

February 17, 2004

MEMORANDUM TO: Ashok C. Thadani, Director  
Office of Nuclear Regulatory Research

FROM: J. E. Dyer, Director **/RA/**  
Office of Nuclear Reactor Regulation

SUBJECT: USER NEED REQUEST FOR SUPPORT IN THE DEVELOPMENT OF  
STANDARD PROCEDURES AND METHODS FOR RISK  
ASSESSMENTS OF INSPECTION FINDINGS AND REACTOR  
INCIDENTS

This memorandum forwards a User Need memorandum (Attachment 1) that requests support in the development of standard procedures and methods for performing risk assessments of inspection findings and reactor incidents.

NRC Inspection Manual Chapter 609, "Significance Determination Process" (SDP) requires that risk analysts utilize appropriate probabilistic risk assessment (PRA) techniques to analyze inspection findings that depart from the SDP phase 1 or phase 2 process. In addition, Management Directive 8.3, "NRC Incident Investigation Program," requires the analysis of reactor incidents. NRR and the regions do not have well-defined procedures for performing these analyses, and therefore the results may vary significantly. The goal of this User Need request is to utilize the expertise developed in RES through the years of implementing the accident sequence precursor (ASP) program to develop procedures and methods that will be utilized by RES, NRR, and the Regions to achieve more consistent results when performing risk assessments.

The Operating Experience and Risk Analysis Branch (OERAB) of RES has the expertise to perform the specific tasks listed in the memorandum. The NRR Division of Safety Systems Analysis, the Inspection Program Branch, and OERAB have discussed the tasks, deliverables, and due dates extensively to prioritize the work.

NRR has determined that these tasks are priority items that should to be accomplished. NRR has ranked the User Need against the four outcome goals; maintaining safety, enhancing public confidence, reducing unnecessary regulatory burden, and increasing the effectiveness and efficiency of our activities. This User Need received a total score of 10 out of a possible 12, and has been assigned a high priority. My staff has used this priority value in their discussions with members of your staff to determine whether your office can support the tasks identified in this user need. These discussions indicate that RES can support the scope and schedule proposed for these tasks without displacing other user need requests. If this should change, we request prior notification of any RES work for NRR that will be displaced.

Attachments: As stated

CONTACT: Richard Rasmussen, NRR/DSSA/SPSB  
415-8380

A. Thadani

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STANDARD PROCEDURES AND METHODS FOR RISK ASSESSMENTS OF  
INSPECTION FINDINGS AND REACTOR INCIDENTS

cc: S. Collins, DEDR  
J. Craig, ADIP  
B. Sheron, ADPT  
S. Black, DSSA  
B. Boger, DIPM  
M. Tschiltz, DSSA  
S. Richards DIPM  
C. Ader, RES  
P. Baranowsky, RES

A. Thadani

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\*See previous concurrence

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NRR-106

<b>OFFICE</b>	NRR:DSSA	NRR:DSSA	NRR:DSSA	NRR:DIPM
<b>NAME</b>	*RRasmussen:nxh2	*MReinhart	*MTschiltz	*SRichards
<b>DATE</b>	07/30/2003	07/30/2003	08/26/2003	12/4/2003
<b>OFFICE</b>	NRR:DSSA	NRR:ADPT	NRR:D	
<b>NAME</b>	*Sblack	BSheron	JDyer	
<b>DATE</b>	12/4/2003	02/13/2004	02/17/2004	

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## USER NEED FOR THE RISK ASSESSMENT STANDARDIZATION PROJECT

### **Project Objectives:**

- Provide standard methods and procedures for performing risk analyses of inspection findings and reactor incidents.
- Improve the coordination among various NRC programs performing risk analyses of licensee performance deficiencies or reactor incidents.
- Reduce the time to perform a risk analysis of licensee performance deficiencies or reactor incidents.
- Ensure independence of RES and the ASP Program.
- Improve internal and external risk communications.
- Provide solutions to technical issues surrounding risk assessments and operating events.
- Provide NRC risk analysts sufficient information to assess the quality of licensee risk analysis results.

### **Summary:**

Risk assessments of reactor incidents and conditions are performed by several groups within the NRC without the benefits of standard procedures, methods, models, and formats. This results in the duplication of efforts, inconsistent products, and conflicting results. In addition, the lack of detailed analysis procedures and methods results in more time needed to complete routine risk analysis of operating events and licensee performance issues. Further, the lack of analysis procedures and methods makes it difficult to communicate risk both internally and externally. Issues surrounding the SDP are identified in the SDP task action plan. The Risk Assessment Standardization Project, as envisioned, will provide consistent methods and formats so that products will meet users' needs. The primary focus of this project is to standardize risk analysis of conditions in the ASP and SDP Phase III programs and the risk analysis of events/conditions in the ASP and incident investigation programs (MD 8.3). This project will satisfy several commitments included in the SDP task action plan.

Major attributes of this project include:

- Develop standard procedures and methods for internal event analysis.
- Develop standard procedures and methods for evaluating external events, large early release frequency (LERF), and low power and shutdown events.
- Revise program procedures to consolidate activities.
- Provide readily available technical support for SDP analysts.
- Develop standard technical training on conducting SDP Phase III and ASP analyses.

**Major Tasks:**

- Develop the following in the context of supporting analyses necessary for evaluating inspection findings and reactor incidents:
  - Procedures and methods for internal initiating events.
  - Procedures and methods for external events.
  - Procedures and methods for LERF.
  - Procedures and methods for low power and shutdown events.
  - Continue development of SPAR models (enhanced SPAR 3 models, develop LERF and SD/LP models).
  - Approach and guidance to evaluate the quality of licensee PRA results.
  - Procedures and protocol for peer reviews.
- Provide readily available technical assistance to NRR and Regional SRA's.
- NRR and RES jointly revise and develop procedures.
- Continue to perform quarterly reviews of SDP findings that are greater than Green. This review was previously requested in user need memorandum NRR-2002-004 dated January 31, 2002.
- Provide technical guidance for training development.

A detailed list of RES deliverables and projected delivery dates are attached as appendix A. Note that NRR and Regions will provide support and review for the above in the form of a users group.

**Basis for Project Development:**

The Risk Assessment Standardization Project will enhance the NRC Nuclear Reactor Strategic Goals as discussed below. The project will also accomplish commitments documented in the SDP task action plan.

- Maintain safety, protection of the environment, and the common defense and security
  - Standard procedures for the risk analysis of events, both internal and external for all operating modes, will improve:
    - Our response capability to reactor incidents (i.e., MD 8.3).
    - Allow for more thorough and consistent peer reviews.
  - Improving coordination of analyses will provide additional time for the analysis of more risk-important events.

- Increase public confidence
  - The use of standard procedures, methods and formats, will facilitate risk communication by improving focus, clarity, and consistency.
    - By enhancing the ability to meet the SDP timeliness goals for the evaluation of inspection findings.
    - By improving the consistency of the results of SDP (for simpler analyses) and ASP (for more complicated and detailed analyses.)
    - By improving methods for the analysis of external events, LERF, and shutdown, thus improving the credibility of results.
- Make NRC activities and decisions more effective, efficient, and realistic.
  - Through the use of standardized methods and procedures, the efficiency of performing and interpreting risk assessments will improve.
  - Through the development of improved and standardized methods for evaluating external and low power and shutdown events.
  - Through the utilization of common procedures and products that produce results from simpler analyses that can be easily used in more complicated and detailed analyses.
  - Through the reduction of the duplication of efforts in performing operational experience reviews.
- Reduce unnecessary regulatory burden on stakeholders.
  - Through improved cooperation and sharing of information between RES and NRR that will reduce the number of requests for data from licensees.
  - Through the development of standard methods and procedures that reduce the review time by external (licensee) stakeholders by increasing the confidence of licensees in the NRC's analyses.

**Priority:**

The priority of this user need was determined using the four reactor safety goals: maintaining safety; increasing public confidence; making NRC activities and decisions more effective, efficient, and realistic; and reducing unnecessary regulatory burden on stakeholders. This user need received a total score of 10 out of a possible 12, and has been assigned a high priority.

## Appendix A

# User Need for the Risk Assessment Standardization Project --- RES Tasks

### Statement of Work

#### 1. **Develop guidelines for the analysis of internal events during power operations.**

RES should document guidelines for the analysis of conditions and events that have been previously performed by the SDP Phase 3, MD 8.3, and ASP processes. These guidelines should provide the analyst with the basic steps (with bases) for formulating assumptions, and recommending the appropriate methods and modeling techniques. The cache of ASP analyses from the ASP database should be reviewed for methods and modeling techniques. The assumptions, methods, and SPAR model changes that were used in the event-specific analysis of conditions and initiating events should be collected and reviewed for applicability to SDP and MD 8.3 process. The guidelines should include examples and necessary worksheets for completing required steps.

Existing methods used in the SDP Phase 3, MD 8.3, and ASP programs should be standardized, where possible. Significant differences of existing methods that should be standardized should be reviewed by an expert panel of senior PRA analysts from RES and NRR for final resolution. The guidelines should note any acceptable differences between programs.

*Reviews.* RES should ensure that an independent PRA analyst reviews each draft guideline. Additionally, each guideline or collection of guidelines should be sent for peer review by the NRC technical staff (NRR, RES, Regions), industry groups (NEI, INPO, EPRI, NSSS owners groups), and the public. Changes in the draft guidelines based on peer comments should be reviewed by an independent PRA analyst. Technical audits by RES/OERAB management should be performed for preliminary and final guidelines prior to issuance. Technical differences should be discussed with the reviewer. If required, unresolved differences should be reviewed by an *expert panel* of NRR and RES senior PRA analysts for final resolution. The response to comments and differences should be documented in the transmittal of the final ASP guideline.

RES should develop guidelines for the analysis of internal events for the following generic and event-specific methods and processes:

##### 1.1 **Generic methods.** Guidelines for generic analysis methods should include:

- a. Treatment of human error and guidelines for human error probability adjustments using the SPAR-H human reliability analysis method.
- b. Treatment of common-cause events and guidelines for common-cause failure probability adjustments. This guideline should include the procedure for calculating CCF probabilities using the CCF database.

- c. Guidelines for updating failure probabilities and initiating event frequencies, including: (i) when to update parameters, (ii) how to calculate parameters using Agency accepted statistical methods, and (iii) where to find the appropriate operating experience data. This guideline should include the procedure for calculating failure probabilities using the RADS/EPIX database, as well as documentation formats for saving updates on the Web.
- d. When and how to perform bounding, sensitivity, and uncertainty analyses. In particular, develop criteria to allow the staff to recognize situations where “The State of Knowledge” correlation, which is described in RG 1.174, might warrant further analysis.
- e. How to determine the duration of a degraded condition and how to window multiple conditions within the framework of the SDP, ASP, and MD 8.3 programs. This guideline should include discussions on the deterministic and probabilistic assessments of equipment and system functionality.
- f. Generic guide on what to consider when developing or modifying event and fault trees. Guidance should include considerations of plant-design features, thermal-hydraulics, top event dependencies, and operator action dependencies.

1.2 **Generic processes.** Guidelines for generic processes should include:

- a. Screening operating events for potential precursors (i.e., CCDP,  $\Delta$ CDP,  $\Delta$ CDF  $\geq 1E-6$ ). This guideline should standardize, where possible, the screening criteria used in the SDP, MD 8.3, and ASP processes.
- b. Performing a risk analysis of a degraded condition. This generic guideline should document a systematic process to initiate and complete a preliminary analysis. The guideline should include the collection of event and plant-specific information (gathering of the facts), formulation of assumptions, links to generic methods and event-specific methods (see below), manipulation of the SPAR model, evaluation of results, and treatment of parameter and modeling uncertainties.
- c. Performing a risk analysis of an initiating event. (See the task on performing a risk analysis of a degraded condition for the general topics in the guideline.)
- d. Documenting the results of a risk analysis using standardized format and content. This guideline should be developed in conjunction with the effort to modify the contents of the GEM printout. (See Task 3)
- e. Conducting formal and informal expert elicitations.
- f. Detailed checklists for peer reviews. These checklists should be the simplified version of the analysis guidelines.

1.3 **Condition-specific analysis.** Guidelines for event and condition-specific analysis of internal events should include:

- a. Loss of offsite power (LOOP) events, including partial LOOPs.
- b. Steam generator tube ruptures.
- c. Primary system pressure boundary cracks and leaks.
- d. Loss-of-coolant accidents—small, medium, and large breaks.
- e. Inadvertent opening/stuck-open relief valve events.
- f. High-energy line break events.

2. **Develop new methods and guidelines for the SDP Phase 3, ASP, and MD 8.3 analysis of internal fires and flooding, external events, internal events during lower power and shutdown operations, and LERF.**

RES should develop new methods and guidelines not covered in Task 1. This effort should require development of new methods and guidelines for the SDP Phase 3, ASP, and MD 8.3 analysis of internal fires and flooding, external events, internal events during lower power and shutdown operations, and LERF. In the case of internal events during lower power and shutdown operations and LERF, this task should involve the close coordination with the SPAR model development effort.<sup>1</sup> Each guideline should provide a systematic process to initiate and complete a preliminary analysis, as well as include examples and necessary worksheets for completing required steps. The guideline should include the collection of event and plant-specific information (gathering of the facts), formulation of assumptions, links to generic methods and event-specific methods, manipulation of the SPAR model, evaluation of results, and treatment of parameter and modeling uncertainties. In addition, event-specific guidelines for calculating site-specific initiating event frequencies and event-effected component failure probabilities should be included.

*Reviews.* The reviews of the guidelines development under this task should be similar to those in Task 1.

*Guidelines.* RES should develop the following new methods and guidelines:

- 2.1 Internal fire events during power operations.
- 2.2 Internal flooding events during power operations.
- 2.3 Seismic events during power operations.
- 2.4 High wind-related events (tornado, hurricanes, high winds) during power operations.
- 2.5 Internal events during low power and shutdown operations. This guideline should be

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<sup>1</sup> The SPAR model development effort is managed under the RES SPAR Model Development Program in accordance with the Integrated SPAR Model Development Plan. This plan conforms to the modeling needs that the SPAR Model Users Group (SMUG) members and their management identified for performing risk-informed regulatory activities. The SMUG is composed of representatives from each of the organizations within the agency's program and regional offices that use risk models in regulatory activities. The SMUG meets on a regular basis to provide technical guidance for the SPAR Model Development Program.

developed in conjunction with the SPAR model development effort for low power and shutdown operations.

- 2.6 Calculation of LERF. This guideline should be developed in conjunction with the SPAR model development effort for LERF calculations.

### 3. **Make SPAR model and GEM enhancements**

RES should make enhancements to the Revision 3 SPAR models and the GEM user interface as listed below. The SPAR model enhancement effort is beyond the existing scope of the SPAR Model Development Program. Future SPAR model enhancements not covered in this task should be supported under Task 4. It is recognized that all enhancements should be made in a model at the same time, and the modification of all models could take 2 or 3 years given the limited availability of experienced contractor staff. Therefore, RES should provide step-by-step procedures for manipulating and modifying the SPAR model for each enhancement.

In addition, this task should develop easy-to-use guidelines for the following commonly performed SAPHIRE and GEM manipulations; a user-friendly, SDP front-end interface for SPAR models; and a Web-based tool box for use in the risk analysis of operating events.

*Reviews.* The SPAR model enhancements should be documented, tested, and reviewed in accordance with the current SPAR model quality assurance program.

- 3.1 ***Enhancement procedures.*** RES should provide step-by-step procedures for making the following enhancements to the Revision 3 SPAR models:

- a. Modify the RCP LOCA model for Westinghouse, B&W and CE pumps in accordance with NRC-approved methodologies.
- b. Update the non-recovery probabilities (i.e., LOOP recovery times). Simplify the GEM module for LOOPS. Remove the feature in GEM for selecting LOOP duration groupings (e.g., plant-centered, severe weather, etc.).
- c. Update failure probabilities of basic events using data from EPIX and updated RES risk studies. Provide the bases for all failure probability parameters in the SPAR models. This should include the revision of the footnotes to the Basic Event Data Table in the SPAR model manuals.
- d. Provide guidance for modifying the SPAR model to include nominal non-recovery probabilities of components that can be recovered locally at the component. Update nominal non-recovery probabilities. (Revision 3 SPAR models include recovery of select components that are recoverable from the control room. These non-recovery probabilities are based on operating experience data from the RES system reliability studies. Revision 2QA SPAR models credited local recovery of components at the sequence level.)
- e. Modify the BWR models to credit long-term recovery of condenser heat

removal and containment venting. SPAR models do not consider long-term containment failure given loss of suppression pool cooling.

- f. Modify the loss of instrument air, loss of service water, and loss of component cooling water event trees to credit recovery of the support system. Provide non-recovery probabilities based on operating experience data, where possible.

3.2 **Model modifications.** RES should make modifications to the Revision 3 SPAR models with the enhancements listed in Task 3.1, above.

3.3 **Guidelines.** RES should develop easy-to-use guidelines for the following commonly performed SAPHIRE and GEM manipulations:

- a. Building and modifying event and fault trees.
- b. Updating basic event parameters for the base and current case models.
- c. Saving changes to the base and current case models.

The easy-to-use procedures should supplement the steps in the guidelines developed in Tasks 1 and 2, and the detailed users' manual for SAPHIRE.

3.4 **GEM user interface.** RES should develop a user-friendly, SDP front-end interface for SPAR models. RES should convene a core group of users (NRR/SPSB, NRR/IIPB, regional SRAs and SRIs) to meet with the SPAR Model Users Group (SMUG), RES/OERAB staff, and contractor to identify needs. RES should develop system specifications and provide them to the core group of users and the SMUG for comment. Following beta testing by key users, RES should make the necessary modifications to the user interface. RES should conduct workshop(s) to train users on the new interface. User support should be provided under Task 4, below.

3.5 **GEM printout.** RES should provide enhancements to the GEM printout of the results of a SPAR model run. Currently, the GEM report can be downloaded and saved in the ASCII text format. RES should modify the report in accordance with the standardized format for SDP and ASP analyses. Capability should be designed into GEM to allow entering text using WordPerfect edit features.

3.6 **Web-based tool box.** RES should develop a Web-based tool box for use in the risk analysis of operating events. This tool box should consolidate up-to-date information for use in ASP, SDP, and MD 8.3 analyses. Examples include guidelines, links to databases (e.g., SDP, ASP, CCF, LERs, 10 CFR 50.72 notifications, etc.), frequently used references, SPAR model basis documents (e.g., NUREGs), and release notes for guidelines and SPAR models. RES should convene a core group of users (NRR/SPSB, NRR/IIPB, RES/OERAB, regional SRAs) to identify needs. RES should document the system specifications and provide to the core group of users for comment. This Web-based system should be maintained under Task 4, below.

#### 4. Provide ongoing technical support

RES should provide technical support to NRR and regional senior reactor analysts (SRAs) on an as-requested basis. Technical support should include on-call support on the use of RES-developed products (guidelines, SPAR models, software codes, Web-based tool box), the maintenance of RES-developed products, enhancements to methods and SPAR models, and the peer review of SDP Phase 3 analyses.

4.1 **On-call assistance.** RES should provide on-call assistance for the following:

- a. The use of RES-developed guidelines used in SDP Phase 3 and MD 8.3 analyses. RES-developed guidelines include those developed in Tasks 1, 2, and 3.
- b. The use of SPAR models, SAPHIRE, and GEM.<sup>2</sup>

No documentation of each specific case of assistance should be provided by RES unless otherwise requested.

4.2 **New methods.** RES should develop new methods or refine existing methods to suit the analysis of unique and complex conditions.

*Work plan.* RES should provide NRR/SPSB with a work plan prior to development. The work plan should include: a work breakdown structure (WBS) with sufficient detail commensurate with the level and complexity of the effort; level of effort estimate for each WBS task; and completion dates of milestones. Reviews should be identified in the work plan. RES should meet with the Region SRA and/or NRR/SPSB within one week following the request to discuss the work plan. Every attempt should be made by RES to complete the development effort within the time frame of the SDP. However, in some cases, the complexity of the development effort or the availability of RES analysts may warrant a greater amount of time. In such cases, NRR and RES management may get involved to discuss the priority of resources to support NRR's needs.

*Reviews.* The content and peer reviews of the guidelines developed under this task should be similar to those in Task 1. However, NRR and RES should jointly determine the extent of the external peer reviews, given that the SDP provides a formal peer review by the licensee.

4.3 **SPAR model enhancements.** RES should provide generic and analysis-specific enhancements to the Revision 3 SPAR models. Generic model enhancements apply to a group of models. Analysis-specific enhancements apply to a unique condition under analysis. RES should provide for each enhancement either a modified version of the model file or step-by-step instructions for manipulating and modifying the SPAR model using GEM and SAPHIRE. Where a model file is provided, the appropriate portions of the SPAR model manual should be revised and

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<sup>2</sup> Contractor support to assist users of SPAR models and Saphire is currently provided by INEEL under existing Job Codes.

provided.

*Work plan.* RES should provide NRR/SPSB with a work plan for the proposed enhancement prior to development. The content of work plans and schedule requirements should be similar to those in Task 4.2, above.

*Reviews.* The enhancements should be documented, tested, and reviewed in accordance with the current SPAR model quality assurance program.

- 4.4 ***Guidelines maintenance.*** RES should maintain the RES-developed guidelines used in SDP Phase 3 and MD 8.3 analyses. RES-developed guidelines include those developed in Tasks 1, 2, and 3. This task should also include the maintenance of the Web-based tool box for the risk analysis of operating events. Each guideline should be reviewed by RES on an annual basis. RES should solicit comments from RES and NRR risk analysts, and SRAs. New and significantly enhanced methods should be covered under Subtask 4.2, above.

*Reviews.* The content and peer reviews of the guidelines revised under this task should be similar to those in Task 1. However, NRR and RES should jointly determine the extent of the external peer reviews, which should depend on the extent of the technical changes.

- 4.5 ***Peer review of SDP Phase 3 analysis.*** Peer reviews should be performed by RES, when requested by NRR, on those SDP Phase 3 analyses (both preliminary and final) that used the standardized guidelines and SPAR models. The review should be performed in accordance with the peer review checklist and should be performed by an analyst not involved in the SDP analysis. The review must be completed no later than two weeks for the preliminary review and one week for the final review after the NRR request in order to support SDP timeliness goals. RES should provide to NRR review comments and the completed peer review checklist. NRR should document resolution to any RES comments and the completed peer review checklist during the preliminary and final SDP determinations, however, NRR should make the final determination for issue disposition.

**Schedules**

<b>Task</b>		<b>Requested Completion Date</b>
1.	Develop guidelines for the analysis of internal events during power operations	October 2004
2.	Develop new methods and guidelines	
2.1	Internal fire events during power operations	TBD
2.2	Internal flooding events during power operations	TBD
2.3	Seismic events during power operations	TBD
2.4	High wind-related events (tornado, hurricanes, high winds) during power operations	TBD
2.5	Internal events during low power and shutdown operations	TBD
2.6	Calculation of LERF	TBD
3.	Make SPAR model and GEM enhancements	
3.1	SPAR model enhancement procedures	October 2004
3.2	SPAR Model modifications	October 2006
3.3	SAPHIRE and GEM manipulations guidelines	October 2004
3.4	GEM user interface modifications	October 2004
3.5	GEM printout modifications	October 2004
3.6	Web-based tool box construction	October 2004
4.	Provide ongoing technical support	Ongoing
4.1	On-call assistance	one day after request
4.2	New methods	meet within one week after request
4.3	SPAR model enhancements	meet within one week after request
4.4	Guidelines maintenance	October each year
4.5	Peer review of SDP Phase 3 analysis, if Requested	
	o First review	2 weeks after request
	o Final review	1 week after request