DS 371 Storage of Spent Fuel (Draft Date: 6 July 2009)

COMMENTS BY REVIEWER Reviewer: Country/Organization: UK (NUSSC) / HSE (ND) Date: 18 September 2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	General		There have been many significant changes to DS 371, and we have been unable to carry out a thorough review within the specified timescale. Our experts have not been able to examine the new set of Annexes, which in our view therefore cannot be considered as complete or definitive.				
2	General	Recommend checking the English before the document is issued.	In parts, the English is not clear, there are some spelling mistakes (eg Para 6.3 (e) "born dilution" should read “boron dilution”), and in other parts, the document is verbose.	X			
3	General	Recommend reviewing the list of Contents against the document to ensure that all titled sections are included.	The list of Contents does not include all of the headings in the text of the document. For example, under Section 3 Roles and Responsibilities, there is no reference to	X Will be addres sed in final ediitng			

			either the “Responsibilities of the Regulatory Body” or the "Responsibilities of the Spent Fuel Owner".				
4	General		GSRs have been introduced into the text. Clearly, these were developed for radioactive waste and lifted across without change into DS 371. It is not clear in DS 371 what they are, or what is their status. Also, the comparability of spent fuel and radioactive waste in the context of DS 371 needs to be set down clearly. This is particularly important as elsewhere in the document, there are strong statements to the contrary that spent fuel is not radioactive waste until designated as waste if or when it is for disposal. Footnote 4 on Page 7 refers to Para 1.1, which states that "spent fuel is considered as a waste	Concept essentially adoipted from joint convention which recognizes that spent fuel can be recognized as a waste or as a resource depending on national approach, but the safety issues			

			in some circumstances". The hazard and potential risk from spent fuel both for safety and security are greater than that of most waste forms and, as such, the operational requirements and thoroughness of the supporting safety case may be significantly different. By implying that it is either similar or a special category of waste, there is the danger that there will be an incorrect perception of the risk and hazard from spent fuel. Therefore, we consider that the use of GSRs in DS 371 should be explained clearly. They should also be reviewed and those that are irrelevant or not very relevant should be deleted.	remain the same either way.			
5	General		A previous comment made by the UK on the need for "contingency" was not accepted; it was argued that this	Contingencies for e.g. degraded fuel			

			was covered under emergency plans. We consider strongly that contingency is an important principle for spent fuel. Spent fuel is usually stored for a very long period of time pending decisions on disposition. The quantities can be large and handling and other operations with spent fuel often take time and are difficult, owing to the fact that it is a significant hazard. If spent fuel has degraded, it is very difficult to handle. There is uncertainty about the continued integrity of cladding and containment owing to the length of storage. Also, after a long period of storage, direct knowledge of that particular fuel type and handling may no longer be available, and therefore, this will add to the difficulties of responding to an emergency. Rather than try to develop a	are included and for e.g. equipment failure. As indicated in later comment however, integrity of cladding should be preserved.			

			solution to a problem while under pressure during an emergency situation, we believe that contingency options and plans should always be available should a problem start to develop. This is a conservative approach. Steps should be taken a long time before an emergency situation arises, and the option of implementation of a contingency plan to restore safe, passive storage should be available.				
6	General		A Glossary would be a helpful addition to DS 371. Particularly, the word "casks" is frequently used but in some statements it might also be meant as a generic term covering for example, "canisters". Rather than "casks" we consider that "packages" would be a better generic term unless a statement is specific to "casks".	Policy is not to have document specific glossaries – the issue was debated by consultants and the			

				preferred term adopted was cask.			
7	Para 2.3	Modify to read: "….all sources of exposures that could arise from current activities **with spent fuel** at the site, leaving……"	Improve clarity	X			
8	Para 4.6, 1st sentence		The phrase "…*and the necessary infrastructure within the working environment*" needs clarification.	X			
9	Requirement 22 (page 14)		This Requirement refers to "*some recommendations to be developed*". This either needs some explanation or the phrase should be deleted.	X			
10	Para 5.1, 3rd sentence	Consider replacing "in the end of storage casks being used there" with "if casks are used, there" to read: "If casks are used, there may be one or separate……"	Improve English	X			
11	Para 5.10		While the design should take benefit from clay layers etc, this should not be seen as a barrier by the safety case. If it has leaked, then there is a			X	Whilst not necessarily a design feature per se – it would provide some benefit.

			loss of containment - a loss of control - and this should not be acceptable. The aim of the safety case should be to ensure that there is proper control of the hazard.				
12	Para 5.19, 5th sentence		The use of the terminology "non-radiological hazards" is unclear. There are internal hazards (such as fire) and external hazards (such as seismic) that are potential initiating events that could give rise to a loss of containment and a radiological release. Therefore, the safety case needs to consider all potential initiating events. Corrosion and flammability are intrinsic properties to the fuel that, without adequate steps being taken, will lead to loss of containment and radiological release. The non-radiological aspect is the chemical toxicity of the fuel to humans. But for spent	X	Text removed		

			fuel, this is outweighed by the severe radiological toxicity.				
13	Para 6.32	Recommend adding a sentence, warning that there is a need to consider routine fuel movements, which could bring the fuel being moved into close proximity to stored fuel or where during movement, the fuel if it was dropped could fall onto stored fuel.	It is also important to consider the way routine fuel movements are carried out in a storage pond, to avoid the possibility of a criticality due to fuel being moved too close to stored fuel.	X			
14	Para 6.34, 2nd sentence	Consider replacing "a reasonably conservative estimate" with "a conservative estimate" to read: "**A conservative estimate** should be made of….."	We would always expect demonstrably conservative estimates to be made with respect to criticality.	X			
15	Para 6.34, (d)	Consider rewording to read: "Optimum moderation should be assumed for operational states and accident conditions to provide a pessimistic assessment of criticality."	Reword to improve clarity.	X			
16	Para 6.38		The integrity of the heat removal system is also important. Tube failures and leaks in the system should not be able to provide a path for chemical species detrimental to either fuel or containment integrity, such as chloride ions, to enter a spent fuel storage pond.		X 6.23 added under structural integrity		

17	Para 6.42	Strongly recommend replacing this paragraph with the version of Para 6.42 contained in the draft of DS 371 dated 2008-02-11.	Fundamentally, we disagree with this. The loss of containment due to failure of the cladding should be avoided at all costs. The cladding is the primary containment for the hazard, ie the nuclear material. If cladding failure is foreseeable, then different storage arrangements should be developed.	X Text modified			
18	Para 6.105	Consider modifying this paragraph to include a recommendation that inspection and monitoring be carried out.	An important purpose of monitoring and inspection is to look for the unforeseen. It is difficult to see how not carrying out some monitoring/inspection can be justified.	X			
19	Para 6.111	Consider adding another bullet point: “Maintenance, inspection and testing”	This would ensure the provision of maintenance to support the continued integrity of the secondary containment (pond, cask etc) and to monitor ageing and obsolescence.	X			
20	Para 6.132, 3rd sentence		The meaning of "*the monitoring of stored object*" is not clear.	X			
21	Appendix I,	Recommend deleting the	We disagree that	Opposi			

	Para I.3, 2nd sentence	following sentence: "Nevertheless in the criticality safety study of pool storage the use of soluble neutron poison should be avoided."	soluble neutron poisons should be avoided. This appears to be inconsistent with statements made elsewhere in the document. For example, Para 6.34(e) allows credit for soluble boron. However, the levels of poison would need to be monitored and maintained.	ng opinions have been expressed. Will have to be discussed by SSCs.			

COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety** (BMU) Page 1 of 6 Country/Organization: Germany Date: September 17, 2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.1 (p. 1)	change 2nd sentence: „Spent fuel is considered as a waste in some circumstances or as a potential future energy resource in others and as such, management options may involve direct disposal (generally known as the ‘once through fuel cycle’) or reprocessing (generally known as the ‘closed fuel cycle’).“	logical sequence; adjustment to the wording in WS-G-2.6 (para 1.4)	X			
2	3.28 (p. 10)	cite ref. [20] in the 1st sentence: „… The operator should draw up emergency plans based on the potential radiological impacts of accidents [20, 21] and …“	text also refers to GS-R-2	X			
3	5.22 (f) (p. 19)	change 2nd sentence: „If necessary, the design of the spent fuel storage facility has to be modified and the safety assessment has to be updated.“	to stress the need for a revision of the safety concept in some cases	X			
4	6.13 (p. 26)	- cited ref. [34] is wrong -	the concept of defence in depth is not even mentioned in WS-G-2.5; text refers to WS-G-2.6 (para 5.2)	X	Reference 34 changed to WS-G-2.6		

5	6.14 (p. 26)	- cited ref. [34] is wrong -	the concept of defence in depth is not even mentioned in WS-G-2.5; text refers to WS-G-2.6 (para 5.2)	X	Reference 34 changed to WS-G-2.6		

Draft Safety Guide „Storage of Spent Fuel“ (DS371), Version 2009-07-06

COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety** (BMU) Page 1 of 6 Country/Organization: Germany Date: September 17, 2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
6	ref. [34] (p. 77)	replace [34] in the list of references: [34] INTERNATIONAL ATOMIC ENERGY AGENCY, Predisposal Management of High Level Radioactive Waste, IAEA Safety Standards Series No. WS-G-2.6, IAEA, Vienna (2003)	see comments to paras 6.13 and 6.14	X			
7	6.31 (p. 29)	change 1st sentence: „…, additional means such as fixed neutron absorbers and/or burnup credit (see Appendix II paras. 7 - 9) could be used.“	to emphasize that, in individual cases, even <u>both</u> methods could be required to maintain the subcriticality of spent fuel; only paras II.7 - II.9 refer to burnup credit	X			
8	6.33	change 2nd sentence:	this safety margin	X			

	(p. 29)	„A 5% margin, after inclusion of all uncertainties in the calculations and data, is being applied in many member states.“	is still in use; to emphasize the necessity to include <u>all</u> uncertainties				
9	6.34 (a) (p. 30)	change 2nd sentence: „Alternatively the highest enrichment may be used to conservatively characterise the fuel assembly.“	clarification	X			
10	6.34 (e) (p. 30)	1st sentence: replace „born“ by „boron“	typing error	X			

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COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety** (BMU) Page 1 of 6 Country/Organization: Germany Date: September 17, 2009							
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
11	6.34 (d) (p. 30)	change 1st sentence: „Optimum moderation and reflection should be assumed for operational states and accident conditions …“ add 4rd sentence: „… drying of a cask. Flooding should be assumed in dry storage situations.“	to combine with 6.34 (f) (both sections belong together technically)	X			
12	6.34 (f) (p. 30)	- add content to 6.34 (d) and delete section -	sections (d) and (f) belong together technically	X			
13	6.34	- both sections should be integrated into	sections (i) and (j)	X			

	(i,j) (p. 30)	a single section -	belong together technically				
14	6.34 (k) (p. 31)	add 3rd sentence: „… depletion level. For burnup credit application in long term storage the possible change of the nuclide composition of the spent fuel with storage time has to be taken into account.“	radioactive decay can change the inventory with regard to criticality analyses	X			
15	6.49, 6.50 (p. 27)	- move both paras to page 35 -	wrong sequence of paras in the draft text			X	They were moved to that section as it was considered the points were more related to structural integrity than layout .Numbers will be changed.
16	6.51.	(i) Controls and tools should be designed user-friendly and ergonomically. (j) Mistaking of tools should be avoided by design. (k) The environmental conditions (noise, brightness) should allow for optimal conditions of work.	All proposals are resulting from German operational experience. See also the “IRS Topical Study on Events connected to Fuel Handling at Nuclear Power Plants (June 2006)”.	X			
17	6.62 (p. 38)	replace [34] by [33]	cited ref. [34] is wrong; text refers to NS-G-1.7	X			

			(paras 6.5 - 6.10)				

Draft Safety Guide „Storage of Spent Fuel“ (DS371), Version 2009-07-06

COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety** (BMU) Page 1 of 6 Country/Organization: Germany Date: September 17, 2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
18	6.65 (p. 38)	replace [34] by [33]	cited ref. [34] is wrong; text refers to NS-G-1.7	X			
19	6.103 (p. 46)	replace [19] by [20]	cited ref. [19] is wrong; text refers to GS-R-2 (paras 5.19 - 5.20)	X			
20	6.119 TABLE 2	Brake systems, interlocks, mechanical integrity, load testing, **overload protection, signaling**		X			
21	6.131 (p. 53)	add 2nd sentence: „… licensing requirements. Sealable casks or containers of approved design for leaking or damaged fuel assemblies should be readily available.“	to substantiate the handling of leaking or damaged fuel assemblies	X			
22	I.2 (p. 59)	add 2nd sentence: „… during such conditions. For water storage pools subcriticality should be demonstrated under all credible water densities including events for which boiling of pool water cannot be excluded.“	clarification	X			

23	I.22	Fuel should be handled by equipment that minimizes the potential for a drop accident. Overraising of spent fuel or other components should be prevented by design features and/or by incorporating dedicated interlocks to inhibit hoist motion in the event that high radiation fields are detected. This should include use of single failure-proof cranes and positive. locking mechanisms on fuel assembly grapples and hooks. **Operator failures should be avoided by applying the four-eyes-principle or check lists**		X			
24	I.24 (p. 63)	change 2nd sentence, cite ref. [36]: „… to prevent boron dilution or boron crystallization where soluble boron is used for criticality control [35, 36]."	prevention of boron crystallization by maintaining pool temperatures above a minimum level; text refers to NS-G-2.5 (para 5.13) and NS-G-4.3 (para 6.11)	X			

COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety** (BMU) Page 1 of 6 Country/Organization: Germany Date: September 17, 2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
25	ref. [35] (p. 77)	[35] INTERNATIONAL ATOMIC ENERGY AGENCY, Core Management and Fuel Handling for Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-2.5, IAEA, Vienna (2002)	add [35] to the list of references (see comment to para I.24)				
26	ref. [36] (p. 77)	[36] INTERNATIONAL ATOMIC ENERGY AGENCY, Core Management and Fuel Handling for Research Reactors, IAEA Safety Standards Series No. NS-G-4.3, IAEA, Vienna (2008)	add [36] to the list of references (see comment to para I.24)				
27	I.33 (p. 64)	- add footnote No. 3 in the footer -	footnote No. 3 is not itemized in the footer				
28	I.68 (a) (p. 70)	„Handling errors when closing or sealing dry storage casks/containers;“	clarification of „dry storage structures“				
29	I.69 (p. 70)	- add footnote No. 5 in the footer -	footnote No. 5 is not itemized in the footer				
30	II.3 (p. 71)	change 2nd sentence: „For the nuclear reactivity analysis special consideration has to be given in the nuclide vector of plutonium as well as in the definition of an enveloping plutonium and uranium ratio.“	criticality analysis of MOX fuel requires knowledge of plutonium nuclide vector				
31	II.7	add new 4rd sentence:	important				

	(p. 72)	„… international standards. This applies to both inventory determination calculations and criticality calculations. A licence …“	additional information for clarification				

COMMENTS BY REVIEWER Reviewer: **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety** (BMU) Page 1 of 6 Country/Organization: Germany Date: September 17, 2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
32	II.8 (p. 72)	change 3rd sentence: „… subcritical conditions. The minimum required burnup value should be verified by independent measures.“	clarification				
33	II.10 (p. 72)	change 3rd sentence: „Issues related specifically to the storage of research reactor fuel, e.g. lower heat generation, higher enrichment and less corrosion-resistant cladding materials, need particular attention.“	adjustment to the wording in para 1.5 (the same features are highlighted there); use of less corrosion-resistant cladding materials is a specific issue in research reactors				
34	II.11 (p. 72)	3rd sentence: replace „SS“ by „stainless steel“	clarification of abbreviation „SS“				
35	II.17 (p. 73)	change 2nd sentence: „This may require placement in a suitably designed canister and specific treatment prior to transferring to the dry storage facility.“	coherent sentence construction				
36	ref. [11] (p. 75)	replace „WS-RG-2.7“ by „WS-G-2.7“	typing error				
37	ref. [20] (p. 75)	- see comments to paras 3.28 and 6.103 -	ref. [20] is not cited in the draft				

			text				
38	ref. [32] (p. 76)	- check the relevance of this reference -	ref. [32] is not cited in the draft text				

TITLE : DS 471 Storage of spent fuel – 2008-07-06

COMMENTS BY REVIEWER Reviewer: F. Féron Page Country/Organization: France/ASN Date: 28/08/2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1.	4.2/5	Delete “long term management”	It seems strange to still have things to do after decommissioning….	X			
2.	5.22 (m)	At the end, add “and a programme of surveillance of the stored spent fuel assemblies”	Clarification to ensure that no only storage conditions but also stored items are included in the surveillance programme.		X – Modified to add as appropriate – for sealed casks it may not be possible.		
3.	Page 24	Update section numbering after 6.4	Section 6.5 is missing	X			
4.	6.42/7	After “static barrier.” add “As far as possible, each containment barrier should be monitored”.	Effectiveness of each barrier should be verified.	X			
5.	6.45 (e)	At the end, replace “.” by “;”	Typo	X			
6.	6.47 (h)/2	Replace “an” by “a”	Typo	X			

COMMENTS BY REVIEWER Reviewer: F. Féron Page Country/Organization: France/ASN Date: 28/08/2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
7.	I.3	Replace I.3 by : “In the criticality safety study of pool storage, the use of soluble neutron poison should be avoided. If this is not possible or if the operating organization choose to use soluble neutron poison such as borated water, the design of the facility should include engineering features to preclude an increase in the reactivity of stored fuel caused by the inadvertent dilution of the pool water by the addition of nonborated water where soluble boron is used for criticality control.”	The avoidance of soluble poison should be first. However, if borated water is used, there is a need for engineered feature.	X			
8.	I.10	At the end of I.10, add “Furthermore, mixing spent fuels in a same zone with different limits or control mode for criticality should be avoided.”	Consider adding the following recommendation	X			
9.	I.24	Replace I.24 by : “Where soluble boron is used for criticality control, operational controls should be implemented to maintain water conditions in accordance with specified values of temperature, pH, redox, activity, and other applicable chemical and physical characteristics so as to prevent boron dilution [35].”	To be consistent with comment 7.	X			

COMMENTS BY REVIEWER Reviewer: F. Féron Page Country/Organization: France/ASN Date: 28/08/2009				RESOLUTION			
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
10.	/						
/	/						

COMMENTS BY REVIEWER Reviewer: H. Tezuka, T. Nakata Country Organization; Japan, JNES			Date 28 / August/ 2009	RESOLUTION			
Comment No.	Para./Line No.	Comments/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modif./rejection
1.	Chapter 6 Defence in depth	This sub-heading and its contents should be moved under the heading GENERAL in Chapter 6.	Defence in depth concept is general aspect.			X	It is generally a design consideration
2.	6.13	Delete the first sentence and replace the last sentence that the US proposed in Jne 2009.	The US proposal is preferable.			X	Standard use concept of failure leading to accidents
3.	6.15	Support the US comment on 6.15: Move first two sentences to section on Structural Integrity; Clarify the phrase: ".the provision of specific systems should be planned..."	The IAEA resolution in not very much justified. The first 2 sentences do fit for engineered safety features more than defence in depth. If the suitable place is not found for these sentences, they can be deleted as the content is obvious.	X			
4.	6.16	Delete this para.	This paragraph concerns not defence in depth but layout. Besides the concept is repeating of (g) and (h) of para. 6.47.			x	Specific request from US to emphasis reserve capacity - an element of defence in depth
5.	6.20	Delete this para.	The 1st sentence is repeating of the last sentence of para.6.1.	X			

COMMENTS BY REVIEWER Reviewer: H. Tezuka, T. Nakata Country Organization; Japan, JNES			Date 28 / August/ 2009	RESOLUTION			
Comment No.	Para./Line No.	Comments/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modif./rejection
			The 2nd sentence is repeating of (g) and (j) of para. 6.3.				
6.	6.49	Delete this para.	The concept of this para. fits rather to "general" than "structural integrity". This can be moved under 'General' however as there is already the same concept in para. 6.1, this can be deleted.	X			
7.	6.32/4-7	~~The possible consequences of such occurrences and their possible consequences should be evaluated using reliable data and verified and validated methodologies. If warranted, appropriate mitigating measures should be provided to ensure that subcriticality will be maintained under all such conditions.~~	For a storage facility it is not necessary to evaluate the consequence of criticality accident due to the reason that the actual spent fuels are enough sub-critical and that the possibility of criticality accident is very low to occur.			X	Could be influenced by both external internal initiating events ????

COMMENTS BY REVIEWER Reviewer: H. Tezuka, T. Nakata Country Organization; Japan, JNES			Date 28 / August/ 2009	RESOLUTION			
Comment No.	Para./Line No.	Comments/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modif./rejection
8.	6.33/3-4	~~A 5% margin, after inclusion of the uncertainties in the calculations and data, has been used in many Member States.~~	In Japan, usually 5% margin is accepted for the regulatory body and sometimes 2% margin is also accepted for reliable calculations. So this explanation is not adequate as for a general example.			X	Specific request for 5 % margin ??????
9.	6.34(a)/1	~~(of U-235)~~ (of fissile materials)	For MOX fuel important fissile is not only U-235.	X			
10.	6.34(d)/1-3	~~bearing in mind that the maximum keff should be evaluated based on a credible moderator density, which may not be optimum, if achieving optimum moderation is not credible~~	Redundant. Besides this is a common sense for any persons who related criticality.			X	Specific request for inclusion - Germany
11.	6.34(d)/4-6	~~The highest nuclear reactivity may be reached at some intermediate density, for example, if water in the pool begins to boil due to failure of the heat removal system or during drying of a cask.~~	Redundant. Besides this is a common sense for any persons who related criticality.			X	Ditto
12.	6.34(f)/1-2	~~(f) Neutron moderation and reflection should be~~	Duplicated to 6.33 and 6.34(d).	X			

COMMENTS BY REVIEWER Reviewer: H. Tezuka, T. Nakata Country Organization; Japan, JNES Date 28 / August/ 2009				RESOLUTION			
Comment No.	Para./Line No.	Comments/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modif./rejection
		~~considered. Flooding should be assumed in dry storage situations.~~					
13.	6.34(i)/	Replace the content with the following: (i) The reactivity changes of the fuel assembly with burn-up may be included appropriately.	For criticality, it is important to consider not only the neutron absorbing characteristics but also neutron reflection and fuel composition changes.	X			
14.	6.36/3-6	Delete the following 2 sentences: ~~For example, spent fuel from fast reactors may have higher multiplication properties than fresh fuel with an initial enrichment. In such instances the assumption of fuel with the highest enrichment may not be conservative.~~ Insert the following sentence instead: For example, BWR fuel with burnable poison may have higher reactivity by burning of poison.	Current example is not correct because in a typical FBR the reactivity of in-core fuel is decreased slightly though that of blanket fuel is increased. Reactivity recover of BWR fuel with burning of burnable poison may be a better example.	X			
15.	6.36/3-6	~~Also, uranium thorium mixed oxide fuel or fuel from research reactors may have very complicated properties that need to be considered.~~	Redundant.			X	Not evident

COMMENTS BY REVIEWER Reviewer: H. Tezuka, T. Nakata Country Organization; Japan, JNES			Date 28 / August/ 2009	RESOLUTION			
Comment No.	Para./Line No.	Comments/Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modif./rejection
16.	I.3	Delete the last sentence that starts with nevertheless.	The last sentence is incorrect for PWRs. Soluble boron is used in PWR fuel storage pools of which boron concentration is usually 2200-2500 ppm. Avoiding the effect of soluble neutron poison in the criticality safety study is quite impractical, where soluble boron is used.	X			

ENISS Comments on the IAEA Draft Safety Guide DS371 "Storage of Spent Fuel" (as of 06 07 09)

COMMENTS BY REVIEWER				RESOLUTION			
Reviewer: W. Zaiss Country/Organization: ENISS			Page 1 of 8 Date:18 Sept. 2009				
Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	New proposal (ENISS Secretariat)
General comments	The scope of this guide covers storage of spent fuel. Therefore all terms regarding encapsulation, dismantling and conditioning of spent fuel should be avoided. The document uses the term "generator of spent fuel" when in most cases the responsibility rests with the "owner of spent fuel". Financial issues are dealt with in related IAEA Safety Requirements and as such only one general statement should be made in this guide (e.g. 3.26) In a few cases retrievability of spent fuel or of spent fuel packages is addressed as "function". In our opinion, retrievability is not a function, but a requirement to be considered in the design of the spent fuel storage facility.						
1	2.1	In particular, the radiation protection of any person who is exposed as a consequence of the storage of spent fuel storage	To make it clear that optimization is the primary principle of radiation protection			X	Constrained optimization is a requirement.

		of spent fuel ~~is required to be within specified dose limits and is to be optimized with due regard to dose constraints.~~ should be optimized and estimated within specified dose limits.	system and should be applied under all circumstances, not only for dose constraint.				
2	3.26	Modify the first sentence to "The operating organization or the owners of the spent fuel as appropriate, should ..."	See the general comments			X	Operator is responsible for the facility and its operation regardless were funding comes from
3	4.7	~~The generator~~ The owner of the spent fuel would fund its management.	For clarification	X			
4	4.8	~~Management systems for spent fuel management activities should include provisions to deal with several funding challenges: (a) For various reasons (e.g. bankruptcy, cessation of business), it may not be feasible to obtain the necessary funds from the spent fuel generator, especially if funds were not set aside at the time the benefits were received from the activity, or if ownership has been transferred to other parties. (b) If funds are to come from public sources, this will compete with~~	3.26 clearly states the requirement for funding to ensure the safe storage of spent fuel. This text is too detailed for a guide on safety. See also general comment			X	Text approved by WASSC and no comment from NUSSC.

		~~other demands for public funding, and it may be difficult to gain access to adequate funds on a timely basis. (c) It may be difficult to make realistic estimates of costs for spent fuel management activities that are still in the planning stage and for which no experience has been accumulated. (d) It may be difficult to estimate anticipated costs for activities that will only begin in the long term, because they will depend strongly on assumptions made about future inflation rates, bank interest rates and technological developments. (e) It may be difficult to set appropriate risk and contingency factors to be built into estimates of future costs, owing to the uncertainty associated with unforeseeable future changes in societal demands, political imperatives, public opinion and the nature of unplanned events that may require resources for dealing with them. (f) If several organizations are involved in the spent fuel management activities, the necessary financial arrangements may be complex and variable. The establishment of an adequate degree of confidence in all the~~					

		~~arrangements so that the necessary continuity of funding throughout the entire series of activities is ensured may be problematic.~~					
5	5.8	The operator should demonstrate ~~as soon as possible that, to the extent possible,~~ the safety , using as much as possible passive safety features ~~are applied~~	The operator has to demonstrate safety and not that he has used passive safety features to the possible extent			X	Demonstrating safety is addressed – this is specifically dealing with passive safety. The text has been approved by WASSC and no comment from NUSSC.
6	5.9	The safety case should explain and justify the functions provided by each barrier and identify the time periods over which they are expected to perform their various safety functions and also ~~the alternative or additional safety functions that operate~~ the way safety is ensured if a barrier does not fully perform.	It is not always necessary to have additional safety functions to manage properly that case.			X	It is requiring an explanation how the defence in depth concept has been implemented. The text has also been agreed by WASSC and no comment from NUSSC.
7	5.22 (d)	An evaluation of hazards and scenarios ~~to include screening of their combinations~~ that may result in the release of radioactive material, to eliminate those of insufficient likelihood or	Any combination of hazards has not to be considered ; it is much clearer in 6.34 item e) : “two unlikely independent and		X		

		consequence.	concurrent incidents are beyond the scope of required analysis"				
8	5.27 (a)	a) When there is any significant change to the installation or permitted radioactive inventory that affects safety	The inventory is going to change with movements of spent fuel in or out of the facility. It should not matter as long as it is within the safety case envelope	X			
9	6.1	…….to ensure removal of residual heat and to ensure retrievability of the spent fuel or spent fuel packages (casks) These safety ~~functions~~ objectives should be maintained during all operational states and accident conditions, taking into account external hazards."	Recommendation should be applicable to wet and dry storage facilities. (to be in line with 6.3 (g), 6.139, 6.140 and 6.141 ENISS comment was accepted in the resolution but not changed here in the document. The retrievability of spent fuel is not a safety function, but a functional objective	X		x	The safety objective is addressed in 2.1 – it derives from the fundamentals.
10	6.3	The storage facility should be designed to fulfill the fundamental safety functions, i.e. control of subcriticality, removal of heat, containment of the radioactive material, ~~retrievability~~ and shielding of radiation. Retrievability of spent fuel or of the spent fuel package should	The retrievability of spent fuel is not a fundamental safety function. To be in accordance with 6.139, 6.140 and 6.141			X	Ditto

		also be considered. The design features should at least, if possible, include the following: If possible, systems for heat removal from the spent fuel should be driven by the energy generated by the spent fuel itself (e.g. natural convection);					
11	6.3 (h)	The spent fuel or spent fuel package (cask) and the storage system should be sufficiently resistant to degradation	This recommendation should be applicable for wet and dry storage (to be in line with 6.3.g, 6.139, 6.140 and 6.141) ENISS comment was accepted in the resolution but not changed in the document.			x	Spent fuel cask is part of the storage system.
12	6.18	… ~~and should be verified using appropriate methods.~~	Not appropriate as a general recommendation especially for dry storage where inspection of fuel assemblies is not appropriate		X Text changed.		
13	6.47(g)	Space should be provided to permit the inspection of spent fuel or spent fuel packages (casks) and inspection and maintenance of components, including spent fuel handling equipment;	Also spent fuel storage in casks should be addressed to be in line with 6.139, 6.140 and 6.141 See also comment to 6.1 and 6.3 (h)	X			

14	6.47(j)	….addressed. ~~in the layout of the facility~~	The encapsulation and conditioning facility may not be part of the spent fuel storage.			X	Indicates “possible” needs for ….
15	6.62	Ventilation systems should satisfy the recommendations of Ref. [334] using a grading approach. ~~Their operation should be compatible with fire protection requirements.~~	We suggest adding a graded approach as ref 33 (not 34) is related to NPPs. Delete the last sentence as in a guide there is no requirement.			X	Graded approach applies throughout. Reason for suggested deletion is not clear.
16	6.65	The operation of the fuel handling and storage areas should be carried out in accordance with the fire protection recommendations of Ref. [334] considering the graded approach. Fire protection measures should be operated in such a way as to limit the risk of damage due to fires to personnel, items important to safety, spent fuel storage areas, spent fuel handling systems and supporting systems.	We suggest adding a graded approach as ref 33(not 34) is related to NPPs			X	Ditto
17	6.101	Where appropriate operational procedures should be developed for spent fuel storage containment systems (e.g. closure seals on storage containers and canisters, and	Not applicable for dry storage in **welded** casks so should be changed to where appropriate. See I.69			X	Some form of monitoring would be put in place even for welded dry casks – this would follow a

		ventilation and filtration systems) to provide monitoring capability. This monitoring should be such that the operating organization will be able to determine when corrective action is needed to maintain safe storage conditions.					documented procedure.
18	6.141	After storage, in case of wet storage, the integrity of the spent fuel and in case of dry storage, the storage/transport casks and associated paperwork has to be examined before transport. The following issues should be checked: (e) In case of the wet storage nuclear safety issues, such as any degradation of the spent fuel itself, the spent fuel support structure and the neutron shielding materials.	For clarification This issue can be performed easily for wet storage facilities. In case of containers there are implemented measures that monitor situation inside the containers. Risk connected with a such spent fuel manipulation is not counterbalanced by adequate benefits.		X "examined" changed to "considered"		

Title: DS-371 - Storage of spent Fuel

COMMENTS BY REVIEWER		RESOLUTION
Reviewer: PNRA	Page.... of....	
Country/Organization: Pakistan	Date:	

Comment No.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/ rejection
1.	2.2	……..Particularly in this case the regulatory body should require the operating organization(s) of the nuclear installation on the site to develop constraints, subject to regulatory approval, or ~~in some cases~~ the regulatory body may establish the dose constraint(s). Requirements on dose constraints are provided in Ref. [10] and guidance in Ref [11].	For better clarity. Otherwise, the some cases for which the regulatory authority may establish the dose constraint should be defined..	X			
2.	5. 22	A facility specific safety case would include different aspect as described in guide. Following point may also be included in para 5.2. **v) Verification of Shielding calculation for spent fuel pool area.**	As all other safety aspects are discussed and this is one of the important safety aspects. So this point may be included.		X added to (m)		
3.		New para may be added in decommissioning of spent fuel facilities.: **The operating organization should ensure the protection of both workers and members of the public against exposure during decommissioning.**	Protection of both workers and members of the public against exposure during decommissioning should also be mentioned.	X			

4.	General	The paragraph 6.82 is missing. Either to add the para 6.82 or to correct the paragraph numbering after para 6.81.	Typo error.				

Comments on IAEA Draft Safety Guide "Storage of Spent Fuel" (DS371)

COMMENTS BY REVIEWER Reviewer: NUSSC Country/Organization: United States of America / NUSSC Date: September 21, 2009				RESOLUTION			
Comment No. / Reviewer	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
1	1.9 / 4	"…operational activities ~~of a nuclear reactor or~~ a spent fuel reprocessing facility, which is addressed in…"	Contradicts previous guidance in 1.9/1-3			X	Could be on the site of an npp
2	3.29 / 3	"…clearly defined, agreed upon and documented."	Clarity	X			
3	4.11 / 2	"…after they have been placed in storage (e.g. threats to the integrity of ~~packages~~ casks or problems associated…"	Package is a defined term for a transportation container and should only be used in that context.	X			
4	5.21 / 7	"…possible ~~slow increase of~~ change in nuclear reactivity over a long time)."	It is not clear how the nuclear reactivity would increase with time.	X			
5	5.22 (a) / 3	Define "items important to safety"	Addition of the definition of the term will add clarity to the guidelines.	X	Text elaborated		
6	5.22(c) / 2-3	"…conditions and external events (e.g. fires, handling accidents and earthquakes ~~analysis of the seismic situation~~)."	The meaning of the analysis of "the seismic situation" is not clear.	X	Text modified		
7	6.6 / 2-3	"…all operational states and credible accident conditions taking also natural phenomena into account. If numerical methods are used, o~~O~~nly verified and validated numerical…"	"all" conditions/events need not be considered and improves clarity.	X	Reference to "numerical" removed.		
8	6.8 / 1-2	"…design, all ~~potential~~ credible	"all" hazards/scenarios	X			

COMMENTS BY REVIEWER Reviewer: NUSSC Country/Organization: United States of America / NUSSC Date: September 21, 2009				RESOLUTION			
Comment No. / Reviewer	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		hazards and scenarios…"	need not be considered				
9	6.10	Delete the last sentence, and revise the section to include conditions under which the cask leak-tightness may not be sufficient for extending the dry cask storage period, without further inspection of the content of the cask.	The last sentence about the necessity for inspection to be evaluated by an accompanying investigation programme, is not necessary, because the previous text specifies the leak-tightness as a criterion for excluding inspection of the content.	X	Text modified		
10	6.11	Add references to documents for guidelines on inspection methods for evaluating the extent of gas generated, degradation of the containment system, etc.	References to the guidelines will add to the usefulness of the current document.			X	References would date to quickly
11	6.16 /1	Add recommendations on the extent of the "reserve storage capacity," and/or the factors to be considered for determining the reserve storage capacity.	The recommendations will increase the usefulness of the current document.	X			
12	6.18 / 1	Provide recommendations on the "appropriate methods" for verifying integrity of spent fuel during the life time of the facility.	The recommendations will increase the usefulness of the current document.	X			
13	6.26 / 1	Explain what is meant by "jams"	Explanation will add clarity to the guidelines.	X			

COMMENTS BY REVIEWER Reviewer: NUSSC Country/Organization: United States of America / NUSSC Date: September 21, 2009				RESOLUTION			
Comment No. / Reviewer	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
14	6.30 / 3-4	"…in such a way as to ensure, through geometrically safe configurations, that subcriticality will be maintained during all operational states and credible accident conditions."	To make it clear that only credible accident conditions need be considered.	X			
15	6.33 / 5-6	"…even under the situation of water flooding of the spent fuel storage locations unless flooding is precluded by location or design feature. The potential for rearrangements compaction of fuel pins should also be considered in demonstrating the required subcriticality margin."	To avoid consideration of what may be an incredible occurrence. In some cases, more reactive geometries may be obtained by spreading fuel pins apart rather than by compacting them.	X			
16	6.34(f)	"Neutron moderation and reflection should be considered. Flooding should be assumed in dry storage situations unless location or design features preclude such flooding."	To avoid consideration of what may be an incredible occurrence.		X		
17	6.35	Explain the term "infinite multiplication factor"	Explanation will add clarity to the guidelines.	X			
18	6.36 / 3-4	"…conservative conditions. For example, spent fuel from reactors may have higher multiplication properties than ~~fresh fuel with an initial enrichment~~ it did initially when it was fresh fuel. In such instances	Revise to improve clarity.	X			

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Comment No. / Reviewer	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
		the assumption of fuel with the…"					
19	6.47(h)	"The layout should be ~~carried out in such a way as to provide a spare storage capacity in order to allow an potential reorganization of the storage~~ designed to facilitate access to any stored fuel without moving or handling other stored fuel;"	Revise to improve clarity.	X			
20	6.52(h) / 4-5	"…where the machine is too close to the pool walls), and also prevent ~~over~~ lifting of spent fuel assemblies or other components over spent fuel, accidental release of loads or the application of incorrect forces."	Revise to improve clarity.	X			
21	6.64 / 4	"…operating personnel. Control and monitoring equipment should be ~~calibrated for the type of use~~ implemented in design of alarms and indications to the operating personnel."	Revise to improve clarity.		X		
22	6.73 / 4	"…instruments should have characteristics and ranges adequate to cover the ~~expected~~ potential radiation levels."	The guidance should extend beyond *expected* radiation levels.	X			
23	6.102(a) / 1	"Crane failure with a water filled and loaded cask, suspended outside pool"	This is not a severe accident, unless failure causes suspended cask to drop back into pool		X Text modified to mean events that could		

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Comment No. / Reviewer	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
			unimpeded. Failure where casks remains suspended is fairly commonplace and should be considered an anticipated transient.		lead to severe accidents.		
24	6.142(e)	"(e) Shielding materials: changes of density and composition, etc. (f) Design features incorporated to ensure subcriticality."	Include assessment of features important to criticality safety.	X			
25	I.62 / 7-8	"…or unloaded from a dry storage cask in a pool environment, then subcriticality should be evaluated with credible optimum moderation.	To avoid consideration of what may be an incredible level of moderation.	X			
26	Annex 1, Short Term Storage	"…concept must include an end point that will be reached within the approximately fifty year time period."	50-yr concept is approximate, not absolute, duration; see also text at section 1.6	X			
27	Annex 1, Long Term Storage	…report as storage beyond approximately fifty years,	50-yr concept is approximate, not absolute, duration; see also text at section 1.6	X			