

March 11, 2005

MEMORANDUM TO: Michael C. Cheok, Assistant Chief  
Operating Experience Risk Analysis Branch  
Division of Risk Analysis and Applications  
Office of Nuclear Regulatory Research

FROM: Patrick D. O'Reilly /RA/  
Operating Experience Risk Analysis Branch  
Division of Risk Analysis and Applications  
Office of Nuclear Regulatory Research

SUBJECT: SUMMARY OF DECEMBER 16, 2004, STANDARDIZED PLANT  
ANALYSIS RISK (SPAR) MODEL USERS GROUP (SMUG) MEETING

On December 16, 2004, the Standardized Plant Analysis Risk (SPAR) Model Users Group (SMUG) met at NRC Headquarters in Rockville, Maryland. Regional office staff participated via teleconferencing. Staff representing two contractors, Idaho National Engineering and Environmental Laboratory (INEEL) and Brookhaven National Laboratory (BNL) - who provide technical support to the SPAR Model Development Program - also participated via teleconferencing. Attachment 1 contains a list of meeting attendees. Attachment 2 is the meeting agenda.

Significant points discussed during the meeting are summarized below.

#### Level 1, Revision 3 SPAR Model Development

Bob Buell, INEEL, reported that the procedural guidance for performing risk analyses with the SPAR models, which is being developed by a sub-contractor (Joe Minarick, SAIC), was on schedule for completion by the end of January 2005.

John Schroeder, INEEL, summarized the features contained in the new, improved loss of offsite power (LOOP)/station blackout (SBO) module recently developed for the Revision 3 SPAR models. The new module does not employ any convolution of time-dependent parameters as had been done in the previous version. The new module contains the recent NRC-approved reactor coolant pump (RCP) seal LOCA model for Westinghouse-designed PWRs, and the proposed Combustion Engineering Owners' Group RCP seal LOCA module, which is in the last stages of review by the NRC staff. This improved module also contains updated emergency diesel-generator (EDG) failure rates and recovery times; new core uncover times; battery depletion time is now explicitly modeled in the event tree instead of being rolled up into a convolution calculation; battery depletion time remains the maximum time credited for recovery of offsite power. This new, improved LOOP/SBO module has been incorporated into each of the 72 Revision 3 SPAR models now stored on the SAGAN server and on the SAPHIRE Users' Group website.

Bob Buell and Steve Eide, INEEL, described another extensive effort recently completed which consisted of updating the basic event failure data contained in the Revision 3 SPAR models to incorporate more recent data collected from the five-year period 1999-2003. In order to accomplish the loading of these data into all 72 models, INEEL developed a automated data loading process that allows this operation to be completed very quickly, in lieu of a manual loading of the data into each model - a very labor-intensive process - as had been done in the past. This data update effort also included an update of the initiating event frequency data in the SPAR models and updating of the alpha factor data contained in the common cause failure model incorporated in the SPAR models. In addition, nearly 3000 basic events in the models have been renamed to clarify and standardize the naming conventions. The final phase of this task, (review basic event names/descriptions to better match plant nomenclature) will be performed as part of the detailed cut set level review process described below.

Bob Buell discussed the 20-30 modeling issues that have been identified as contributing to the differences observed between the estimated baseline core damage frequency (CDF) obtained from the Revision 3 SPAR models and the corresponding CDF estimated by the respective licensee's PRA. Attachment 3 contains a prioritized list of these modeling issues. These issues were identified from: (1) the results of the onsite QA reviews of the Revision 3 SPAR models; (2) the results of the comparison exercise conducted with the Pilot Plants in the Mitigating Systems Performance Index (MSPI) Development Program; and (3) user feedback. Out of these issues, it was determined that ten either had a relatively large impact on the CDF comparison for a significant number of Revision 3 SPAR models or else they had a medium impact on the CDF comparison for a majority of the models (so-called significant, key issues). In developing the LOOP/SBO module discussed above, the top four modeling issues have already been addressed and their resolution incorporated into the Revision 3 SPAR models.

Bob Buell described the second part of the enhanced Revision 3 SPAR model development effort. This consists of performing a cut set level review of the Revision 3 SPAR models for the 61 plants that did not participate in the MSPI Pilot Plant comparison exercise. In this review, the results obtained with the Revision 3 SPAR model for a plant are compared with the corresponding results from the licensee's PRA down to the cut set level. Any differences observed are then explored with the licensee's PRA staff in an effort to determine the cause(s) and appropriate changes are made to the SPAR model so that it accurately portrays the anticipated response of the plant to the specific initiator considered. A cut set level review has recently been started on the first five SPAR models to undergo this process.

Another SPAR model upgrade task consisted of developing usage limitation screens for each of the Revision 3 SPAR models. Each set of these screens contains a summary of the significant differences between the SPAR model and the corresponding licensee's PRA. All of the plant-specific usage limitation screens have been developed and incorporated into the models, which were recently posted on the SAGAN server and the SAPHIRE Users Group Website.

#### Low Power/Shutdown (LP/SD) SPAR Model Development

Pat O'Reilly, RES/OERAB, reported that the revision of the draft NUREG/CR Report on the SPAR human reliability analysis (HRA) method has been completed, and preparation of a "plain English" Foreword is in progress. When this task has been finished, the report will be submitted for management review prior to publication.

Bill Galyean and Dan Henry, INEEL, reported that the project recently completed revising the LP/SD SPAR models for River Bend and Grand Gulf to address the comments generated by the onsite review of the River Bend LP/SD SPAR model against the licensee's shutdown PRA and the review of the Grand Gulf LP/SD SPAR model with the licensee's PRA staff. In addition, the project completed a revision of the LP/SD SPAR model template for BWR 3s/4s to make it consistent with the comments obtained during the onsite review of the LP/SD SPAR model for Peach Bottom 2 & 3.

The plans for the remainder of FY 2005 call for scheduling and performing a number of onsite QA reviews of other LP/SD SPAR models. Any remaining funding left in the FY 2005 budget (this project suffered a budgetary reduction of ~40% at the beginning of the fiscal year), will be applied to support development of additional LP/SD SPAR models. Two candidate plants have been identified: Davis-Besse (licensee has completed a shutdown PRA for this plant) and Hatch 1 & 2 (licensee has plans to prepare a shutdown PRA for this plant).

#### LERF SPAR Model Development

John Lehner, BNL, reported that the LERF SPAR model for the second lead plant, a BWR 3/4 with a Mark I containment (Peach Bottom 2 & 3) was completed and the model was transmitted to the licensee in October. Work has begun on development of the LERF SPAR model for the third lead plant, a Westinghouse PWR with an ice condenser containment (Sequoyah 1 & 2). Completion of this model is currently scheduled for May 2005.

#### Development of External Events Analysis Capability

Selim Sancaktar, RES/OERAB, discussed the results of the study performed by INEEL regarding the feasibility of expanding the Level 1, Revision 3 SPAR models to include external events initiators. Basically, it consisted of modifying the existing Revision 3 SPAR models to consider external events (e.g., internal fires and internal floods). The effort also evaluated a proposed standardized approach for incorporating seismic risk into the SPAR models, which could be used for all plants, whether or not they had performed a seismic PRA.

In summary, the project developed a method which successfully incorporated external events (including flooding and fire) into the existing Revision 3 SPAR model for Limerick 1 and 2. Then, using the results of this effort, the project developed a procedure (including validation of the results) for incorporating external events into all of the SPAR models. When compared with the results from the plant PRA, the SPAR model contribution to CDF from internal flooding was approximately one-fourth of the corresponding contribution in the plant PRA; for internal fires, the CDF contribution for the SPAR model is approximately twice the corresponding contribution in the plant PRA.

Evaluation of the approach for incorporating seismic risk into the SPAR models for the case of Limerick 1 and 2 was complicated by the fact that the licensee had performed an seismic margins analysis (SMA) to estimate the plant's seismic vulnerability to satisfy the IPEEE requirements of Generic Letter 88-20. Consequently, there was little useful current seismic information available for the plant. As an alternative, the project used component and structure fragilities and overall seismic core damage frequency (CDF) results from an older LGS SARA report (an early seismic report on Limerick). This information was supplemented with material from other sources to develop a Limerick seismic model for the SPAR model. Results obtained

using the SPAR model based on the Lawrence Livermore National Laboratory (LLNL) hazard curve were approximately three times the seismic CDF reported in the LGS SARA report.

These results and a discussion of the development effort have been documented in a draft report, which will be transmitted soon to cognizant user organizations for review/comment.

#### Development of User-Friendly I/O Interface

Pat O'Reilly, RES/OERAB, reported that the prototype user-friendly, input/output (I/O) interface has been completed and is under review by the project's Technical Monitor prior to being transmitted to key users for beta testing and comment. Responding to a number of comments about the use of the interface, Mark Reinhart, NRR/SPSB, remarked that further discussion about the interface and its potential role within the SDP process is needed-once the beta testing phase has been completed-before any decision can be made regarding future plans for this analysis tool.

#### SAPHIRE/GEM Items

Dan O'Neal , RES/PRAB, the SAPHIRE Project Manager, announced that SAPHIRE 7.21 has been approved and is now available on the SAGAN server and the SAPHIRE Users Group Website for general use.

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MEMORANDUM DATED: 03/11/05

SUBJECT: SUMMARY OF DECEMBER 16, 2004, STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL USERS GROUP (SMUG) MEETING

Distribution:

OERAB RF  
 DRAA RF  
 BSheron, NRR/ADPT  
 JCraig/CPaperiello, RES  
 EThornsbury, ACRS  
 MWeston, ACRS  
SPAR Model Users Group  
 DLoveless, RGN-IV  
 EGoldfeiz, RES/DRAA/OERAB  
 DO'Neal, RES/DRAA/OERAB  
 HVandermolen, RES/DSARE/REAHFB  
 WSchmidt, RGN-I  
 JRidgely, RES/DRAA/PRAB  
 SBurgess, RGN-III  
 RBernhard, RGN-II  
 YLi, RES/DET/ERAB  
 RGibbs, NRR/DIPM/IIPB  
Management of SPAR Model User Organizations  
 TReis, NRR/DIPM/IROB  
 SRichards, NRR/DIPM/IIPB  
 MEvans, RES/DET/ERAB  
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 DLew, RES/DRAA/PRAB  
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 MReinhart, NRR/DSSA/SPSB

SPAR Model Users

AEI-Bassioni, NRR/DSSA/SPSB  
 DDube, RES/DRAA/OERAB  
 ELois, RES/DRAA/PRAB  
 MPohida, NRR/DSSA/SPSB  
 Mfranovich, NRR/DSSA/SPSB  
 SWong, NRR/DSSA/SPSB  
 JAnderson, NRR/DIPM/IIPB  
 WRogers, RGN-II  
 DMarksberry, RES/DRAA/OERAB  
 GDemoss, RES/DRAA/OERAB  
 MRunyan, RGN-IV  
 RBywater, RGN-IV  
 LKozak, RGN-III  
 WCook, RGN-III  
 CCross, RGN-I  
 MLaur, NRR/DSSA/SPSB  
 DPassehl, RGN-I  
 HHamzehee, RES/DRAA/PRAB  
 ARubin, RES/DRAA/PRAB  
 WBeckner, NRR/DIPM/IROB  
 CAder, RES/DRAA  
 NChokshi, RES/DRAA/OERAB

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**SPAR MODEL USERS GROUP (SMUG) MEETING  
DECEMBER 16, 2004**

**Attendance List**

<u>Name</u>	<u>Organization</u>
Christiana Lui	RES/DRAA/OERAB
Pat O'Reilly	RES/DRAA/OERAB
Eli Goldfeiz	RES/DRAA/OERAB
Dan O'Neal	RES/DRAA/PRAB
Selim Sancaktar	RES/DRAA/OERAB
Don Dube	RES/DRAA/OERAB
Gary Demoss	RES/DRAA/OERAB
Mark Reinhart	NRR/DSSA/SPSB
Marty Stutzke	NRR/DSSA/SPSB
Mike Franovich	NRR/DSSA/SPSB
Russell Gibbs	NRR/DIPM/IIPB
Laura Kozak*	RGN-III/DRS
John Lehner*	BNL
C. C. Lin*	BNL
Bob Buell*	INEEL
John Schroeder*	INEEL
Bill Galyean*	INEEL
Dan Henry*	INEEL

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\* Participated via teleconferencing.

## **SPAR MODEL USERS GROUP (SMUG) MEETING AGENDA**

**DECEMBER 16, 2004; 1:30PM EST  
Conference Room: O-9B6**

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### **AGENDA ITEMS**

- Level 1, Revision 3 SPAR Model Development
  - Development of LOOP/SBO Module
  - Development of Enhanced Revision 3 SPAR Models
    - Modeling Issue Resolution
  - Development of Precautionary Screens
- Low Power/Shutdown SPAR Model Development
  - Preparation of Final NUREG/CR Report on SPAR HRA Method
  - Onsite QA Review of LP/SD SPAR Model for River Bend
  - Review of LP/SD SPAR Model for Grand Gulf
- Level 2/LERF SPAR Model Development
  - Status of Project
    - Model for second lead plant [BWR with Mark I containment (Peach Bottom 2 & 3 - Lead Plant)]
  - External Events
    - Status
    - Technical Approach
- SAPHIRE/GEM Items
  - Status of SAPHIRE Development
  - User-Friendly Interface for Use with SPAR Models
    - Final Results of User Survey

**IDENTIFY DATE FOR NEXT MEETING; AGENDA ITEMS**

## **PRIORITIZED LIST OF MODELING ISSUES**

### **Most Significant, Key Issues**

- LOOP/SBO Modeling Issues [including IE frequency, EDG mission time, offsite power recovery curves, convolution of failure-to-run events, etc.]\*
- RCP Seal Failure Modeling\*
- Common Cause Failure Modeling Issues (including methodology used, updating of the Alpha Factor data used in the SPAR Models)\*
- Data Issues (including outdated data used in SPAR models; other data differences between SPAR models and PRAs)\*
- Acceptable Probability Values for Sump Plugging and Suppression Pool Strainer Plugging (Generic Safety Issue 191)
- Estimation of Support System Initiating Event Frequencies (esp. Service Water System) & Construction Methodology
- Timing to Core Uncovery during SBOs for Various Scenarios (RCP seal LOCAs, stuck-open safety-relief valves, etc.) [thermal-hydraulic considerations affecting specific accident sequences initiated by station blackout]
- Termination of SBO Sequences at Battery Depletion
- Credit for RPV Injection Following Containment Failure in BWR Models [thermal-hydraulic considerations affecting specific accident sequences that involve containment failure]

### **Significant Issues**

- Expanding Level of Detail in Modeling BOP Systems (applies to SPAR models only)
- Addition of Lower Importance or Non-Typical Initiators to SPAR Models (applies to SPAR models only)
- PORV Success Criteria during Feed & Bleed Cooling (based on thermal-hydraulic calculations using the MAAP code)
- Steam Generator Tube Rupture Event Tree Modeling\*

## Less Significant Issues

- Modeling of Consequential Reactor Coolant Pump Seal LOCAs
- Credit for Recovery of System Hardware
- Credit for RWST Refill during PWR Small LOCA/RCP Seal LOCA Events to Preclude Sump Recirculation (based on thermal-hydraulic calculations using the MAAP code)
- Credit for RHR during Small LOCA/RCP Seal LOCA Events at PWRs with Ice Condenser Containments (thermal-hydraulic issue)
- Requirement for Accumulator Injection during Small LOCA or Medium LOCA Events (based on thermal-hydraulic calculations using the MAAP code)
- Timing to Containment/Equipment Failure Due to Containment Heatup in BWRs (thermal-hydraulic considerations affecting specific accident sequences involving containment integrity/equipment availability)
- Lower Limit of Human Error Probability for Failure to Initiate All Decay Heat Removal in BWR Models
- Lack of Detailed Instrumentation and Electric Power Modeling in SPAR Models
- Usability Issue: Division of the SPAR Model Transient Event Tree into Several Sub-Trees\*
- Allocation of Electrical Bus Failure Initiating Events to All Appropriate Buses in SPAR Models\*
- Elimination of Preferential Alignment of Alternate/ Backup EDGs in SPAR Models\*
- HPCI Injection Valve Modeling in SPAR Models\*
- Separation of LOOP Models into Single and Dual Unit Events for Multi-Unit Plants
- Incorporation of New System Study (e.g., RPS) Logic/Data into SPAR Models\*
- Separation of RCP Seal Failure Probability in PWR Models into Two Parts: LOOP/SBO-Related and Non-LOOP/SBO-Related\*
- Credit for RCIC As a Source of Depressurization Equivalent to an ADS Valve (based on thermal-hydraulic calculations using the MAAP code)
- MSPI Support: Separation of failure-to-start/failure-to-start Compound Events & Allocation of Test & Maintenance Unavailability for Normally Operating Components Among All Trains (SPAR model issue only)\*

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\* NOTE: Denotes issue that has already been addressed (e.g., incorporation of new, improved LOOP/SBO module into SPAR models), or is currently being addressed as part of model update process (e.g., incorporation of updated equipment failure data into SPAR models).