DS488 Design of the Reactor Core for Nuclear Power Plants

COMMENTS						RESOLUTION			
NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
1	Switzer-land	1	1.4/ (a) and many other instances	Fuel rods or fuel pins instead of fuel elements	At least for German speaking people, "fuel element", verbally translated "Brennelement", means "fuel assembly". Even though "fuel element" is used in many other IAEA documents in the same way, it might be time to change to a term that is generally applied by everybody else.			X	Refer to IAEA safety Glossary; Fuel rod is the term used in LWR community, while fuel element is used in both LWR and PHWR communities.
2	Japan	1	1.7	Add after para. 1.7., not in the footnote 3. "Design extension conditions with core melt are out of scope of the reactor core design".	Clarify the scope. This should be expressly stated here.	X	Added the proposed statement in the main text of Para. 2.9 (not in a footnote) where plant states are described.		
3	Switzer-land	2	2.4/1,2	"fuel matrix" should be introduced and explained in some way.	"matrix" is used for many other things as well. Therefore, it should be explained what is meant here.	X	Added the definition of "fuel matrix" in a new footnote: "Fuel matrix" refers to the structure/microstructure of various types of ceramic fuel pellets.		
4	Czech R	1	2.4	Physical barriers considered as part of or affecting reactor core design include ~~the fuel matrix,~~ the fuel cladding and the reactor pressure vessel for LWRs (or fuel channels for PHW Rs).	Fuel matrix is usually not considered to be a physical barrier, which can be considered in plant design. Especially ceramic fuel never retains its integrity and radioactive particles always			X	The safety function performed by the fuel matrix as a barrier is to retain or delay the release of radioactive products from the fission

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					leaks from the fuel matrix. For the fuel matrix tightness it is impossible to establish any relevant design criteria and demonstrate their fulfilment by any design method. We therefore propose to delete fuel matrix from the list of physical barriers and leave fuel rod cladding, primary circuit pressure boundary and containment only.				process. Under normal operation, the matrix of standard fuels retains more than 90% of the fission gases and 100% of the solid fission products. Total retention could be expected with high performance fuel concepts. See also Para. 32 of INSAG-10 report for identification of physical barriers, which include fuel matrix.
5	Canada	1	2.5	To credibly support claims of safety for a facility, the reactor core should be of a design that has been proven either by: • equivalent applications based on operational experience or on the results of relevant research programs; or, • according to the design and design	Existing wording “is not allowed to be used” is not appropriate regulatory language for a safety guide.	X			

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				verification/validation processes stated in applicable codes and standards (as indicated in paras 4.14 and 4.16 of Ref. [1]).					
6	Canada	2	2.7	The reactor fuel design should account for features that will facilitate the future waste management. ~~and reprocessing~~.	It is not appropriate for IAEA to recommend design to facilitate reprocessing in a safety guide. This is a Member State's decision to make as a matter of energy policy.	X	Reworded to read as: "waste management (including reprocessing when applicable)". This revised statement represents current practice on reprocessing.		
7	Czech R	2	2.7	The reactor fuel system design should account for features that will facilitate the future waste management and reprocessing. Physical conditions of discharged fuel system from the reactor core affect the design of the storage and disposal systems of the used fuel system. Guidance to account for the impact of used fuel system conditions on the design of the fuel system handling and storage systems is described in Refs[6] and [7].	We propose to use „fuel system" instead of "fuel" or "fuel assembly". All components shall be treated as potential waste.	X	The word "fuel design" in the first line is changed to "fuel element and fuel assembly design."		NOTE: This paragraph is intended to accommodate the impact of the in-reactor fuel design limits on compliance of used fuel with the back end limits (rod internal pressure, clad creep-out and rupture, etc..) including fuel assemblies structure behavior (embrittlement by hydrogen pickup, modification of

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									coolable geometry by fuel assemblies distortion, etc.). Therefore this paragraph is not intended to other components (e.g., control rods) of the "fuel system" for waste management.
8	Switzer-land	3	2.14/2nd sentence	Leaktightness and structural integrity … are required to prevent radioactive material from being spread.	Clumsy formulation	X	Reworded to read as: "Leaktightness and structural integrity of the fuel elements are required to maintain these barriers to the release of radioactive materials."		
9	Switzer-land	4	2.16/1	Either "For all Safety Classes …" or "For the Safety Classes …"		X	Reworded to read as: "For all Safety Classes …".		
10	Sweden	1	2.21	"The safety assessment of the reactor core should be reviewed…"	It is not clear what the phrase "The reactor core design" means here. Is it core management strategies or the associated safety analysis or safety assessment? (Compare also with 3.13.)			X	The baseline of this document deals with all aspects of reactor core design. The design of the reactor core is clarified in Para. 1.4.
11	Switzer-land	5	2.22/2	degraded coolant chemistry conditions,	"Chemistry" cannot degrade, but conditions can.	X			
12	Egypt	1	2.24/ 3	…..,using the deterministic and probabilistic approach	Safety analysis is performed with both deterministic and			X	The probabilistic safety analysis

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					probabilistic approach				approach is not considered directly applicable to reactor core design.
13	Egypt	2	2.25/ a	(a) The operating state (e.g. , the thermal – hydraulic conditions , the power level at partial and full load , fuel burnup and xenon transient)	Power level at subcritical is not common used with power reactor and fuel burn up is also parameter in operating state.	X	Reworded to read as: "(e.g., thermal-hydraulic conditions, power levels and time in the cycle)".		
14	Japan	2	2.25/b	(b) The temperature coefficient of reactivity for the fuel (a so called doppler coefficient)	Clarification. Sometimes "Doppler coefficient" is widely used.	X			
15	Czech R	3	2.25/h		In our opinion a more detailed explanation or definition of the term "individual channel transient response" is necessary.	X	Added "(for BWRs)".		
16	Czech R	4	2.26	The hydrogen buildup as a result of Exothermic reaction between the ~~Zircaloy~~ cladding and water at high temperature will threaten the integrity of the containment and therefore it should also be evaluated.	As there are many fuel rod cladding materials (not just Zircaloy), we propose using "cladding material" instead of "Zircaloy".	X	H pick up is specific to zirconium based alloys. Reworded "Zircaloy" to "zirconium based alloy".		
17	Egypt	3	2.26	….. will threaten the integrity of the pressure vessel and containment and therefore it should also evaluated.	Hydrogen generations threaten both pressure vessel and containment and precautions should be taken for both two components.	X	Reworded to read as: "….may threaten the integrity of the pressure vessel for LWRs (of the pressure tubes for PHWRs) and of the containment and		

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							should be evaluated.”		
18	Finland	1	3.4	… Burnable ~~poison~~ *absorber* material (e.g., Gd, Dy, B and Er) may be used, for example, blended in sintered UO2 pellets or coated on their surface, to suppress temporarily the excess reactivity resulting from a high concentration of the fissile material in the fuel.	Instead of burnable poison we would prefer burnable absorber in conjunction with doped fuel. The motivation for this is that poison is in general something harmful and thus something to avoid. However, in the case of e.g. Gd-doped fuel (or other similar materials) the Gd is put on purpose to avoid excess reactivity at the beginning of the lifecycle. Consequently, it is something wanted and useful. Thus, burnable absorber would be better.	X			
19	Korea	1	3.4	The fuel for use in thermal reactors contains a fissile material(e.g. uranium U-235, Pu-239)	Plutonium is added.	X			
20	Switzer-land	6	3.4/ last para, and many other instances	Burnable absorber …	“burnable poison” suggests something dangerous and bad, whereas “burnable absorber” more exactly says what is meant.	X			
21	Canada	3	3.4	~~Examples of the pellet material include:~~ • ~~Enriched uranium dioxide (UO2);~~ • ~~Natural uranium dioxide (UO2) (for use in PHWRs);~~ • ~~Mixed oxide (UO2~~	These examples are not necessary to support the guidance statement. Practitioners using this safety guide are well aware of the types of fuel in use around the world. It is not the role of this guide to appear to recommend	X	Note that this safety Guide can be used by regulator, designer, operator and fabricator. The sentence is taken from the main text and is replaced in a new		

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				~~PuO2) ;~~ • ~~Thorium-based fuel (e.g., ThO2, thorium-blended UO2, thorium-blended mixed-oxide fuel);~~ • ~~Reprocessed uranium dioxide (UO2); and~~ • ~~Doped fuel pellets (e.g., Cr, Al, Si) to improve their performance (for use in LWRs).~~ ~~Burnable poison material (e.g., Gd, Dy, B and Er) may be used, for example, blended in sintered UO2 pellets or coated on their surface, to suppress temporarily the excess reactivity resulting from a high concentration of the fissile material in the fuel.~~	various fuel types and burnable poisons being used.		footnote for possible use by designer, fabricator or operator.		
22	Czech R	5	3.4/c	~~(c) Thermal performance (i.e., high thermal conductivity for operational states and high thermal diffusivity for accident conditions)~~	High thermal conductivity of all ceramic fuel material is poor. It would be better to delete this requirement from the list.			X	Thermal conductivity and thermal diffusivity of ceramic fuels are poor but can be improved by enhancing their sintering and density. It is important also to promote fuel design concepts with enhanced thermal

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									conductivity and thermal diffusivity (i.e. metallic fuels). Reworded to read as: "(e.g., high thermal conductivity for operational states and high thermal diffusivity for accident conditions are desirable)."
23	Canada	4.	3.5	~~. The fissile material is typically fabricated in cylindrical form of sintered pellets, and is loaded in cylindrical cladding tubes that have low neutron absorption properties and high mechanical strength. The~~ Fuel cladding material should be selected with consideration of the following properties:	The opening sentence is not necessary as the user of the document should be familiar with the purpose of cladding.	X			

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				~~Zirconium-based alloy materials (e.g., Zircaloy-2, Zircaloy-4, Zirlo and Optimized Zirlo, M5, E110) are typically used for the cladding material. Other innovative cladding materials, e.g., enhanced accident tolerant fuel, with focus on more benign steam reaction and lower hydrogen generation, are under development.~~	The paragraph on Zircaloy is not necessary to support the guidance statement. It is not the role of this safety guide to provide public education or appear to recommend material types for fuel cladding.	X	Note that this safety Guide can be used by regulator, designer, operator and fabricator. The sentence is taken from the main text and is replaced in a new footnote for possible use by designer, fabricator or operator.		
24	Switzer-land	7	3.5/2,3	… ~~that have low neutron absorption properties and high mechanical strength~~	All relevant properties are named in the following list and do not need to be duplicated.	X			
25	Switzer-land	8	3.5/e	Adequate breakaway oxidation resistance at high temperature over longer time;	"High time-integrated temperature conditions" seems to be a strange expression.	X	Added a new footnote in Para. 3.5: "Integrated-time temperature refers to the assessment of total time achievable at a given cladding temperature without reaching oxidation breakaway (uncontrolled oxidation kinetics)".		
26	Switzer-land	9	3.5., last para.	…, ZIRLO™, Optimized ZIRLO™, M5®, …	Trade marks should be written correctly	X			
27	Switzer-land	10	3.6	Re-edit whole paragraph by an expert	Seems to be a somewhat strange attempt to explain LWR water chemistry in one	X	The explanation part is taken out from the main text as suggested		

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					paragraph. Instead of an unsuccessful attempt to name everything, it might be a better idea to leave out explanations and to just state that the design should account for all interactions between chemical conditions in the coolant and fuel and core components.		and is replaced in a new footnote. The explanation part is reserved for possible use by designers or operators.		
28	Switzer-land	11	3.7/3	…heat from the core, provided …	improved readability	X	Close to Comment #32 (Canada Comment #5).		
29	Switzer-land	12	3.7/4,5	…flow instabilities that induce fluctuations…	“consequent” does not seem to be the appropriate expression.	X	Reword “consequent” to read as “resultant”.		
30	Germany	1	3.9/1	The choice of moderator and the spacing of the fuel within it should meet engineering and safety requirements while aiming at optimizing ~~be based on the need to optimize~~ the neutron economy, and hence fuel consumption~~, and to meet engineering and safety requirements~~.	The order of the requirements should take into account their importance.	X			
31	Germany	2	3.9/2	The moderator should be allowed to contain a soluble neutron absorber to maintain adequate shutdown margins during operational states of PWRs, and as an additional shutdown system for BWRs.	Usually, BWRs are operated without soluble neutron absorber; boric acid is only provided for accidental conditions.	X	Reworded to read as: “Depending on the reactor design, the moderator may contain a soluble neutron absorber to maintain adequate shutdown margins during operational states.”		

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32	Canada	5.	3.6 to 3.9	*Rewrote three clauses as a combined Coolant / Moderator Section:* **Coolant and Moderator Fluids**	As currently written, some text appears to be design instructions rather than guidance on safety. Text worded to make guidance clearer. Also, for all reactor types discussed in this safety guide, coolant and moderator have same considerations.		See disposition below for each paragraph.		.
				3.6 The design should account for the effects and compatibility of any chemical additives on fuel and core components. (e.g. chemistry control additives, soluble neutron absorbers)		X	Rephrased according to Comment # 27 (Switzerland Comment #10).		

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				3.7 Fluids should be physically and chemically stable with respect both to high temperatures and to nuclear irradiation in order to fulfil their primary function such as: the continuous removal of heat from the core, and in some cases, control of reactivity. The reactor core design should also include the following safety considerations associated with the fluid medium that affect the fuel and core design:				X	Suggested rewording "coolant" to "fluid" is not accepted, since "fluid" is not a term generally used in LWR community, while "coolant" is used by both LWR and PHWR communities".
				3.8 The design should account for the effect of changes in fluid density (including fluid phase changes) on core reactivity and core power, both locally and globally.				X	The same rationale for Para. 3.7 immediately above.
				3.9 Delete.	3.9 should be deleted or rewritten because it does not provide safety guidance; rather it is written as a design instruction.			X	Rephrased according to Comment #30 (German Comment #1)

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33	Czech R	6	3.7/b		We believe that more detailed specification, definition, requirements are necessary for instance for "removal of defective fuel as appropriate, e.g. during the nearest core reloading"			X	The wording "as appropriate" is maintained. Indeed, the radio chemical specifications may force the operator to shutdown the reactor before planned outage.
					Neutronic Design and Thermal-Hydraulic design – common comment – include the requirement that "Excessive Fuel assembly/ fuel element bundle distortions should be carefully considered for in the core design, though it may significantly change rod spacing and equivalent hydraulic diameter".	X	Para. 3.43 (d) already captures fuel assembly distortion effects on thermal hydraulic design. Para 3.43 (b) is modified to caputre fuel element bowing and fuel assembly distortion effects on nuetronic design. Modified (b) of Para. 3.43 says: "Bowing of fuel elements or distorsion of fuel assemblies should be limited so that thermal-hydraulic behaviour, power distribution, fuel performance, and fuel handling are not adversely affected."		
34	Switzer-	13	3.10, last	Measures should be provided	Measures to prevent hydrogen	X	Reworded to read as:		

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	land		sentence	to prevent deflagration or explosion of hydrogen generated by radiolysis in the moderator.	deflagration or explosion are not important, because radiolysis takes place, but because this might lead to severe damage… In our view, no specific justification is needed.		"Measures should be provided to prevent deflagration or explosion of hydrogen generated by radiolysis in the moderator."		
35	Japan	3	3.13	Nuclear key safety parameters influencing neutronic core design and fuel management strategies should be established from the ~~deterministic~~ safety analyses.	Clarification of the definition For the possibility of applying the statistical safety evaluations and other probabilistic approaches.	X			
36	Germany	3	3.13/1	…deterministic safety analyses that verify the compliance with fuel design limits described in paras 3.49-3.59. <u>In the analyses, uncertainties should be estimated and considered.</u>	The BEPU (Best Estimate Plus Uncertainty) approach should be applied.			X	SSG-2 (DS491) describes the DSA methods.
37	Switzer-land	14	3.13, last sentence/ para.	Sentence is hardly understandable.	Sentence is too long and complicated. Re-edit, divide into more than one sentence.	X	Rephrased to read as: "The safety impacts of any major modifications on the reactor core design should be assessed using the nuclear key safety parameters, in order to assure that the specified fuel design limits are not violated. Such modifications may include:		

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							(a) major plant design, equipment or operational modifications, (b) major in-core fuel management changes such as large cycle length extension, (c) new fuel type introduction (e.g., mixed-oxide fuel or gadolinium fuel), and (d) fuel burnup limit extension.”		
38	Switzer-land	15	3.13, last sentence/ para.	Suggestion for last part: … in order to assure that the specified fuel design limits are not violated due to the modifications.		X			
39	Czech R	7	3.13/new	(i) power distribution stability	Include into the set of typical nuclear key safety parameters also the following: “power distribution stability”, as it can be seen it is significantly discussed in the following paragraphs.	X	Bullet (f) is reworded to read as: “Radial and axial power peaking factors, including allowance for Xe induced oscillation”		
40	Korea	2	3.13/new	(i) The stability against Xenon oscillation	Addition of xenon oscillation is suggested as a typical nuclear key safety parameter.	X	Close to Comment #39 (Czech Comment #7).		
41	Korea	3	3.14, line 3~4	And the efficiency of the means of reactivity control for normal operation ~~of the~~	Accident condition is suggested in place of shutdown one.	X	Reworded to read as: “for normal operation of the plant at power,		

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				~~plant at power and at shutdown~~ and accident conditions.			shutdown, and accident conditions".		
42	Japan	4	3.15	Key reactivity parameters such as reactivity coefficients should be evaluated for each core state (e.g. zero power, full power, beginning of cycle, end of cycle)	Clarification. The word "state" is ambiguous and may indicate power conditions such as zero power, full power and so on.	X	Reworded to read as: "for selected core operating conditions (e.g., zero power, full power, beginning of cycle, end of cycle)".		
43	Japan	5	3.16/9	These reactivity insertion analyses should be performed for all fuel types in the core (e.g. UO2 or mixed-oxide fuel, or a representative core with conservative assumption) and…	Extension of definition For the case in which a representative core is selected in the analyses.	X	Reworded to read as: "all fuel types in the core (e.g. UO_2 or mixed-oxide fuel) or a representative core with appropriate provisions and …".		
44	Sweden	2	3.17	Add two more examples in the list of parameters that can affect local power; bow of fuel assemblies, mixed cores (PWR).	Other aspects can affect the local power distribution too and relevant to assess and make provisions for. It is mentioned in § 3.41, but I still find it relevant to mention in the section where it should be evaluated with respect to safety and limits (TH).	X	Reworded to read as: "(e.g., mixed core, crud induced power shifts or axial offset anomalies for PWRs, fuel assembly bow or distortion)".		
45	Czech R	8	3.17	Variations in the power distribution caused by local variations in reactivity due ……. should be carefully addressed in the core design and in the design of the control system.	Modify the wording "Variations in the power distribution caused by local variations in reactivity due ……. should be carefully addressed in the core design and in the design of the control system."			X	The selection of wording "should" is sufficient.

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46	Canada	6.	3.17	~~Power changes can be controlled by movement of the control rods. Additional design features may include:~~ ~~a) Arranging the control rod banks so as to avoid the large radial and axial distortions of the power distribution (PWR);~~ ~~b) Adjusting the boron concentration of the reactor coolant to control reactivity (PWR);~~ ~~c) Adjusting the circulation flow rate (BWR); and~~ d) ~~Adjusting the levels of light water in liquid zone compartments, and also solid absorber and/or adjuster rods and liquid absorber (PHWR).~~	This text does not support the guidance statement from a safety perspective. It is not the role of this safety guide to recommend specific design measures for control of power.			X	Note that this Safety Guide can be used by regulator, designer, operator and fabricator. The description remains unchanged for possible use by designer or operator.
47	Switzer-land	16	3.17/a	…avoid ~~the~~ large …	Just one of many indications that this part of the report should be reviewed and re-edited by a native English speaking person	X			
48	Finland	2	3.19	The effects of the depletion of burnable *absorber* on the core reactivity should be evaluated to ensure adequate	The same reasoning for Finland comment #1 on Para. 3.4	X			

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				shutdown margin in all the resulting applicable core conditions throughout the fuel cycle.					
49	Switzer-land	17	3.19	The effects of ~~the~~ depletion of burnable absorber[6] on the core reactivity should be evaluated to ensure adequate shutdown margin in all ~~the~~ resulting applicable core conditions throughout the fuel cycle.	Just another example of what is said above.	X			
50	Finland	3	Foot note 6	For PWRs, in order to maintain a negative moderator temperature coefficient, the designer may choose to reduce the required concentration of the burnable *absorber* in the moderator by adding fixed burnable *absorber* to the fuel pellet or to the fuel assembly in the form of burnable poison rods. Burnable *absorber* may also be used to flatten the power distribution and to reduce variations in reactivity during fuel burnup.	The same reasoning for Finland comment #1 on Para. 3.4	X			
51	Switzer-land	18	3.20	Re-edit, divide up into two sentences.	Something seems to be grammatically wrong.	X	The sentence is split to read as: The thermal-hydraulic design of the reactor core should include adequate margins and		

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							provisions to assure that (a) Specified thermal-hydraulic design limits are not exceeded in operational states (i.e., during normal operation and anticipated operational occurrences), and (b) The failure rates of fuel elements during design basis accidents and design extension conditions without significant fuel degradation remain below acceptance levels.		
52	Czech R	9	3.20	Add the sentence: The thermal-hydraulic design should carefully consider the core inlet coolant temperature distribution and core outlet coolant temperature stratification and these effects	Include the requirement, that “the thermal-hydraulic design should carefully consider the core inlet coolant temperature distribution and core outlet coolant temperature stratification and these effects	X	The proposed sentence is added in Para. 3.22: “For LWRs, the thermal-hydraulic design should also consider core inlet and outlet coolant		

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				should be considered in the core monitoring and protection systems.	should be considered in the core monitoring and protection systems.”		temperature and flow distributions. These effects should also be considered in the core monitoring and protection systems.”		
53	Japan	6	3.20 3.21	The 1st line on para 3.20 describes “appropriate margins”, and the 1st line on para 3.21 describe “sufficient margins”. The expression should be unified as “adequate margin” following the SSR-2/1 (Rev. 1).	Be consisted with used in SSR-2/1 (Rev. 1).	X			
54	Japan	7	3.20	Meaning of the “margin” is ambiguous. Definition of margin should be clarified in the footnote. For instance, margin between simulation result and fuel degradation level, or margin between simulation result and acceptance criteria)	Clarification.	X	The definition of margin is added as a new footnote in Para. 2.12: “In the context of this Safety Guide, “margin” refers to the difference between the maximum value of a physical parameter and the acceptance criterion defined for this specific physical parameter.”		
55	Japan	8	3.22/ 2nd para.	The design should assure that ~~steady state power ratios~~ <u>ratios of operating power to critical power</u> are maintained within limits established for	Clarification.	X	The proposed statement is incorporated with slight modification; “The design should		

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				defined ratios <u>at the steady state condition.</u>			assure that the minimum ratio of operating power to critical power (i.e., a minimum critical heat flux ratio, a minimum departure from nucleate boiling ratio, a minimum critical channel power ratio or a minimum critical power ratio) should cover the fact that the critical heat flux correlations have been developed from tests performed at steady-state conditions.”		
56	Switzer-land	19	3.22	spacer grids?	… and what are braces?	X	“Braces” is removed. “Grid” is reworded to “spacer and mixing grids”.		
57	Czech R	10	3.25		The fuel rod / fuel assembly / fuel system design shall assure not only absence of fuel rod cladding failure, but absence of system damage, which is much wider task. This requirement is oversimplified and should be drafted more specifically.	X	Reworded the 1st line of the Para. 3.25 to read as: “The design should assure that the structural integrity of the fuel assemblies (geometry) and the structural integrity of the fuel elements (leaktightness) are maintained.”		NOTE: the term “fuel system” is not used in this document. We distinguish fuel elements, fuel assemblies and CRDM. Burnable absorber rods are treated together with fuel elements. i.e., fuel elements (with or without burnable

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									absorbers). These are presented in bullets (a) through (c) in Para. 1.4. Para. 3.25 applies fuel elements (with or without burnable absorbers) and fuel assemblies. To clarify this, the 1st line of this paragraph is modified as represented in the column left. The CRDM is covered in Para. 3.79 at the same level of details for the fuel assemblies.
58	Finland	4	3.26	The design of the fuel elements, control devices, burnable absorber and fuel assemblies should address the irradiation and environmental conditions	The same reasoning for Finland comment #1 on Para. 3.4	X			
59	Canada	7.	3.27	Several key contributors throughout their lifetime should be addressed; important key contributors to fuel reliability ~~as identified by the Institute of Nuclear Power Operations (INPO) [12]~~ include:	It is not appropriate for IAEA to be seen to endorse INPO or WANO documents. They are not regulatory agencies but rather organizations with a specific industry interests. The statement should be written as an IAEA regulatory	X	INPO is removed.		

COMMENTS						RESOLUTION			
NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
					statement.				
60	Czech R	11	3.27		It is not clear, what the term „reliable“ relating to the FEs and FAs shall mean and why it is not applied to the whole fuel system. Define reliability and extent this requirement to the whole fuel system.			X	“Reliability” used in this document has no difference with the term “reliability” normally used. No definition is provided. Para. 2.18 states that reliability design is required for fuel and control & protection system.
61	Switzer-land	20	3.28	… fission gas release~~s~~ in the free volume~~s~~ of …		X			
62	Switzer-land	21	3.29, 2nd para.	Re-edit	Strange sentences, probably wrong grammar, logics do not fit, … As an example, why are solid and gaseous fission products used for specifying the initial conditions for accident analyses? 3rd sentence: why plural (releases, impacts)?	X	Removed the following phrases from the 2nd para. For clarification: “, and also are used for specifying the initial conditions for accident analyses.” Editorial comments are accepted.		
63	Switzer-land	22	3.30., 1st para.	… ~~constrained~~ limited, …	“constrain” means something like mechanically prevent something from growing, and that is certainly not what is meant here.	X			
64	Switzer-land	23	3.30., 1st para.	… do not compromise (or endanger) structural integrity	clumsy formulation	X	Reworded to read as: “do not affect the		

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				… and safety functions of …			structural integrity of fuel assemblies or the performance of control rod safety functions.”		
65	Switzer-land	24	3.30., 2nd para.	Grid spring~~s~~ relaxation under irradiation should be assessed to limit the risk for ~~end of life~~ grid-to-rod fretting.		X	Accepted the proposed wording with a replacement of” risk” to” potential”		
66	Switzer-land	25	3.30., 2nd para.	~~metallurgical~~ mechanical?	Tensile strength, ductility, growth or creep/relaxation are probably better designated as mechanical properties.	X			
67	Switzer-land	26	3.30., 2nd para.	The effect of irradiation on ~~the~~ buckling resistance …		X			
68	Switzer-land	27	3.33., 2nd para., 5th line	…, cladding creep behavior~~s~~ at low stress~~es~~ …		X			
69	Switzer-land	28	3.35.	what are “unloaded pellets”?	The whole para. might require some editing.	X	Reworded to “missing pellets”.		
70	Finland	5	3.36 heading	*Effects of burnable absorber in the fuel* 3.36. The design should include analyses to demonstrate that the fuel element can accommodate the effects of any in-fuel burnable *absorber* on fuel pellets thermal, mechanical, chemical, and microstructural properties and on fuel element behavior. The amount and the kinetics of volatile fission products releases to the free volumes of the fuel elements might be	The same reasoning for Finland comment #1 on Para. 3.4	X			

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
				affected by the presence of burnable *absorber* in the fuel pellets.					
71	Switzer-land	29	3.36.	~~The amount and the kinetics of volatile fission products releases to the free volumes of the fuel elements might be affected by the presence of burnable poisons in the fuel pellets.~~	The impact of burnable absorber on fission gas release with all its consequences is covered by the first sentence as well. Thus, the 2^{nd} sentence can be deleted without replacement.	X			
72	Switzer-land	30	3.37	Delete	Seems to be another attempt to justify, why certain things might be important. In the current form, no information important for design purposes is added.			X	The explanation part is taken out from the main text and is replaced in a new footnote. This footnote paragraph provides a support to a recent technical approach on the effect of initial hydrogen contents on degraded fuel performance under accident conditions. H pickup correlation is becoming part of design basis.
73	Switzer-land	31	3.38.	Re-edit or delete	Another attempt of a short lecture on an issue that might be important for safety, but including all background information in a safety guide is simply not possible (and not necessary).	X	The explanation part is taken out from the main text and is replaced in a new footnote. The same rationale for		

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							the above Comment #72 (Switzerland Comment #30).		
74	Switzer-land	32	3.39	re-edit or delete	It is true that the hydrogen content in the cladding should be limited, but controlling the moisture during fabrication is by far not the most important means to keep the content low.	X	Reworded to read as: "For PHWRs, initial hydrogen content in the fuel element should be limited to reduce the likelihood of fuel defects being caused by hydrogen induced embrittlement of the cladding".		NOTE: Agree to Commenter that it is not a serious issue for LWRs. For PHWRs, however it is still counted as a serious issue.
75	Switzer-land	33	3.41	re-edit, shorten	Enumeration of effects and items important for hydraulic effects will never be exhaustive. Therefore, it might be better to leave it out.	X	Removed as suggested.		
76	Switzer-land	34	3.43	For what operational states?		X	Reworded to "all applicable plant states", which is defined in Para. 2.9.		
77	Japan	9	3.43/ Foot note 9	In BWRs, the pressure difference between the inside and outside of the boundary of the channel box may induce bowing and bulging ~~swelling~~ of the channel box. This deformation, as well as fuel cladding bowing, may consequently increase the local flux peaking ~~factor~~ and friction of control rods movement.	Technically, one of the issues for channel box in BWR is not swelling but bulging. In addition, bowing of channel box may increase friction of control rods movement, so in order to avoid this, specific consideration should be necessary.	X			
78	Switzer-	35	3.43/ (a)	re-edit	"swelling" does not seem to	X	Reworded bullet (a) to		

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
	land		and foot note 10		be the correct expression. What is described in the footnote is fuel channel bulge. “channel box” should be replaced by “fuel channel”.		read as: “The clearance within and adjacent to the fuel assembly should provide space to allow for irradiation induced growth and bowing (LWRs) and bulging of the fuel channel (BWRs).”		
79	Switzer-land	36	3.44	re-edit	1st sentence and the following list do not fit together grammatically.	X	Rephrased to read as “For accident conditions (design basis accidents and design extension conditions without significant fuel degradation), the design should prevent any interaction between fuel elements or fuel assemblies and fuel assembly support structures that would impede safety systems from performing their functions as specified in the safety analysis. In particular, the following should be assured”.		
80	Switzer-land	37	3.45	re-edit	Do not try to provide justifications for everything. What is meant by “excess hydrides”?	X	Explanation part is taken from the main text and is replaced in a new footnote.		

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
							The phrase “pellet-cladding mechanical interaction at high burnup where excess hydrides exists in the cladding” is modified to read as: “excess pellet-cladding mechanical interaction combined with cladding embrittlement due to in-reactor hydriding at high burnup.”		
81	Japan	10	3.45/2nd para.	During ~~rapid DBA~~ power excursion ~~transients~~…	Better wording.	X	Reworded to read as: “design basis accidents that lead to rapid power transients”.		
82	Switzer-land	38	Footnote 11	Delete	These speculation-type statements do not seem to add any information of value.			X	This footnote provides an important message that power ramp failures do not occur until the critical burnup is reached. This is essential information to understand the power ramp failures. This information can be used to justify conservatism of the current verification methods

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									using burnup independent SCC/PCI failure limits.
83	Czech R	12	3.48 and further (pg. 18, Fuel design limits)		This chapter shall be extended to the whole fuel system. There is no reason to ignore control rods and other components, which perform their design functions strongly influencing nuclear safety as well. Criteria shall be established.	X	This paragraph and subsequent paragraphs are applicable to fuel elements, fuel assemblies and burnable absorber rods, as per discussion in Comment #57 (Czech Comment #10). For control rods, a new sentence is added in Para. 3.72 to read as: “The design of the solid reactivity control devices should address the irradiation and environmental conditions (e.g., coolant chemistry, irradiation effects; static and dynamic mechanical loads including flow induced vibration; and changes in the chemical characteristics of the constituent materials). The design should assure that these items		

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							can withstand handling loads during refueling operations, transport and storage. Important items that are typically considered for the design of the reactivity control devices are described in Annex I.”		
84	Finland	6	3.50	No harmful interaction between fuel elements and fuel assembly top and bottom nozzles causing deformation of the elements occurs (for LWRs).	In the requirement 3.50, item (a) is confusing and should be rephrased. It now states “No geometrical interaction between fuel elements and fuel assembly top and bottom nozzles occurs (for LWRs)”. This gives the wrong impression that the fuel elements and nozzles are not allowed to touch each other since it says that no interaction is allowed. Now one can read it so that the elements should be floating in the air between the bottom and top nozzles. The idea behind this item is that now harmful interaction should take place that would cause rod bowing or other deformation. One suggestions for rephrasing is “No harmful interaction between fuel elements and fuel assembly top and bottom nozzles	X	A new footnote is added for clarification: “To avoid fuel elements and fuel assemblies bow.”		

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					causing deformation of the elements occurs (for LWRs)." And correspondingly to PHWRs.				
85	Czech R	13	3.53		Design bases for fuel rod and assembly discharge burnup limits shall be required and explained in much deeper detail (goals?). E.g. shall be mentioned fuel rod fission gas release, internal pressure, cladding collapse, axial growth or fuel assembly deformation etc.			X	All the design features mentioned by the commenter are already included in the Guide, that is, Para. 3.28 for fission gas release, Para. 3.29 for internal gas pressure, Paras 3.49 and 3.54 for cladding collapse, Paras 3.30, 3.42 and 3.50 for axial growth.
86	Switzer-land	39	Heading in front of 3.54.	Avoid abbreviations	DBA and DEC was not introduced (not included in list of abbreviations either)	X			
87	Korea	4	3.56/a	[errata] … In addition,	[errata] addtion -> addition	X			
88	Czech R	14	3.56/a	Peak cladding temperature during the accidental transient should not exceed a level where the oxidation of the cladding in consequence of a metal - water reaction accelerates uncontrollably ~~(e.g., 1,204ºC for loss-of-coolant accidents or~~	The value of maximum allowable cladding PCT of 1204 °C for LOCA is highly inadequate and obsolete. It does not reflect irradiation effects. It should not be mentioned here.	X	Rephrased to read as: "Peak cladding temperature during the accidental transient should not exceed a level where cladding oxidation causes excessive cladding embrittlement or accelerates		

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				~~other justified value for more rapid transients than loss of coolant accidents)~~			uncontrollably".		
89	Japan	11	3.56/c	(c) The allowable enthalpy or enthalpy rise should be limited to a value, taking into account the pre-transient hydrogen content of the cladding, fuel burnup and Pu contents (e.g., for reactivity initiated ~~accident transients~~ events); and	For the allowable enthalpy, fuel buenup and Pu contects should be considered taking into account RIA demonstration tests such as CABRI in France and NSSR in Japan. Unappropriate wording for "reactivity initiated accident transients".	X	Reworded to read as: "The allowable enthalpy or enthalpy rise for reactivity initiated accidents should be limited to values which account for initial fuel element conditions (e.g., pre-transient hydrogen content of the cladding, fuel burnup, etc.)".		
90	Egypt	4	3.64/ 2	……..so that theses devices and instrumentation are accurately and cannot be moved by inadvertent operator actions,	The word " the " should be deleted.	X			
91	Czech R	15	Top of the pg. 21	REACTOR INTERNALS AND MECHANICAL DESIGN	Term „core structures" is inadequate and misleading. It should be replaced with „reactor internals" or equivalent term. As a "core structure" may be deemed FA, RCCA etc.			X	"Reactor internals" include components and structures of RCS, and thus it cannot replace "Core Structures". IAEA Safety Glossary indicates that core components include all structures except fuel assembly in the

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
									core. Since control rods are also included in core components, we uses the term "core structure" to limit the context to structures. The definition of structure in Para. 1.4 is extended: "additional structures (e.g., reactor internals, core support plates, lower and upper internal structure in LWRs)"
92	Japan	12	3.70/6	The instrumentation should monitor parameters of these systems that can affect the ~~fission process~~ change in the power levels over their expected ranges for all applicable plant states including refueling.	Better wording. The expression "the fission process" is not obvious in meaning.	X	Reworded to read as: "The instrumentation should monitor relevant parameters over their expected ranges for all applicable plant states including refuelling."		
93	Finland	7	3.71	The means of control of reactivity should be designed to enable the power level and the power distribution to be maintained within safe operational limits. This includes compensating for changes in reactivity to keep	The same reasoning for Finland comment #1 on Para. 3.4	X			

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
				the process parameters within specified operational limits, such as those associated with: (a) Normal power manoeuvers; (b) Changes in xenon concentrations; (c) Effects relating to temperature coefficients; (d) The rate of flow of coolant or changes in coolant or moderator temperature; (e) The depletion of fuel and of burnable *absorber*; and (f) Cumulative poisoning by fission products.					
94	Switzer-land	40	3.72	… (in LWRs)?	Why limited to PWRs?	X	The following conditional statement is removed: “for example when the reactor vessel is open for maintenance or refuelling (in PWRs)”.		
95	Finland	8	3.72	(a) PWR Use of solid neutron absorber rods; Use of soluble absorber in the moderator or coolant; Use of fuel with distributed or discrete burnable *absorber*; and Use of a batch refuelling and loading pattern. (b) BWR Use of solid neutron	The same reasoning for Finland comment #1 on Para. 3.4	X			

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
				absorber blades; □ Control of the coolant flow (moderator density); □ Use of fuel with distributed or discrete burnable *absorber*; and □ Use of a batch refuelling and loading pattern. …					
96	Canada	8.	3.72	~~The types of reactivity control devices used for regulating the core reactivity and the power distribution for different reactor designs include the following:~~ ~~(a) PWR….~~ ~~(b) BWR…~~ ~~(c) PHWR~~	These examples are not necessary to support the guidance statement. Practitioners using this safety guide are well aware of the types of reactivity control devices in use around the world.	X	Note that this safety Guide can be used by regulator, designer, operator and fabricator. The sentence is taken from the main text and is replaced in a new footnote for possible use by designer or operator.		
97	Japan	14	3.79/2	… such as burnup, changes in physical properties and production of ~~fission~~ helium gases.	Editorial As this sentence mentions the control system and not fuel.	X	Reworded to "… of gases". (Including "helium" seems too detailed for Safety Guide.)		
98	Japan	13	3.79/a	Add the following as "other considerations". Control rods should be replaced or exchanged taking into account its irradiation., especially in BWR.	Management for control rods should be introduced in case of the control rods have been inserted in the core for a long time, especially in BWR.	X	Reworded to read as: "Control rods should be replaced or exchanged accordingly". This statement applies to all reactor type fuels.		
99	Egypt	5	3.81	The design should ensure the	The protection systems should	X			

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
				necessary independence from plant processes and control and protection systems	be separated from control systems as you explained at para 3.96				
100	Japan	15	Table-1 BWR	B_4C in steel tubes/Hafnium plates or mixed them	There is a hybrid control rods type consisted of B_4C and Hf plates.	X	Added "(or a hybrid design)"		
101	Finland	9	3.89	The design of shutdown systems, as stated in para. 6.5 of Ref. [1], is required to account for wear out of the control rod cladding and for the effects of irradiation, such as burnup, changes in physical properties and production of helium gases. The bullet items in para. 3.79 are also applicable to the design of shutdown systems. Specific recommendations for diverse shutdown systems injecting *absorbers* to the reactor coolant system are described in Ref. [13].	The same reasoning for Finland comment #1 on Para. 3.4	X			
102	Czech R	16	3.96		should be clearly stated whether control rods used for the power control purposes can be used also for the shutdown purposes.			X	The comment is already stated in Para. 3.94.
103	Switzer-land	41	3.97/2	… plant design limits, **a** partial trip system …		X			
104	Czech R	17	3.99a	Limits and setpoints should consider impacts of the fuel burnup shadowing effects and coolant stratification (coolant	Operational limits and setpoints – include the requirement that the limits and setpoints should consider	X	The proposed sentence is incorporated as a new sentence in Para. 3.98.		

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
				temperature distribution).	impacts of the fuel burnup shadowing effects and coolant stratification (coolant temperature distribution).				
105	Egypt	6	3.101	The meaning of the first sentence of para 3.101 is not clear could you express it in easy way.		X	The sentence is split into two sentences. The 1st line is revised to read as: "Equipment performance, operational limits and procedures should be defined to prevent excessive rod worths or reactivity insertion rates."		
106	ECJRC	**1**	3.103 / 1-5 Core Monitoring System (CMS)	3.103. As imposed by Requirement 59 of Ref. [1], the provision of adequate core monitoring instrumentation is required to support reactor protection and control systems, as well as to supply sufficiently detailed and timely information on the local heat generation conditions prevailing in the core. The core design should accommodate the detectors and devices for adequate monitoring of the magnitude and changes of core power, as well as the local distribution of heat generation in the core, in order to enable any required modification of core	Para 3.103 needs a more precise wording, because in its present format it is misleading. Reactivity is an abstraction and it cannot be measured directly. Reactor protection and control systems generally rely on ex-core detectors and (in some cases) on fast in-core SPNDs. Both types of detectors sense the magnitude of neutron flux and the protective or control actions respond to the changes detected in the neutron flux. See also 3.70 and 3.107.	X	The proposed modification is incorporated with change of "imposed" to "established".		

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
				parameters, while ensuring that they are maintained within defined operating ranges.					
107	ECJRC	**2**	3.103 / 8-9 CMS	Appropriate devices should be available to localize the fuel assemblies containing failed fuel rods (e.g. a sipping device).	The detection of failed fuel rods is important in all reactor types, not only in PHWRs.	X	Para. 3.131 describes defective fuel and location. The sentence for PHWR system in Para. 3.103 is removed since it is repeated in Para. 3.131.		
108	ECJRC	**3**	3.103 / 8-9 CMS	-	It must be noted that in general the reactor coolant activity measurement system is not part of the CMS; it rather belongs to the primary coolant makeup and water cleaning system.	X	A new footnote is added in Para. 3.104: "Reactor coolant activity is measured by the device belonging to the primary coolant makeup and water cleaning system; for details see Ref. [NS-G-1.9]. "		
109	ECJRC	**4**	3.104/c	(c) <u>Reactor</u> coolant flow rate	Individual fuel assembly flow rates cannot be measured directly for PWR and BWR cores; they can only be deduced from the global reactor flow rate and the core bypass flow rate.	X			
110	Japan	**16**	3.104/d	(d) Water level <u>(for a BWR)</u>;	Clarification As being a BWR-specific parameter.	X			
111	ECJRC	**5**	3.104 / 18 CMS	(e) Thermal-hydraulic core parameters (e.g. …, reserve	For PWRs besides DNBR the reserve to bulk boiling is often			X	Margin to coolant boiling is not a

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				to coolant boiling for PWRs)	used as limiting parameter.				safety parameter but operational limit.
112	Germany	4	3.104 (h)	Concentration of soluble boron <u>and the B-10 content</u> (for a PWR).	For the absorption efficacy, the B-10 isotope is relevant.	X			
113	Czech R	18	3.104 additional bullet	(i) appropriate spatial power distribution peaking powers	include into the list of the measured parameters for the purpose of the core monitoring also "appropriate spatial power distribution peaking powers"	X	Reworded item (a) to read as "Spatial distribution of the neutron flux and related power distribution peaking factors" to reflect this comment.		
114	Czech R	19	3.107	Both ex-core and in-core neutron detectors should be calibrated periodically considering the impact of the spatial power distribution changes due to core control and/or core burnup effects.	modify the requirement as follows "Both ex-core and in-core neutron detectors should be calibrated periodically considering the impact of the spatial power distribution changes due to core control and/or core burnup effects."	X	The proposed sentence is captured by modification of some neighboring sentences together as below: "Measurements of the local power at different positions in the core should be performed to ensure that adequate safety margins are maintained considering the impact of the spatial power distribution changes due to core control and/or core burnup effects. ………. Both ex-core and in-core neutron detectors should be calibrated		

COMMENTS						RESOLUTION			
NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
							periodically.”		
115	ECJRC	**6**	3.108 / 1 CMS	A computerized core monitoring system <u>should</u> be used to ensure that the status of the core is within the operational limits assumed in the safety analysis.	Application of a computerized CMS is recommended, since a suitable on-line CMS needs to apply complex algorithms and thus requires large computing resources. Replacing "may" by "should" is proposed.	X			
116	Czech R	20	3.109	During reactor shutdown, a minimum set of instruments or combination of the instruments and neutron sources should be available to monitor the reactivity (e.g. using the flux detectors with an adequate sensitivity) during the whole period the fuel assemblies are located in the reactor vessel including the fuel loading and approach to criticality.	modify the requirement of the first sentence as follows “During reactor shutdown, a minimum set of instruments or combination of the instruments and neutron sources should be available to monitor the reactivity (e.g. using the flux detectors with an adequate sensitivity) during the whole period the fuel assemblies are located in the reactor vessel including the fuel loading and approach to criticality.”	X	Rephrased to read as: “During reactor shutdown, a minimum set of instruments or combination of instruments and neutron sources should be available to monitor neutron flux and heat generation distribution (e.g., using flux detectors with an adequate sensitivity) whenever fuel assemblies are present in the reactor vessel, including fuel loading and start-up phases.”		
117	Czech R	21	3.111 a	(a) The source function properly, i.e. sufficient readings are available from the neutron flux monitors, for their planned lifetime;	More specific formulation of the – “The source function properly, i.e. sufficient readings are available from the neutron flux monitors, for their planned lifetime; and …” is necessary	X	Rephrased to read as: “(a) The sources function properly to provide sufficient signals from the neutron flux monitors over their planned lifetime;”		
118	Canada	9.	3.113	~~A~~ Fuel cycles should be	Reworded into a clearer safety	X			

COMMENTS						RESOLUTION			
NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
				developed with appropriate ~~levels of enrichment and appropriate~~ means of controlling the core reactivity and the power distribution ~~so as to extract energy from the fuel in an economic and reliable manner within~~ to address fuel design limits.	statement. Economy of fuel use is not a safety consideration and a guidance statement already exists earlier in the guide that speaks to designing to reduce waste.				
119	Czech R	22	3.114	(a) The pattern and orientation of fuel assemblies in ea ch fuel cycle (for LWRs); (b) The schedule for the subsequent unloading and loading of fuel assemblies; (c) The configurations of reactivity control and shutdown devices; (d) The fuel assemblies to be shuffled; and (e) Burnable poisons and other core components to be removed, inserted or adjusted. (f) fuel assembly enrichment and configuration	Add new item „fuel assembly enrichment and configuration“. The nuclear fuel assembly design (choice of rod enrichment and distribution within assembly) is an integral part of the core design.	X	Reworded (a) to read as: “(a) Loading patterns (including enrichment and configuration of fuel elements) and orientation of fuel assemblies in each fuel cycle (for LWRs);”.		
120	Finland	10	3.114	… (e) Burnable *absorber* and other core components to be removed, inserted or adjusted.	The same reasoning for Finland comment #1 on Para. 3.4	X			
121	Japan	17	3.124/1	When fuel assemblies of	Clarification			X	A mixed-oxide

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				different types are loaded into the core (a so-called mixed core , excluding the Mixed-Oxide Fuel Core in para. 3.126.),	To avoid the conflict with the posterior para.				fueled core is a subset of a mixed core, so the structure and order of the presentation appears correct. There is no 100% MOX fuel core and there is always hybrid UO2/MOX fuel core.
122	Switzer-land	42	3.124/6	… thermal-hydraulic responses of the ~~fuels~~ fuel types (e.g. in …		X			
123	Egypt	7	3.126	……to ensure that nuclear design limits (for both the initial and subsequent reload cores) and fuel design limits are met …..	The word of that is doubled	X			
124	Japan	18	3.126/a	Add the following after (a). Pu vector (Pu-238, Pu-239, Pu-240, Pu-241 with decay and Am-241) should be considered in core design from the viewpoint of changing reactivity and key neutronics parameters assuming the reactor start-up time.	Pu vectors, especially Pu-241 decay, should be considered for core design from the viewpoint of changing reactivity and main ley parameters.	X	A new footnote is added to capture the comment: “Isotopic composition and Pu content in mixed-oxide fuel depend strongly on the discharge burnup of spent fuel assemblies from which plutonium has been extracted. The ratio of fissile isotopes for the plutonium also varies; this will affect the characteristics of the reactor core. In		

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							addition, the Pu vector (Pu-238, Pu-239, Pu-240, Pu-241 and Am-241) should be incorporated in the mixed-oxide core design, recognizing that there are changes affecting reactivity and key neutronics parameters as a function of the start-up time after mixed-oxide fuel fabrication. These features should be taken into account in core design and safety analyses.”		
125	Finland	11	3.126/b	… (b) In the mixed-oxide core, control rod and absorber *worth*~~s~~ are reduced as a result of neutron spectrum hardening due to the higher thermal absorption cross sections of plutonium compared with uranium, and as a result, the reactor shut-down margin can be reduced. To compensate for the reduced shutdown margin, additional control rods or absorption capability of the *absorber* materials (e.g., B-10	Typo The same reasoning for Finland comment #1 on Para. 3.4	X			

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				enrichment increase) should be implemented; …					
126	Germany	5	3.126 (c)	The kinetic parameters for mixed-oxide fuel, namely, the total fraction of delayed neutrons and the prompt neutron lifetime are ~~slightly~~ lower than those for UO2 fuel.	The delayed neutron fraction of MOX is only ~1/2 of that of UO2; this cannot be called "slightly lower".	X			
127	Germany	6	3.126 (d)	This effect can be reduced with ~~enrichment~~ variations of the Plutonium content and core design pattern adjustments.	MOX fuel assemblies usually contain fuel pins with graded Pu contents.	X			
128	Switzer-land	44	3.130	Re-edit	Again, leave out all background information and just state that perturbations related to load following operation should be limited.		The background description is taken out and is replaced in a new footnote.		
129	Switzer-land	45	3.131	Re-edit	Same remark as above. One sentence in the 1st para. would be enough. 2nd para.: Never heard about secondary oxidation. Probably, it is about secondary hydriding, but again, avoid providing a lecture on failure mechanisms. Last sentence: something seems to be wrong (… continued operated …)	X	Corrected: secondary oxidation to secondary hydriding; The background description is taken out and is replaced in a new footnote. This is required to address Comment #107 (EC JRC Comment #2).		
130	Sweden	3	3.131 fw	Fuel failures and leaking fuel can affect the operation of the	In Sweden we have a regulation on damaged fuel			X	This is a good piece of experience and

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				plant and be troublesome from several aspects; worker doses, degradation of the innermost barriers at normal operation, operation with respect to control rod positioning and unplanned outages and the possibility to detect other leaking fuel elements. A sound strategy with respect to leaking fuel is to minimize the amount of damaged fuel elements. To reduce the amount of fuel element damage it can be necessary to impose restrictions to operation, improve housekeeping or enhance the fuel construction. Root cause analysis of leaking fuel elements should be done in order to take relevant action.	that requires licensees to report damages to the authority, and to do a root cause analysis and to learn from the incident. There can be actions that are necessary to take for further operation or enhancing safety margin and so on. And I am sure several other countries s have too. Zero-by-10 is also a couple of years ago already. So I think that IAEA can raise the expectation on reducing leaking fuel and I suggest another paragraph.				should be provided to the design via operation experience; Most MS do not consider the proposed activities activities as part of design but as part of operation or surveillance program.
131	Switzer-land	46	3.132	with **correspondingly designed replacement rods,** solid dummy rods or vacancies.	This is state-of-the-art Replace “filler” with “dummy”, in order to eliminate an expression that is not introduced.	X	The word “filler rods” is removed as it is not used.		
132	Switzer-land	47	3.134./6	… post irradiation behavior~~s~~ …		X			
133	Switzer-land	48	3.134/(a) 2nd sentence	re-edit	There seems to be a logic error. Fuel handling accidents are not avoided by limiting	X	Rephrased: “Even though fuel elements can withstand some		

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					rod internal pressure. In the best case, this limits the consequences of a fuel handling accident.		extent of over-pressurization exceeding the normal coolant pressure without failure in normal operation, such highly pressurized used fuel elements should not be acceptable to handle when coolant counter-pressure is diminished (e.g., in spent fuel storage facilities)."		
134	Switzer-land	49	3.134/(a) 3rd sentence	re-edit	Either delete the second part with the explanation attempts or specify what is meant with "…continue to release gases." Probably not fission gas release, but helium produced by alpha decay.	X	Reworded "gases" to "helium gases".		
135	Switzer-land	50	3.134/(d)	re-edit	"fuel isotopic vector degradation": it should be more precisely stated what is meant.		A new footnote is added to: "High discharge burnups degrade spent fuel isotopic compositions and therefore its energetic quality. As a result Pu content in mixed-oxide fuel has to be increased to maintain parity with UO_2 enrichment."		
136	Switzer-land	51	3.134. (e)	re-edit	Delete either "retention" or "release". The current text	X			

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					does not make sense.				
137	Switzer-land	52	4.3. last line	… to ~~its~~ their installation		X			
138	Korea	5	4.4	[errata] ; and(e) Any combination => ; and (e) Any combination..	[errata]	X			
139	Sweden	4	4.4	A line break is missing in the last row of the list.	Editorial	X			
140	Canada	10.	4.4	Methods of qualification should ~~be adequate, which may include~~ consider:	Existing wording is a weak safety statement. Use of the word 'adequate' begs a further discussion on what 'adequate' means in this clause.	X			
141	Switzer-land	53	4.5./2	The ~~bases~~ basis for …		X			
142	Switzer-land	54	4.6. last line	… ~~the accuracy of~~ correct location and positioning	Location and positioning (or orientation) are either wrong or correct, but not more or less accurate.	X			
143	Switzer-land	55	4.8.	Out-**of**-reactor (2x)	Alternative: out-of-pile	X			
144	Finland	12	4.9	… (a) Fuel and burnable *absorber* rod growth; …	See. 3.4 reasoning	X			
145	Switzer-land	56	4.9/ 1st para.	re-edit	Hard to understand, maybe even logically wrong. What exactly is the aim of test reactor or lead use assembly irradiation? Probably not to	X	Reworded to read as: "In-reactor testing of design features through irradiations in materials test reactors		

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					determine an experience, but an upper limit or something in that direction.		or through lead-use assembly irradiation should be used to justify the specified maximum burnup or fluence limit for a new design."		
146	Germany	7	4.9/c	Fuel element, spacer grid, and channel box (~~for BWRs~~ if present) oxidation and hydride levels;	There are LWRs of non-BWR type with channel boxes (e.g. VVER-440).	X			
147	Switzer-land	57	4.9/c, g	~~channel box~~ fuel channel		X			
148	Switzer-land	58	4.9/k	~~(LWRs)~~ (PWRs)	There are no holddown springs in BWRs	X			
149	Switzer-land	59	4.9/m	~~LWRs~~ PWRs	There are no guide tubes in BWR assemblies	X			
150	Czech R	23	Annex I		Item "f" from section "Cladding" shall be moved to section „Fuel element performance".	X			
151	Czech R	24	Annex I		Include Discrete burnable absorber assembly, Neutron source assembly, Hydraulic plug assembly (guiding tubes plugs).	X			
152	Switzer-land	60	p. 41	ABBRE~~B~~VIATIONS	Rather poor list; why not extend it under the heading "Abbreviations and acronyms"?	X	Typo is corrected. Instruction for technical editing is to minimize to use abbreviations and acronyms.		
153	Switzer-land	61	General Comment	The language is complicated, with long sentences,			Full technical editing will be conducted at		

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				sometimes grammatically incorrect, not flowing. A potential remedy could be that the entire document or at least the parts of concern are reviewed and re-edited by a person with English as mother tongue or with very good skills in writing technical reports in English.			Step 10 later.		
154	Switzer-land	62	General Comment	In some parts, e.g. paragraphs 3.25. – 3.59. and 3.126. – 3.134, one tries to justify design requirements by providing a lot of background information on physics, fuel performance mechanisms, etc. (examples, but by far not all cases, are included in the review form). This should be avoided, in order to keep the guide concise. It will anyway never be possible to provide all background information for each design requirement, because this would end up with a comprehensive textbook. Therefore, at least these parts should be re-edited by an expert with corresponding background, in order to eliminate unnecessary information on the one hand, and to accentuate the design		X	Background information has been taken out from the main text and replaced in footnotes to retain it in this Safety Guide, considering that this Safety Guide will be used by various users, e.g., from regulator, designer, operator or fabricators. The rationale for reserving these description in footnotes are mainly in order to: (1) Not mislead users to wrong or different interpretation of the design recommendation statements (users usually have different		

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				requirements on the other hand.			interpretation depending on their positions, e.g., regulator, designer or operator); (2) Provide users with the background information of design recommendations related to new technical challenges that have been recently issued (3) Be consistent with other MS's comments. (some MS suggest to have detailed background information.)		
155	Czech R	25	General		The guide shall clearly distinguish between fuel system (fuel), core and reactor system including reactor internals (reactor), as the design safety requirements to those systems are different. The guide often mixes up requirements applicable to fuel, core and reactor. Individual systems and their interfaces shall be clearly distinguished, concerning	X	Specific comments are all addressed in specific sections. Close to Comment # 57 (Czech Comment #10) and Comment #83 (Czech Comment #12).		

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NO.	MS	Com. No.	Para/Line No.	Proposed new text	Reason	Accep-ted	Accepted, but modified as follows	Rejec-ted	Reason for modification/rejec-tion
					applicable requirements.				
156	Czech R	26	General		The guide shall address all components of the fuel system (fuel rods, fuel assemblies, control rods, discrete burnable absorbers, neutron sources, hydraulic plugs) which could be used to build specific core. The fuel system design safety requirements shall be formulated for any component located in any predefined plant location (reactor, fuel pool, fresh fuel storage, spent fuel storage, loading machine, fuel repair and inspection equipment) with respect to fundamental safety functions. Some components are incompletely assessed (e.g. control rods) or entirely neglected in the guide (neutron source assembly, discrete burnable absorbers).	X	Close to Comment #155 (Czech Comment #25). Specific comments are all addressed in specific sections. For clarification, see Para. 1.4 for the scope of the Safety Guide.		
157	Czech R	27	General		The core shall be understood as arbitrary configuration of fuel assemblies and other components in the reactor core barrel in any operational mode. This configuration shall be assessed from the state of loaded single assembly in the refuelling mode to the full core set at nominal power. The	X	Added a new paragraph: 3.120a.”Safety assessment should address any event that may cause inadvertent criticality during core loading or unloading and during handling phases.”		

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					core design safety requirements shall be formulated for any configuration with respect to any fundamental safety function.				
158	Czech R	28	General		The fuel assembly and the core shall be perceived as two regular fully integrated systems of the plant. Design and safety approach shall be exactly the same as for other safety systems or safety related systems. Damage (of any plant system) of the fuel assembly, not only fuel element, shall be excluded under Normal operation and anticipated operational occurrences (see par. 2.4).	X	Reworded in Para. 2.4 to read as "For normal operation and anticipated operational occurrences, fuel elements and fuel assemblies are required to maintain their structural integrity …".		
159	Czech R	29	General		Consider using expression „shall" instead „should" where are the requirements of IAEA SSR 2/1 explicitly concerned (e.g. 2.20 pg 5 – see Req 29 of the SSR 2/1).			X	Only Safety Requirements publications (e.g., SSR-2/1) are allowed to use "shall" statements. Safety Guides are written with using "should" statements.