Section 6
DS491. (SSG-2 Rev. 1, Deterministic Safety Analysis for NPPs)

COMMENTS BY REVIEWER Reviewer: ……..Page.... of.... Country/Organization: ……. Date:				RESOLUTION			
Country Org.	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
France 17	6.1 Line 4	~~Margins~~ Conservatisms might be introduced in many ways, such as in physical models, in initial and boundary conditions or in acceptance criteria.	Here the word conservatisms should be used instead of 'margins'	X			
Observer ENISS-46	6.2	Please refer to Table 2 in this paragraph	For better understanding, this paragraph should make explicit reference to table 2		*At the end of §6.2 will be added:* "…;see Table 1" *[Note: Table 2 became Table 1]*		
Observer ENISS-47	6.2 line 2	Ask for clarification	"conservative, combined or even best estimate approach, associated with sensitivity analysis": If "associated" is related to "conservative" this is not consistent with #2.9 and #2.10 To be clarified (Table 2)		*The first sentence will be modified as follows:* "Uncertainties in computational predictions…combined or even best estimate approach~~, associated with sensitivity analysis as appropriate~~, or explicitly using …"		
CAN 59	6.3	Suggest the following changes,	The complementary approaches would certainly			X	*§7.30 indicates that acceptance criteria*

		To demonstrate compliance with anticipated operational occurrences acceptance criteria, two complementary approaches should be considered, the realistic approach, using plant control and limitation systems (para 7.17-7.26) and a more conservative approach, using only safety systems (para 7.27-7.44). The acceptance criteria for the conservative approach assuming malfunction of plant control and limitation systems should take into the overall frequency of the postulated event sequence.	demonstrate the robustness of the safety case. The more conservative approach assumes that the plant control and limitation systems do not function as intended. If the frequency of the AOO with control/limitation system malfunction is beyond what is normally considered as the AOO range, then a less stringent acceptance criteria should be applied.				*should be the same for "conservative AOO" and 'realistic' AOO:* "7.30 For conservative analysis of AOO the technical acceptance criteria related to fuel integrity and radiological acceptance criteria should be the same as presented above for realistic analysis of AOO"
GER 23	6.3	6.3. To demonstrate compliance with anticipated operational occurrences acceptance criteria, two complementary approaches should be considered, the realistic approach, using plant control and limitation systems (para 7.17-7.26) and a more conservative approach, using only safety systems (para 7.27-7.44).	The intention of the approach is not clear. From German experience it is only allowed to handle AOOs with operational systems. The usage of safety systems for AOOs is forbidden. Thus, the analyses of AOOs should only consider operational systems available during the transients. The usage of safety systems would contradict the level-of-defense concept. Is the intention of the more conservative approach to show that in case of the failure of operational systems the transition to the DBA level can be managed			X	*§5.75 (e) from SSR-2/1 Rev. 1, indicates to analyse AOO only with safety systems:* "(e) Demonstration that the management of AOO and DBA is possible by safety actions for the automatic actuation of safety systems in combination with prescribed actions by the operator"

			by the plant design? Should be discussed.				
Observer ENISS-48	6.4	Ask for clarification	This paragraph is not consistent with #2.10 ("conservative approach is not suggested") → to be clarified		*§6.4 will be modified as follows:* "6.4. In accordance with SSR-2/1 (Rev.1), §5.26 [1] the deterministic …performed using conservative analysis (see §2.14), including consideration…"		
CAN 18	6.6, 1st sentence	6.6. When best estimate analysis is used, adequate margins to integrity of barriers should still be ensured. It should then be demonstrated by sensitivity analysis that cliff-edge effects[7] ~~(abrupt change in the result of the analysis for a realistic variation of inputs)~~ potentially leading to early or large radioactive releases can be reliably avoided. [7] Definition of a 'cliff-edge effect' is provided in ~~SSR-2/1 (Rev 1), § 5.21 [1]~~ the Safety Glossary. The term ~~„plant parameter"~~ "plant parameter" in the definition should be interpreted in a broad sense, i.e. as any plant physical variable, design aspect, equipment condition, magnitude of a hazard, etc. that can influence equipment or plant performance.	The term "cliff edge effect" is <u>defined</u> in the Safety Glossary. SSR-2/1 does not include the term in its definitions, though it does repeat the text in several footnotes. This guide should not paraphrase that definition in the main text. The application in DSA described in the footnote is sufficient.	X	*Additionally, 6.1 will be modified as follows:* "Margins might be introduced in many ways, such as in acceptance criteria or through conservative assumptions in physical models, and in initial and boundary conditions ~~or in acceptance criteria~~."		
Observer	6.7, 6.8/All	*Please see rationale*	The scope of paras 6.7 and			X	*This is done for DBA*

EC/JRC-59			6.8 regarding sensitivity analysis both in terms of plant state (AOOs, DBAs, DEC) and deterministic safety analysis approach (conservative, BEPU, combined, realistic) should be added. It is the opinion of this reviewer that such activity is restricted to the field of severe accident simulations but only within probabilistic, i.e. Level 2 PRA, analysis.				*and some AOO*
Observer WNA 3	6.7	6.7. For best estimate analysis, parameters to which the analysis results are most sensitive should be identified.	Cliff edge effect is relevant for best estimate analysis, not for conservative analysis			X	*Absence of 'cliff edge effect' has to be always demonstrated*
Observer EC/JRC-60	6.7/7 (addition)	To overcome this issue, global sensitivity analysis techniques should be applied such as Monte-Carlo Filtering, Scatter plots or Sobol indices.	Last sentence in para 6.7 identifies a problem arising from performing sensitivity analysis by varying one parameter at a time yet without offering any solution / recommendation to avoid this shortcoming, which seems to me slightly contradictory.			X	*Out of the scope of this guide; the methods proposed may not yet receive common agreement. The last sentence is a warning suggesting that results should be considered with caution*
CZ 18	6.8 Line 1	6.8. For practical reasons, only a limited number of parameters usually considered to have ~~with~~ the strongest effect on results of analysis can be involved in sensitivity analysis.	Without performing of sensitivity analyses the parameters with strongest effect cannot be exactly identified. Or insert to text reference describing how to evaluate parameters with strongest effect on analyses result.		"6.8. For practical reasons, only a limited number of parameters identified as having the more significant ~~with the strongest~~ effects on results ~~of analysis~~		

					can be involved in sensitivity analysis. Variation…”		
Observer EC/JRC-61	6.9 Line 1	For conservative deterministic safety…	Referred option in bullet 2 is option 3 in Table 2, hence not conservative but BEPU.		*‘Conservative’ is used here according to §2.14. Para 6.9 will be modified:* “6.9. For conservative DSA of AOOs and DBAs (see §2.14), in addition to the fully…”		
Observer ENISS-49	6.9 Line 10	(…) in the second ~~phase~~ case the results are expressed in terms of ranges, percentiles or probability distributions of calculated parameters	When using a BEPU method, the output results may be expressed under various formats: ranges, percentiles (e.g. 95%/95%), probability distribution.		*Calculated parameters hardly follows a known statistical distribution (e.g. Gaussian) this is why the use of ‘Wilks’; suggested change is:* “… in the second ~~phase~~ case the results are expressed in terms of ~~ranges~~ percentiles or confidence intervals of the calculated parameters”		
Observer EC/JRC-62	6.9 Line 11	... in terms of ranges probabilistic distribution functions or confidence	For precision's sake.		*See resolution to ENISS-49*		

		intervals of the calculated parameters.					
Observer EC/JRC-63	6.11/1	…should ~~take into account~~ be updated according to plant real configuration e.g. number of PWR steam generator plugged tubes, implemented plant modifications of any kind affecting modelling components and signals, or any ongoing process such as aging affecting simulated phenomena by the code.	For precision's sake.			X	*Too detailed for the Safety Guide; it seems preferable not to incorporate the change*
Observer EC/JRC-64	6.12/New	Deterministic safety analysis approach in the frame of design extension conditions should consider BEPU approach due to the large uncertainties related to the involved phenomena. Best estimate –default–values provided by the code can significantly deviate from bounding values when uncertainties are incorporated into the calculations. Critical severe accident phenomena such hydrogen generation, corium quenching or fission product release, transport and chemistry feature large uncertainties that can, at least partly, be addressed by identifying governing phenomena, quantifying their uncertainty and propagating through statistical tools by means of representative accident sequence code simulations.	The importance played by uncertainties in severe accident simulation codes has already been discussed. It is not well balanced if the two following subsections are only focused on AOOs and DBAs while not mentioning DECs, moreover when several applications derived from using severe accident codes greatly impact on safety improvements, e.g. mitigating system design such number of PARs or filter type in the Containment Filtered Venting.			X	*The formulation may be considered complex. Nevertheless, the concept is to be covered in Section 7 (see §7.4) where Best Estimate (without BEPU) is allowed.*
Observer EC/JRC-65	6.14 Line 5	… may be different depending on the type of ~~PIE~~ transient	Uncertainty is not (only) PIE-specific but sequence-specific.	X	*(Event sequence could also be used)*		
Observer ENISS-50	6.14	The paragraph should be removed or simplified	For simplification, as these issues are already presented in paragraph 2.11.			X	*See §1.16 (line 2). Section 2 only introduces basic*

							concepts and terminology used in DSA; doesn't provide recommendations ('should' statements), e.g. in §2.11. These recommendations are provided in §6.14
CAN 60	6.15 (To be added at the end)	Suggest the following changes, *Therefore, the appropriate conservatism in initial and boundary conditions should be selected individually, depending on the specific transient and acceptance criteria. Initial conditions that cannot occur at the same time in combination need not be considered.*	Consistent with para 6.19, selection of conservatism for individual initial/boundary conditions should consider if the conditions can occur at the same time.		"…and acceptance criteria. Combinations of initial conditions that cannot occur at the same time do not need to be considered."		
Observer EC/JRC-66	6.15/5 (addition)	… i.e. initial and boundary conditions which are conservative for one specific transient or acceptance criterion could at the same time be not conservative to another transient or acceptance criterion.	For clarification's sake.		*See resolution to CAN-60 (basically included there)*		
Observer ENISS-51	6.20	Operating conditions … negligible ~~probability~~ frequency of occurrence may not need to be considered in selection of conservative initial conditions. Initial conditions should consider stationary state with normal operation equipment operating prior to the initiating fault.	Initial plant state should consider stationary state with normal operation equipment available.	X *(frequency)*	*The last sentence suggested will be added to para §3.5 (now §3.4, once moved down §3.1)*		
Madaga 2	6.21	BEST ESTIMATE DETERMINISTIC SAFETY ANALYSIS WITH QUANTIFICATION OF UNCERTAINTIES FOR	It is better to put the las s of DBAs in LowerCase even within an UpperCase title		*Editorial. When "DBAs" is used in a title of the SG, it will be*		

		ANTICIPATED OPERATIONAL OCCURRENCES AND DBA~~S~~s			*wrote in full* (DESIGN BASIS ACCIDENTS ~~DBAs~~)		
Observer EC/JRC-67	6.21/2	… ~~may~~ should be addressed by in case of making use of best-estimate computer codes in combination with …	For clarification's sake: the text as currently is seems to give to user's choice the alternative of assessing uncertainty in the best-estimate option, i.e. best-estimate code and BICs. But according to option 3 in Table 2, associated uncertainties should indeed be calculated.			X	*BEPU is not the only means thus* "may" *is the correct term*
PL 6.	Page 34/35 *(General, paras 6.21-6.29)*	General remark about "BEST ESTIMATE DETERMINISTIC SAFETY ANALYSIS WITH QUANTIFICATION OF UNCERTAINTIES FOR ANTICIPATED OPERATIONAL OCCURRENCES AND DBAS" subchapter: statistical method (propagation of input uncertainty) is well described and all important features are discussed. I would like to propose to create further points about "extrapolation of output uncertainty" approach, for the clarification and better understanding. It should cover issues like: • general idea - The inaccuracies are obtained by experimental/calculation comparison, then the inaccuracies is 'extrapolated ' to get uncertainty.	Proposition to expand the information about second method of BEPU analysis - "propagation of output uncertainty". The method is a good alternative to statistical method and more information would be useful.			X	*Not sure whether this relevant change would be supported. It is quite detailed and §6.26 seems more clear and simplified than the proposed text*

		Experimental data are obtained from qualified Integral Test Facilities. • resources and databases of results of calculations and comparisons to experimental data needed to obtain results • Positive like - one broad methodology for uncertainty evaluation, accuracy qualification and answering scaling issue • Expert judgement minimized • drawbacks like the the process of 'extrapolation' of output errors is not based upon fundamental principles					
Observer ENISS-52	6.21 to 6.29	These paragraphs are not specific to AOO or DBA and should be included in section #5 within a subsection related to UQ	For better structure of the document. See general comment nb 2.			X	*This subsection addresses the quantification of margins, so uncertainty quantification is part of Section 6*
France-18	6.23 Line 3.	A reliable assessment of the uncertainties is needed to carry out acceptable best estimate analyses with quantification of uncertainties, especially for the identification of aleatory and epistemic sources of uncertainties, these two different sources should be treated differently when performing the uncertainty analysis. Code-to-data comparisons are the preferred means to quantify the uncertainties. However, a combination	Treatment of aleatory and epistemic uncertainties are different and have to be specified in this document.	X			

		of sensitivity studies, code to code comparisons and expert judgements may also be used as an input for the assessment					
CAN 61	6.23 Line 3 plus line 5	Suggest the following changes, *Code-to-data comparisons are the preferred means to quantify the epistemic uncertainties. However, a combination of sensitivity studies, code to code comparisons and expert judgements may also be used as an input for the assessment. For aleatory uncertainties, the preferred means is the collection of nuclear power plant data of initial and boundary conditions that are relevant to the events being considered.*	As noted in this para, it is important to recognize the distinction between aleatory and epistemic uncertainties. This is particularly important for some applications or methods of Best Estimate Analysis with Uncertainties. Aleatory uncertainties generally refer to random variations in process conditions while epistemic uncertainties are related to ability to measure or predict a condition accurately. Use of code-to-data or code-to-code comparisons cannot readily establish the aleatory uncertainties.	X	*Reference to GSR Part 4 (Rev. 1), Req. 17 [2] will be made at the end of the existing wording of §6.21.*		
USA 6	6.23 & 6.24 (p. 34)	Remove line between 6.23 & 6.24.	Editorial. Line serves no purpose.	X	Editorial		
USA 7	6.28 (p. 35), Last sentence	However, attention should be given to the fact that the regression or correlation techniques might ~~have~~ also have drawbacks, especially when the response is not linear or when the cross-correlation effects are important.	Editorial / clarity	X	Editorial		
Observer EC/JRC-68	6.29/3	… that is analyzed. The ranking PIRT tool application should identify…	For precision's sake.		"... for each event that is analysed. This PIRT ~~The~~		

					~~ranking~~ should identify the most important …”		
Observer EC/JRC-69	6.29/5 (addition)	… on available data. If the number of output relevant phenomena is high, an additional filter taking only those lacking on sufficient knowledge might be applied.	Several international PIRT applications have performed this further filtering step.			X	*It seems not necessary, quite detailed.*
Observer EC/JRC-70	6.29/6	… to determine the overall uncertainty of the figures of merit used to check compliance with acceptance criteria specific of that particular code, plant characterization and accident sequence simulation.	It is unclear what is the reference subject when talking about 'the same process can be applied'. What is the mentioned process?			X	*It seems not necessary, quite detailed.*
PL 5	6.29 Line 8	Proposition of additional text: High level of expertise and experience is needed to fix ranges of variations of input parameters and to carry out PIRT process.	PIRT process is very sensible to expert judgment so it should be noted that expertise and experience is needed.			X	*It seems not necessary. The idea is covered by the first sentence of 6.29:* “… based on expert judgement…”