolled and unauthorized treatment, accumulation, movement, transfer and transport of nuclear fissile materials"	Add safety principles to safety criteria and margins		See text change of 1.4		
1	Para 2.12, Page 9	The list of controlled parameters: "Safety criteria based on the critical values of controlled parameters such as mass, volume, concentration, geometry, moderation, taking into account reflection, interaction and neutron absorption" should be supplemented with isotopic composition and density.	Supplement the list of controlled parameters.	X			
2	Para 3.17, Page 14	It is proposed to delete the parameter "Limitation on distance between separate criticality safe systems", which is an individual case of the parameter "Limitation of the geometry of the system to safe geometry".	Duplication of information.			X	Retained to ensure interaction is considered.

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: V Medvedev, S. Kondratyev Country/Organization: Ukraine/ State Scientific and Technical Center for Nuclear and Radiation Safety Date: April 14, 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
3	Handling and storage of fresh fuel Page 31	It is proposed to supplement the section "Handling and storage of fresh fuel" with the following provisions: "Nuclear safety in storage of fresh fuel is ensured by: • limitations on the location of fuel assemblies in packages, covers, racks; • limitations on the number of fuel assemblies in packages, covers, racks; • limitations on the number of packages and covers in a group; • limitations on the location of groups of packages, covers, racks; • use of heterogeneous absorbers; • monitoring over the location of fuel assemblies, packages, covers, racks; • monitoring over the presence of moderators."	Supplement requirements on safe handling of fresh fuel.			X	Adequately covered in 5.27
4	Spent fuel operations (prior to reprocessing, longer term storage or disposal) Page 32	It is proposed to supplement the subsection "Spent fuel operations" with the following: *Monitoring over the presence, state and composition of the cooling media in spent fuel storage facility.* A storage facility should be equipped with the following systems needed to ensure safety: water cooling; water treatment; process control	Supplement requirements on safe storage of spent fuel in reactor pool.			X	Adequately covered in 5.37 & 5.38 and in Ref. [31].

CRITICALITY SAFETY FOR FACILITIES AND ACTIVITIES HANDLING FISSIONABLE MATERIAL (DS407)

COMMENTS BY REVIEWER Reviewer: V Medvedev, S. Kondratyev Country/Organization: Ukraine/ State Scientific and Technical Center for Nuclear and Radiation Safety Date: April 14, 2011				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		(amount of homogeneous absorbers in racks; water level, temperature, water chemistry; amount of hydrogen in air); radiation monitoring; ventilation; pool filling and emptying; monitoring, collection and return of leaks; makeup.					
5	During transport Page 42	It is proposed to supplement the subsection "During transport" with the following: 1) "Packaging for storage and transport of nuclear fissile material should be safe due to their geometry or other design features". 2) "Packaging with nuclear fissile material should be reliably fixed on the vehicle to prevent its turnover or displacement in normal transport conditions: turning, bumping, braking and jolting. The speed of the vehicle should ensure safe transport."			Additional text added similar to proposed text.		
6	DEFINITIONS Page 54	It is proposed to supplement this section "DEFINITIONS" with the term "double contingency principle" and its definition.	Explain its meaning.			X	Refer to IAEA Safety Glossary
7							