August 13, 2001

MEMORANDUM TO: Mark A. Cunningham, Chief
Probabilistic Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

FROM: Patrick W. Baranowsky, Chief
Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

SUBJECT: COMMENTS ON "ASME STANDARD FOR PROBABILISTIC RISK ASSESSMENT FOR NUCLEAR POWER PLANT APPLICATIONS"

We have reviewed the draft "ASME Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications" in terms of OERAB risk assessment programs: SPAR models (Level 1, Level 2/LERF and LP/SD models), the Reliability and Availability Data System (RADS), the Common Cause Failure (CCF) Database, risk-based performance indicators, and system and component reliability studies. Our review covered the high level requirements (HLRs) and the supporting requirements for each HLR. In particular, we assessed whether the standards for our data, methods and models would meet the more rigorous requirements of Capability Category III. Our review covered all of the nine PRA elements (i.e., initiating events analysis, accident sequence analysis, etc.) except for PRA Configuration Control and Internal Flooding. Internal flooding will be addressed along with seismic, fire, and other external events in future SPAR model development. We expended approximately three staff weeks of effort to complete this review.

Our summary conclusions are:

- The ASME Standard high level and supporting requirements are appropriate. We do not propose any changes in the requirements.
- The OERAB programs meet the ASME Standard high level requirements and supporting requirements except in three areas:
  - SPAR model documentation
    - The Level 1 SPAR model documentation does not completely provide the basis for the selection and grouping of initiating events.
    - The basis for key assumptions is not completely documented for the Level 1 SPAR models.
    - The Level 2/LERF SPAR model documentation does not adequately describe the treatment of feasible operator actions following the onset of core damage. Nor does the documentation adequately describe the environmental impacts (including the impact of containment failure) on continued operation of equipment and operator actions as required in the Standard.

- ○ The SPAR models do not include uncertainty parameters in the estimates of human error probabilities (HEPs) as required by the ASME supporting requirements.

- ○ The Level 2/ LERF SPAR models do not provide a qualitative or quantitative assessment of the uncertainty of the results.

We believe the SPAR development program should address these requirements.

- We plan to make the ASME Standard documentation requirements the standards for future documentation of SPAR models.

- Future Level 2/LERF SPAR models will explicitly incorporate uncertainties in the analyses.

- A methodology for estimating the uncertainty in HEPs in SPAR models is needed. I am requesting PRAB's assistance in the development of methods for estimating the uncertainty in HEPs in SPAR models. Once the methods are developed, we will include estimates of the uncertainty for HEPs in future SPAR models. I will contact you to discuss this matter further.

We will develop estimates of the additional cost for these modifications to the existing SPAR model development activities in March 2002 when feasibility analyses are completed and detailed model development plans are in place. This activity will be coordinated with the SPAR Models Users Group.

Attachment 1 shows the detailed comparisons of the ASME high level requirements for each PRA element with our programs and comments on whether our programs met the high level and the more detailed supporting requirements.

If you have any questions, please contact Bennett Brady (415-6363) of my staff.

Attachment: As stated

cc: S. Newberry
M. Drouin
OERAB Staff

MEMORANDUM DATED: 8/13/01

SUBJECT: COMMENTS ON “ASME STANDARD FOR PROBABILISTIC RISK ASSESSMENT FOR NUCLEAR POWER PLANT APPLICATIONS”

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Attachment 1

COMPARISON OF SPAR MODELS WITH PROPOSED STANDARD FOR PROBABILISTIC RISK ASSESSMENT FOR NUCLEAR POWER PLANT APPLICATIONS, REVISION 14A, MAY 11, 2001

Types of SPAR Models Reviewed:

- There are several types of SPAR models available or under development: Level 1, Revision 2QA and Revision 3i SPAR models (for analyzing operational events/conditions occurring during full power operation); (2) Level 1 SPAR models for analyzing operational events/conditions occurring during low power/shutdown (LP/SD) operation; (3) Level 2/LERF models for estimating the large early release frequency associated with operational events/conditions; and (4) external events analysis capability for analyzing the risk associated with operational events/conditions involving external initiators (e.g., seismic events, fires, flooding, extremely severe weather).

Key Points Considered in Comparison:

- The purpose of the SPAR models is to provide staff analysts with a consistent set of analysis tools for performing their regulatory activities, such as estimating the risk associated with operational events/conditions and inspection findings.

Level 1, Revision 3i and Revision 2QA SPAR Models

- The Revision 3i, Revision 2QA SPAR models do not model a plant to the same level of detail as a licensee's plant PRA; the level of detail captured in the SPAR models is less than the detail contained in a licensee's PRA model.

- The Revision 3i and Revision 2QA SPAR models have a limited scope. For example, the initiating event analysis did not consider all possible initiators. Only those, based on the plant's IPE or PRA, which were considered to be significant contributors to plant risk are included. In addition, all plant systems are not included in the SPAR models. The systems analysis for a specific plant only considered, based on the plant's IPE or PRA, those systems which were risk significant for that plant. In addition, the Revision 2QA SPAR models do not include support systems, with the exception of the emergency a.c. power distribution system.

- The success criteria and the dependencies contained in the Revision 3i and Revision 2QA SPAR models for a specific plant used the available information regarding the success criteria and dependencies found in that plant's IPE or PRA.

- The scope of the Revision 3i and the Revision 2QA SPAR models does not include actuation systems.

- The QA process for the Revision 2QA SPAR models consisted of a systematic review by a team of independent contractors, who were familiar with the NRC staff's review of the individual plant examinations (IPEs) submitted by the licensees in response to Generic Letter 88-20.

- The QA process for the Revision 3i SPAR models consists of an internal QA review and an external, onsite QA review. In the external QA review held at the specific plant site, the SPAR model is reviewed against the licensee's PRA model for that plant. Both reviews are conducted according to written procedures. The internal QA review of a Revision 3i SPAR model is conducted by a PRA analyst who did not construct the model. The external QA review is conducted by the PRA analyst who constructed the model, the regional office SRA, OERAB staff, and the licensee's PRA staff.

Level 1, LP/SD SPAR Models

- The Level 1, LP/SD SPAR models currently consist of a detailed PWR LP/SD model based on the Surry Low Power/Shutdown PRA documented in NUREG/CR-6144, a detailed BWR LP/SD model based on the Grand Gulf Low Power/Shutdown PRA documented in NUREG/CR-6143, a PWR template for developing other PWR LP/SD models, a BWR 5/6 template for developing LP/SD models of other BWR 5s and 6s, and a BWR 4 template for developing LP/SD models of BWR 4s.

- The scope of the detailed PWR LP/SD SPAR model is limited to three of the plant operating states (POSs); fifteen POSs were analyzed in NUREG/CR-6144. The PWR LP/SD SPAR model considered only those POSs that NUREG/CR-6144 concluded were the dominant risk contributors. The structure for the event trees for the POSs considered was taken from NUREG/CR-6144. POS information, time window information, and other items specific to shutdown operations were also taken from the NUREG/CR report. The system fault tree models, common cause failure modeling, and loss-of-offsite power recovery modeling were taken from the Revision 3i SPAR model for Surry.

- The PWR LP/SD template is essentially a working LP/SD model that has had all plant-specific fault tree logic removed. It was developed using the information contained in NUREG/CR-6144 and in the Revision 3i SPAR model for Surry.

- The scope of the detailed BWR LP/SD SPAR model is limited to three of the seven plant operating states (POSs) characterized in NUREG/CR-6143; one POS was analyzed (although in great detail) in NUREG/CR-6143. The BWR LP/SD SPAR model greatly simplified the model from NUREG/CR-6143, and added two more POSs. The structure for the event trees for the POSs considered was taken from NUREG/CR-6143. POS information, time window information, and other items specific to shutdown operations were also taken from the NUREG/CR report. The system fault tree models, common cause failure modeling, and loss-of-offsite power recovery modeling were taken from the Revision 3i SPAR model for Grand Gulf.

- The BWR 5/6 and the BWR 4 LP/SD templates followed the same modeling strategy as the PWR LP/SD template in that they are essentially working LP/SD models with all plant-specific fault tree logic removed. The BWR 5/6 template was developed using the information contained in the BWR LP/SD SPAR model and in the Revision 3i SPAR model for Grand Gulf.

- Because the LP/SD SPAR models for PWRs and BWRs use system fault tree models, common cause failure modeling, loss-of-offsite power recovery modeling, and human reliability analysis methods from the Revision 3i SPAR models, most of the results of the comparison of the Revision 3i SPAR models with the proposed ASME Standard on PRA apply to the LP/SD SPAR models as well. Two notable exceptions are the initiating event analysis and the success criteria areas. For these areas, the LP/SD SPAR models relied on the information contained in the two NUREG/CR reports.

Level 2/LERF SPAR Models

- The development of the Level 2/LERF SPAR models required the binning of all Level 1 accident sequences leading to core damage into a plant damage state (PDS) based on the conditions of the reactor coolant system (RCS) and the status of important accident mitigation systems at the time of core damage. Since the end states of the existing Level 1 models only indicate the core status (OK or core damage) for the accident sequences, and do not include sufficient containment system information that is crucial for Level 2 analysis, bridge event trees (BETs) were developed which model the required containment systems.

- The BETs were then linked to those accident sequences leading to core damage. The use of BETs allowed system dependencies between the various systems, such as electrical power, to be accounted for in the fault trees that support the BET top events.

- The LERF modeling process follows the NUREG-1150 Level 2 modeling process in that a detailed LERF event tree for each PDS was created which models the progression of the severe accident, including containment performance, through early containment failure.

Initiating Events Analysis		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
The initiating event analysis shall provide a reasonably complete identification of initiating events.	Yes	The approach used in the initiating events analysis for the Revision 3i SPAR models meets this HLR to the extent required, commensurate with the intended use and limited scope of the models.
The initiating event analysis shall group the initiating events so that events in the same group have similar mitigation requirements (that is, the requirements for most events in the group are less restrictive than the limiting mitigation requirements for the group) to facilitate an efficient but realistic estimation of CDF.	Yes	
The initiating event analysis shall estimate the annual frequency of each initiating event or initiating event group.	Yes	The Revision 3i SPAR models use the initiating event frequencies obtained from operating experience data and documented in NUREG/CR-5750 published by RES/DRAA/OERAB.

Initiating Events Analysis (Continued)		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
The initiating event analysis shall be documented in a manner that facilitates PRA applications, upgrades, and peer review by describing the processes that were followed to select, group, and screen the initiating event list and to model and quantify the initiating event frequencies, with assumptions and bases stated.	No	The users manuals for the Revision 3i SPAR models provide very little documentation regarding the initiating events analysis for the models, such as the basis for initiating event selection, grouping of initiating events, etc. However, the frequencies for the initiating events are identified and relevant references cited. Nevertheless, the SPAR models do not meet Supporting Requirements IE-D1, IE-D2, IE-D3, and IE-D4.

Accident Sequence Analysis		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
The accident sequence analysis shall describe the plant-specific scenarios that can lead to core damage following each initiating event or initiating event category. These scenarios shall address system responses and operator actions, including recovery actions, that support the key safety functions necessary to prevent core damage.	Yes	An objective of the SPAR model development effort is to produce plant-specific models that realistically model the anticipated response of the plant to specific accident initiators. During the external QA process for the Revision 3i SPAR models, the event tree structure is checked against the event tree structure in the licensee's PRA model.
Dependencies due to initiating events, human interface, functional dependencies, environmental and spatial impacts, and common cause failures shall be addressed.	Yes	The SPAR models consider the same dependencies as the licensee's PRA model. The common cause failure methodology (Alpha Factor Method) used in the Revision 3i SPAR models is a recognized, industry-accepted method for treating CCFs. Supporting Requirements AS-B4 and AS-B5 (address PLG approach) do not apply to the SPAR models.
Documentation shall be performed in a manner that facilitates peer review, as well as future upgrades and applications of the PRA by describing the processes that were used, and providing details of the assumptions made and their bases.	No	The documentation does not explicitly state the basis for assumptions in a consistent manner (e.g., no basis is given for the treatment of the condensate storage tanks). It also does not differentiate assumptions from key facts. The SPAR models do not meet Supporting Requirements AS-C1, AS-C2, AS-C3, and AS-C4.

Success Criteria		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
The overall success criteria for the PRA and the system, structure, component and human action success criteria used in the PRA shall be defined and referenced, and shall be consistent with the features, procedures, and operating philosophy of the plant.	Yes	The Revision 3i SPAR models use the same success criteria as those used in the licensee's PRA.
The thermal/hydraulic, structural and other supporting engineering bases shall be capable of providing success criteria and event timing sufficient for quantification of CDF and LERF, determination of the relative impact of success criteria on SSC and human action importance, and the impact of uncertainty on this determination.	Yes	The Revision 3i SPAR models implicitly rely on those thermal-hydraulic, structural, and other engineering bases used to generate the success criteria in the licensee's PRA or in the FSAR. For those cases in which the SPAR models use different success paths (e.g., secondary side depressurization and cooldown for some PWR accident sequences in which HPI fails), event-specific thermal-hydraulic analyses have been performed by the NRC staff to confirm that credit for the assumed success path can be taken on the basis of plant response, time available, and desired outcome (steady state condition).

Success Criteria(Continued)		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
Documentation shall be performed in a manner that facilitates peer review, as well as future upgrades and applications of the PRA, by describing the processes that were used, and providing details of the assumptions made and their bases.	No	The documentation for the Revision 3i SPAR models does not consistently identify the bases for the assumptions used to derive the success criteria (licensee's PRA). This includes the cases for which specific thermal-hydraulic analyses have been performed by the NRC staff to confirm the viability of different success criteria and success paths. The SPAR models do not meet Supporting Requirements SC-C1, SC-C2, and SC-C4.

Systems Analysis		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
The systems analysis shall provide a reasonably complete treatment of the causes of system failure and unavailability modes represented in the initiating events analysis and sequence definition.	Yes	The Revision 3i SPAR models meet this HLR to the extent required, commensurate with their level of detail, limited scope, and intended use. The external QA process includes an onsite QA review of model against the licensee's PRA model. This review also involves the licensee's PRA staff.
The systems analysis shall provide a reasonably complete treatment of common cause failures and intersystem and intra-system dependencies.	Yes	
The systems analysis shall be documented in a manner that facilitates PRA applications, upgrades, and peer review by describing the processes that were followed to select, to model, and to quantify the system unavailability. Assumptions and bases shall be stated.	No	Documentation for the Revision 3i SPAR models does not meet Supporting Requirement SY-C1 because it is inconsistent and incomplete.

Human Reliability Analysis		
High Level Requirement - Pre-Initiator HRA	Revision 3i SPAR Models Meet It?	Comment
A systematic process shall be used to identify those specific routine activities which, if no completed correctly, may impact the availability of equipment necessary to perform system function modeling in the PRA.	Yes	The process used in developing the Revision 3i SPAR models meets the intent of this HLR to the extent required, commensurate with the level of detail in the models and their intended purpose.
Screening of activities that need not be addressed explicitly in the model shall be based on an assessment of how plant-specific operational practices limit the likelihood of errors in such activities.	Yes	The process used in developing the Revision 3i SPAR models meets this HLR to the extent required, commensurate with the level of detail in the models and their intended purpose.
For each activity that is not screened, an appropriate human failure event (HFE) shall be defined to characterize the impact of the failure as an unavailability, of a component, system , or function modeled in the PRA.	Yes	The Revision 3i SPAR models meet this HLR to the extent required, commensurate with the level of detail in the models, their intended purpose, and limited scope. Supporting Requirement HR-C3 does not apply to the SPAR models, since actuation systems are not included in the models.
The assessment of the probabilities of the pre-initiator human failure events shall be performed by using a systematic process that addresses the plant-specific and activity-specific influences on human performance.	Yes	The Revision 3i SPAR models meet this HLR to the extent required, commensurate with the level of detail in the models, their intended purpose, and limited scope.

Human Reliability Analysis (Continued)		
High Level Requirement - Pre-Initiator HRA	Revision 3i SPAR Models Meet It?	Comment
A systematic review of the relevant procedures shall be used to identify the set of operator responses required for each of the accident sequences.	Yes	
Human failure events shall be defined that represent the impact of not properly performing the required responses, consistent with the structure and level of detail of the accident sequences.	Yes	
The assessment of the probabilities of the post-initiator HFEs shall be performed using a well-defined and self-consistent process that addresses the plant-specific and scenario-specific influences on human performance, and addresses potential dependencies between human failure events in the same accident sequence.	No	Although the Revision 3i SPAR models meet Supporting Requirements HR-G1 through HR-G8, they do not meet Supporting Requirement HR-G9 because they do not consider uncertainty in the estimates of human error probabilities.
Recovery actions (at the cutset or scenario level) shall be modeled only if it has been demonstrated that the action is plausible, and feasible for those scenarios to which they are applied. Estimates of probabilities of failure shall address dependency on prior human failures in the scenario.	Yes	
Pre- and Post-Initiator HRA		
The HRA shall be documented in a manner that facilitates PRA applications, upgrades and peer review by describing the processes that were used, and providing details of the assumptions made and their bases.	Yes	

Data Analysis		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
Each parameter shall be clearly defined in terms of the logic model, basic event boundary, and the model used to evaluate event probability.	Yes	
The rationale for grouping components into a homogeneous population for the purposes of parameter estimation shall consider both the design, environmental, and service conditions of the components in the as-built and as-operated plant.	Yes	
Generic parameter estimates shall be chosen and plant-specific data shall be collected consistent with the parameter definitions of HLR A above and the grouping rationale of HLR B above.	Yes	The Revision 3i SPAR models meet this HLR to the extent required, commensurate with the level of detail in the models, their intended purpose, and limited scope.
The parameter estimates shall be cased on relevant generic industry or plant-specific evidence. Where feasible, generic and plant-specific evidence shall be integrated using acceptable methods to obtain plant-specific parameter estimates. Parameter estimates for the important parameters shall be accompanied by a characterization of the uncertainty.	Yes	The Revision 3i SPAR models meet this HLR to the extent required, commensurate with the level of detail in the models, their intended purpose, and limited scope.
Documentation shall be performed in a manner that facilitates peer review, as well as future upgrades and applications of the PRA by describing the processes that were used, and providing details of the assumptions made and their bases.	No	The Revision 3i SPAR models do not meet Supporting Requirement DA-E1 because the documentation of the data analysis is not consistent and complete.

Internal Flooding		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
Different flood areas of the plant and the SSCs located within the area shall be identified.	N/A	The scope of the Revision 3i SPAR models does not include internal flooding. Internal flooding is considered an external initiator.
The potential flood sources in the plant and their associated flooding mechanisms shall be identified.	N/A	The scope of the Revision 3i SPAR models does not include internal flooding. Internal flooding is considered an external initiator.
The potential flooding scenarios shall be developed for each flood source by identifying the propagation path(s) of the water and the affected SSCs.	N/A	The scope of the Revision 3i SPAR models does not include internal flooding. Internal flooding is considered an external initiator.
Flooding-induced initiating events shall be identified and their frequencies estimated.	N/A	The scope of the Revision 3i SPAR models does not include internal flooding. Internal flooding is considered an external initiator.
Flood-induced accident sequences shall be quantified.	N/A	The scope of the Revision 3i SPAR models does not include internal flooding. Internal flooding is considered an external initiator.
The internal flooding analysis shall be documented in a manner that facilitates PRA applications, upgrades, and peer review by describing the processes that were followed, with assumptions and bases stated.	N/A	The scope of the Revision 3i SPAR models does not include internal flooding. Internal flooding is considered an external initiator.

Quantification		
High Level Requirement	Revision 3i SPAR Models Meet It?	Comment
The Level 1 quantification shall quantify core damage frequency.	Yes	
The quantification shall use appropriate models and codes, and shall account for method-specific limitations and features.	Yes	
Model quantification shall determine that all identified dependencies are addressed appropriately.	Yes	
The quantification results shall be reviewed and important contributors to CDF, such as initiating events, accident sequences, equipment failures and operator errors, shall be identified. The results shall be traceable to the inputs and assumptions made in the PRA.	Yes	
Uncertainties in the PRA results shall be characterized. Sources of model uncertainty and key assumptions shall be identified, and their potential impact on the results understood.	Yes	The Revision 3i SPAR models meet this HLR to the extent required, commensurate with the level of detail in the models, their intended purpose, and limited scope.
Documentation shall be performed in a manner that facilitates peer review, as well as future upgrades and applications of the PRA by describing the processes that were used, and providing details of the assumptions made and their bases.	No	The Revision 3i SPAR models do not meet Supporting Requirements QU-F1 and QU-F3 through QU-F6.

LERF Analysis		
High Level Requirement	LERF SPAR Models Meet It?	Comment
Plant Damage Analysis		
Core damage sequences shall be grouped into plant damage states based on their accident progression attributes.	Yes	
Accident Progression Analysis		
LERF evaluations shall include an analysis of the credible severe accident phenomena.	Yes	
LERF evaluations shall include an analysis of containment system performance.	Yes	
LERF evaluations shall include an analysis of containment structural capability.	Yes	
LERF Quantification		
The frequency of different containment failure modes leading to a large early release shall be quantified and aggregated.	Yes	
LERF shall be quantified in a manner that captures factors important to risk and supports an understanding of the sources of uncertainty.	No	The LERF SPAR models do not meet Supporting Requirement LE-F2 because they do not provide either a qualitative or a quantitative assessment of the sources of uncertainty in the results.

LERF Analysis		
High Level Requirement	LERF SPAR Models Meet It?	Comment
Documentation		
The documentation of the LERF analysis shall be performed in a manner that facilitates peer review, as well as future upgrades and applications of the PRA by describing the processes that were used, and providing details of the assumptions made and their bases.	No	The documentation for the LERF SPAR models is incomplete in that it does not adequately describe the treatment of feasible operator actions following the onset of core damage. Nor does it describe the environmental impacts (and impact of containment failure) on continued operation of equipment and operator actions. Therefore the LERF SPAR models do not meet Supporting Requirements LE-C8 and LE-C9.

Peer Review (In the Case of the Revision 3i SPAR Models - Quality Assurance)		
QA Area	**QA Requirement**	**<u>Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?</u>**
Frequency	Once, prior to PRA use	The Revision 3i SPAR model QA process meets the PRA Standard to the extent required, commensurate with the level of detail in the models, their intended purpose, and their limited scope.
	Peer review of each PRA upgrade	Not Applicable - No way to implement this requirement for Revision 3i SPAR model, since licensees are not required to notify NRC whenever they have completed an upgrade of their PRA model.
Elements of Written Methodology Used		
Process for selection of QA team	Acceptable Guidance in NEI-00-02	The Revision 3i SPAR models meet this requirement, commensurate with the level of detail, the purpose of the models, and their limited scope. Only one individual conducts the internal QA review and the external QA review. A PRA analyst other than the one who constructed the specific model conducts the internal QA review of a Revision 3i SPAR model. The PRA analyst who constructed the model conducts the external QA review of the model, together with a regional office SRA, OERAB staff and the licensee's PRA staff.

Peer Review (In the Case of the Revision 3i SPAR Models - Quality Assurance) (Continued)		
QA Area	**QA Requirement**	**<u>Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?</u>**
Training in QA process	Acceptable Guidance in NEI-00-02	Yes, to the extent required, commensurate with the level of detail in the models, their intended purpose, and their limited scope.
Approach for assessing PRA against Section 4 of PRA Standard	Acceptable Guidance in NEI-00-02	Yes, to the extent required, commensurate with the level of detail in the models, their intended purpose, and their limited scope. An important consideration is that the SPAR model QA process reviews the model against the licensee's PRA model, not against the PRA Standard per se.
DPO process	Acceptable Guidance in NEI-00-02	Yes, to the extent required, commensurate with the level of detail in the models, their intended purpose, and their limited scope. The agency has a formal process for treating a DPO expressed by its contractors that is separate from the QA process.

Peer Review (In the Case of the Revision 3i SPAR Models - Quality Assurance) (Continued)		
QA Area	**QA Requirement**	**Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?**
Process for reviewing PRA configuration control	Acceptable Guidance in NEI-00-02	Yes, to the extent required, commensurate with the level of detail in the models, their intended purpose, and their limited scope. Configuration control of Revision 3i SPAR model development is governed by the Form 189 and reviewed by the NRC/RES Project Manager.
Method for documenting review results	Acceptable Guidance in NEI-00-02	Yes, to the extent required, commensurate with the level of detail in the models, their intended purpose, and their limited scope.
QA Team Composition and Qualifications	Collective Qualifications	Yes, to the extent required, commensurate with the level of detail in the models, their intended purpose, and their limited scope.
QA Team Composition and Qualifications	Individual Team Member Qualifications	See comment on Selection of Team Members above.

PRA Element to be QA'd	Scope	Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?
Initiating Event Analysis	Entire IE analysis	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
Accident Sequence Analysis	Accident sequence model for a BOP transient.	Yes
	Accident sequence model containing LOOP/Station Blackout considerations.	Yes
	Accident sequence model for a loss of a support system initiating event.	Yes
	LOCA accident sequence model.	Yes
	ISLOCA accident sequence model.	Yes
	SGTR accident sequence model for PWRs only.	Yes
	ATWS accident sequence model.	Yes
Success Criteria	Definition of core damage used in the success criteria evaluations and supporting bases.	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
	Modeling of conditions corresponding to a safe stable state.	Yes

PRA Element to be QA'd	Scope	Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?
	Core and containment response conditions used in defining LERF and supporting bases.	The scope of the Level 1, Revision 3i SPAR models does not include LERF.
	Core and containment system success criteria used in the PRA for mitigating each modeled initiating event.	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
	Generic bases (including assumptions) used to establish the success criteria for systems credited in the PRA and the applicability to the modeled plant.	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
	Plant-specific bases (including assumptions) used to establish the system success criteria for systems credited in the PRA.	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
	Calculations performed specifically for the PRA, for each computer code used to establish core cooling or decay heat removal success criteria and accident sequence timing.	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
	Calculations performed specifically for the PRA, for each computer code used to establish support system success criteria (e.g., a room heat-up calculation used to establish room cooling requirements or a load shedding evaluation used to determine battery life during an SBO).	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.

PRA Element to be QA'd	Scope	Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?
	Containment response calculations, performed specifically for the PRA, for the dominant plant damage states.	The scope of the Level 1, Revision 3i SPAR models does not include LERF.
	Expert judgements used in establishing success criteria used in the PRA.	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
Systems Analysis	Dominant systems contributing to the CDF or LERF calculated in the PRA.	Yes
	Different models reflecting different levels of detail.	Yes
	Front-line system for each mitigating function (e.g., reactivity control, coolant injection, and decay heat removal).	Yes
	Each major type of support system (e.g., electrical power, cooling water, instrument air, and HVAC)	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
	Complex system with variable success criteria (e.g., a cooling water system requiring different numbers of pumps for success dependent upon whether non-safety loads are isolated).	Yes
Human Reliability Analysis	HEPs for dominant human actions contributing to the CDF or LERF calculated in the PRA.	Yes
	The selection and implementation of any screening HEPs used in the PRA.	Yes

PRA Element to be QA'd	Scope	Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?
	Post-accident HEPs.	Yes
	Pre-initiator HEPs for both instrumentation miscalibration and failure of equipment.	Yes
	HEPs for the same human action, but with different times required for success.	Yes
	HEPs for dependent human actions.	Yes
	HEPs less than 1E-4.	Yes
	HEPs involving remote actions in harsh environments.	Yes
Data Analysis	Data values for component failure modes contributing to the CDF or LERF calculated in the PRA.	Yes
	Common cause failure values.	Yes
	The numerator and denominator for one data value for each major failure mode (e.g., failure to start, failure to run, and test and maintenance unavailabilities).	Yes, to the extent required, commensurate with the level of detail in the models and their intended purpose.
Internal Flooding	Dominant internal flooding contributors to the CDF or LERF calculated in the PRA.	The scope of the Revision 3i SPAR models does not include internal flooding (considered an external event initiator).

PRA Element to be QA'd	Scope	Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?
	The screening of any flood areas.	The scope of the Revision 3i SPAR models does not include internal flooding (considered an external initiator).
	Internal flood initiating event frequencies.	The scope of the Revision 3i SPAR models does not include internal flooding (considered an external event initiator).
	Internal flooding scenario involving each identified flood source.	The scope of the Revision 3i SPAR models does not include internal flooding (considered an external event initiator).
	Internal flooding scenarios involving flood propagation to adjacent flood areas.	The scope of the Revision 3i SPAR models does not include internal flooding (considered an external event initiator).
	Internal flooding scenario that involves each of the flood-induced component failure mechanisms (i.e., one flood scenario for each mechanism).	The scope of the Revision 3i SPAR models does not include internal flooding (considered an external event initiator).
	One internal flooding scenario involving each type of identified accident initiator (e.g, transient and LOCA).	The scope of the Revision 3i SPAR models does not include internal flooding (considered an external event initiator).
Quantification - Level 1	Appropriateness of the computer codes used in the quantification.	Yes
	The truncation values and process.	Yes
	The recovery analysis.	Yes

PRA Element to be QA'd	**Scope**	**Does Rev. 3 SPAR Model QA (Internal + External) Process Meet the PRA Standard?**
	Model asymmetries and sensitivity studies.	Yes
	The process for generating modules (if used).	Yes
	Logic flags (if used).	Yes
	The solution of logic loops (if appropriate).	Yes

COMPARISON OF RADS AND CCF DATABASE WITH PROPOSED STANDARDS FOR PROBABILISTIC RISK ASSESSMENT

4.4.6 DATA ANALYSIS		
High Level Requirement	RADS and CCF Data Meet It?	Comment
HLR DA-A Each parameter shall be clearly (RES File Code) RES 2C-1fined in terms of the logic model, basic event boundary, and the model used to evaluate event probability.	Yes	The parameters computed by RADS (demand failure probability and operating failure rate) and CCF Database meet the high level and supporting requirements for clear definitions in most aspects. EPIX data entered in RADS do not meet DA-A1 in that component boundaries are not defined. However, EPIX provides a structure that groups devices similarly to generally accepted PRA component boundaries but does not provide explicit component boundaries. NRC is working with INPO and industry for clearer and more consistent reporting of components in EPIX.
HLR DA-B The rationale for grouping components into a homogeneous population for the purposes of parameter estimation shall consider both the design, environmental, and service conditions of the components in the as-built and as-operated plant.	Yes	RADS meets the high level and Capability Category III for the supporting requirements. The system provides statistical tests of homogeneity to determine if data for components can be pooled across systems and plants, etc.

HLR DA - C Generic parameter estimates shall be chosen and plant-specific data shall be collected consistent with the parameter definitions of HLR A and the grouping rationale of HLR B.	Yes	RADS uses plant-specific data reported in EPIX. CCF Database uses plant-specific data from NPRDS, LERs, and EPIX. Data meet the high level and Capability Category III supporting requirements for the most part. EPIX data do not meet all the supporting requirements in DA-C6 through DA-C10. RES has been working with INPO and industry to provide data that are defined and grouped in accordance with HLR DA-A and HLR DA-B. If these data are not provided in EPIX, RES plans to develop “workaround data” that will meet the supporting requirements.
HLLR DA -D The parameter estimates shall be based on relevant generic industry or plant specific evidence. Where feasible, generic and plant specific evidence shall be integrated using acceptable methods to obtain plant specific parameter estimates. Parameter estimates for the important parameters shall be accompanied by a characterization of the uncertainty.	Yes	For the parameters which RADS and the CCF Database provide estimates, the systems would meet the high level requirements and Capability Category III supporting requirements. RADS and CCF Database provide classical and Bayesian techniques for computing both plant specific and industry wide estimates and a statistical representation of the uncertainty. The CCF Database uses both the Alpha Factor Model and the Multiple Greek Letter Model to estimate CCF parameters. The ASME Standard references NUREG/CR-5485 that was developed as part of the documentation of the CCF Database to provide guidance on how to apply the CCF Database information to PRA studies.
HLR DA-E Documentation shall be performed in a manner that facilitates peer review, as well as future upgrades and application of the PRA by describing the processes that were used, and providing details of the	Yes	RADS and CCF provide extensive documentation on the model and methods used for computing parameter estimates. The systems provide the analyst options for selecting components, systems, events, time period, prior distributions, etc. for their studies. Analysts should provide documentation in their studies and analyses on the data and methods selected in using these systems and methods for grouping components.

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REMARKS

Comments on "ASME Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications"

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