July 16, 2003

NOTE TO: Stuart Richards, Chief
Inspection Program Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation

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

FROM: Mark F. Reinhart, Chief **/RA/**
Licensing Section
Probabilistic Safety Assessment Branch
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

SUBJECT: RESULTS OF THE ALVIN W. VOGTLE GENERATING PLANT UNITS 1 AND 2 SDP PHASE 2 NOTEBOOK BENCHMARKING VISIT

During March, 2002, NRC staff and contractors visited the Southern Nuclear Company in Birmingham, Al to compare the Alvin W. Vogtle Generating Plant Units 1 and 2 Significance Determination Process (SDP) Phase 2 notebook and the licensee's risk model results to ensure that the SDP notebook was generally conservative. The Vogtle PSA did not include external initiating events; so no sensitivity studies were performed to assess the impact of these initiators on SDP color determinations. In addition, the results from analyses using the NRC's draft Revision 3i Standard Plant Analysis Risk (SPAR) model for Vogtle were compared with the licensee's risk model. The results of the SPAR model benchmarking effort will be documented in next revision of the SPAR (revision 3) model documentation.

The benchmarking visit identified that there was a good correlation between the Phase 2 SDP Notebook and the licensee's PSA. The results indicate that the Vogtle Phase 2 notebook was generally more conservative in comparison to the licensee's PSA. The revision 1 SDP notebook will capture about 87% (results matched or overestimated the licensee's PSA by one order of magnitude) of the risk significance of inspection findings. A summary of the results of comparisons of hypothetical inspection findings between the SDP notebook and the licensee's PSA are as follows.

CONTACT: Peter Wilson, SPSB/DSSA/NRR
301-415-1114

2.6%	(1 of 39 cases)	Non-conservative; underestimation of risk significance (by two orders of magnitude)
2.6%	(1 of 39 cases)	Non-conservative; underestimation of risk significance (by one order of magnitude)
7.7%	(3 of 39 cases)	Conservative; overestimation of risk significance (by two orders of magnitude)
30.8%	(12 of 39 cases)	Conservative; overestimation of risk significance (by one order of magnitude)
56.4%	(22 of 39 cases)	Consistent risk significance

One characteristic of the licensee's PSA that contributed to a large percentage of the overestimates obtained by the Rev. 1 SDP notebook was the licensee's use of initiating event frequencies that were smaller than those of the Rev. 1 SDP notebook. For example, the licensee's frequencies for small LOCA and medium LOCA were 4.97E-4/year and 3.98E-5/year, while the notebook's "credits" for them were 3 and 4, respectively.

The two under estimates were due to modeling differences between the notebook and the Vogtle PSA. See attachment A for further details.

The Rev-1 SDP notebook was improved as a result of the benchmarking activity. The number of cases that the Rev-1 SDP would match that of the updated licensee's PSA has increased from 12 to 22. The number of over estimations dropped from 26 to 15 cases. However, the number of underestimations increased from 1 to 2.

The licensee's PSA staff was very knowledgeable of the plant model and provided very helpful comments during the benchmark visit.

Attachment A describes the process and results of the comparison of the Vogtle SDP Phase 2 Notebook and the licensee's PSA.

Attachment: As stated

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SUMMARY REPORT ON BENCHMARKING TRIP

TO ALVIN W. VOGTLE ELECTRIC GENERATING PLANT

UNITS 1 AND 2

G. Martinez-Guridi

Brookhaven National Laboratory (BNL)
Energy Sciences and Technology Department
Upton, NY 11973

May 29, 2003

Attachment A

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1. INTRODUCTION

A benchmarking of the Alvin W. Vogtle Electric Generating Plant Units 1 and 2, Significance Determination Process (SDP) Risk-Informed Inspection Notebook was conducted during a plant site visit on March 10-12, 2003. Rudolph Bernhard and Peter Wilson (NRC), supported by Gerardo Martinez-Guridi (BNL), participated in this benchmarking exercise.

In preparation for the plant site visit, BNL staff reviewed the Rev. 0 Vogtle SDP notebook and evaluated a set of hypothetical inspection findings using the Rev. 0 SDP notebook, plant system diagrams and information in the licensee's updated PRA.

The major activities performed during this plant site visit were:

1. Discussed licensee's comments on the Rev. 0 SDP notebook.

2. Obtained listings of the Risk Achievement Worth (RAW) values for basic events of the internal events PRA model.

3. Identified a target set of basic events (hypothetical inspection findings) for the benchmarking exercise.

4. Performed benchmarking of the Rev. 0 SDP notebook considering the licensee's proposed modifications to this notebook.

5. Identified overestimates and reviewed the licensee's PRA model to determine the underlying reasons. Additional changes to the SDP notebook were proposed, as appropriate.

Chapter 2 presents a summary of the results obtained during benchmarking, Chapter 3 discusses the proposed revisions to the Rev. 0 SDP notebook, and Chapter 4 discusses the results from both internal and external events. Finally, Attachment 1 shows a list of the participants in the benchmarking activities.

2. SUMMARY RESULTS FROM BENCHMARKING

Summary of Benchmarking Results

Benchmarking of the SDP Notebook for the Alvin W. Vogtle Electric Generating Plant Units 1 and 2 was conducted comparing the risk significance of the inspection findings obtained using the notebook with that obtained using the plant PRA. The benchmarking identified the hypothetical inspection findings for which the results of the evaluation using the notebook were under or overestimations compared to the plant PRA.

Thirty-nine cases of hypothetical findings were evaluated. A summary of the results of the risk characterization of hypothetical inspection findings for Unit 1 is as follows:

2.6%	(1 of 39 cases)	Non-conservative; underestimation of risk significance (by two orders of magnitude)
2.6%	(1 of 39 cases)	Non-conservative; underestimation of risk significance (by one order of magnitude)
7.7%	(3 of 39 cases)	Conservative; overestimation of risk significance (by two orders of magnitude)
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56.4%	(22 of 39 cases)	Consistent risk significance

Detailed results of benchmarking are summarized in Table 1 which consists of eight column headings. In the first two columns, the out-of-service components, including human errors, are identified for the case analyses. The colors assigned for significance characterization from using the Rev. 0 SDP notebook before incorporation of the licensee's comments are shown in the third column. The licensee's basic events for which the RAW was found, representing the hypothetical finding, is presented in the fourth column. The fifth and sixth columns show the RAW values and the associated colors, respectively, based on the licensee's latest PRA model. The colors assigned for significance characterization from using the SDP notebook after incorporation of the licensee's comments and the outcome of comparing the results between the SDP Rev. 1 notebook and the plant PRA are shown in the seventh column. Finally, the eighth column presents some comments about the evaluations.

A comparative summary of the benchmarking results is provided in Table 2. This table shows the number of cases where the SDP was more or less conservative, the SDP matched the outcome from the licensee's PRA model, and the cases not modeled by the licensee. The percentages associated with these cases also are shown on this Table. The Rev. 1 SDP notebook was consistent (same color) in 56.4% of the inspection findings, 38.5% of overestimates, and 5.1% of underestimates.

Observations on the Licensee's PRA

One characteristic of the licensee's PRA contributes to the percentage of overestimates obtained by the Rev. 1 SDP notebook. The licensee's frequencies of several initiating events were smaller than those of the Rev. 1 SDP notebook. For example, the licensee's frequencies for small LOCA

and medium LOCA were 4.97E-4/year and 3.98E-5/year, while the notebook's "credits" for them were 3 and 4, respectively. Also, ATWS was evaluated by the licensee as an initiating event, such as a turbine trip, and failure of the reactor protection system, and other factors. The frequency of the initiating event and failure of the reactor protection system for the most dominant minimal cut set was about 4E-7/year, while the notebook's "credit" for ATWSwas6.

Discussion of Non-conservative Results by the Notebook

The Rev. 1 notebook yielded two underestimates out of the 39 hypothetical findings evaluated: operator fails to terminate SI following MSLB, and operator fails to trip RCPs. They are discussed next.

Operator fails to terminate SI following MSLB. The licensee's PRA obtained yellow, and the notebook yielded green. The licensee's model of MSLB considered that the operator had to terminate SI regardless of whether the MSIVs close or not. On the other hand, the notebook's model of MSLB considered that this operator action was not required if all steam paths were isolated using the MSIVs. Hence, in the notebook's model, the failure to terminate SI was in a sequence with the failure of all steam paths to be isolated, which has a credit of 2. This credit accounted for the difference in colors between the licensee's PRA and the notebook.

Operator fails to trip RCPs. The licensee's PRA obtained yellow, and the notebook yielded white. The importance of this operator action in the licensee's PRA came from the scenario of a total loss of NSCW. This total loss was not modeled in the SDP notebook because the notebook assumed that, given a total loss of RCP seal cooling due to a total loss of NSCW, a RCP seal LOCA that cannot be mitigated follows, regardless of whether the operator tripped the RCPs or not.

Discussion of Conservative Results by the Notebook

The Rev. 1 notebook produced 15 overestimates, 3 by two orders of magnitude, and 12 by one order of magnitude. The three overestimates by two orders of magnitude were: battery charger of bus A fails, operator fails to switch over in LPR, and operator fails to recover AC power in < 5 hours after a LOOP. They are discussed next.

Battery charger of bus A fails. The licensee's PRA obtained green, and the notebook yielded yellow. This difference was because of different assumptions in treating this failure by the notebook and the licensee. There were two 100% battery chargers in each DC bus and one battery charger can handle all safety loads. On failure of one battery charger, the other battery charger automatically provides power to the DC bus. In addition, the licensee considered that the loss of the battery charger would be annunciated in the control room, and hence the failure of the charger would not cause the loss of its associated DC bus. On the other hand, the current SDP usage rules assume that without the battery charger the associated battery will discharge under normal loads and result in a loss of the DC bus, and require that each worksheet specified by Table 2 (of the notebook) for the equipment powered by the affected DC train to be solved considering this equipment unavailable.

Operator fails to switch over in LPR. The licensee's PRA obtained yellow, and the notebook yielded red (3). In general, for those scenarios in which the SDP notebook models LPR, the licensee modeled shutdown cooling. If shutdown cooling failed, then the licensee credited LPR. Accordingly, in the licensee's model, both shutdown cooling and LPR have to fail for core damage

to occur. Hence, the licensee's PRA obtained a color that was lower than the one from the notebook because of the additional credit that it took for shutdown cooling.

Operator fails to recover AC power in < 5 hours after a LOOP. The licensee's PSA obtained green, and the notebook yielded yellow. The SDP notebook considered that a RCP seal LOCA would occur after a station blackout (SBO) due to loss of RCP seal cooling, and that AC power had to be recovered before core uncovery, roughly estimated in about 5 hours. On the other hand, in the licensee's PSA, the cause of a RCP seal LOCA resulted from a loss of RCP seal cooling mainly due to the loss of NSCW (or combinations of failures of components of NSCW with other components inside the plant) after the LOOP. Accordingly, recovering AC power did not help to prevent core damage after this LOCA. Hence, failing to recover AC power in less than 5 hours after a LOOP had a low risk significance (green) in the licensee's PRA.

The 12 overestimates by one color were: one accumulator fails, one pump of CCW fails, one pump of ECW fails, one Atmospheric Relief Valve (ARV) fails to open, one standby pump of NSCW fails, one primary block valve fails to close, one RHR pump fails, AMSAC fails, one PORV fails to close, operator fails to switchover in HPR, operator fails to conduct emergency boration after ATWS, and operator fails to recover one NSCW pump after loss of NSCW.

Changes Incorporated Following Benchmarking Resulting in Updating of Benchmarking Results

Following benchmarking, we incorporated some additional changes to the Rev. 1 notebook as follows:

– BNL requested the licensee to clarify the equipment and success criteria used for depressurization in scenarios of small LOCA. The licensee indicated that this depressurization was achieved by using 2/4 secondary ARVs or 3/3 steam dump valves. This equipment and success criteria was used to update the following worksheets: SLOCA and LNSCW.

2. The credit for the action "Operator trips RCPs" was changed to operator action = 2 because the licensee estimated a human error probability (HEP) = 2.25E-2.

3. The ACCW provides cooling for the following components: RCP thermal barrier heat exchanger and the RCP bearing oil coolers, the CVCS' letdown heat exchanger, the CVCS' excess letdown heat exchanger, and the CVCS' seal water heat exchanger. Loss of cooling to the RCP bearing oil coolers could result in overheating and failure of bearing. Bearing failure, in turn, could cause the shaft to vibrate and thereby result in the potential for seal failure if the RCP was not tripped. Cooling to the RCP thermal barrier heat exchanger was lost, but RCP seal cooling would be provided by the centrifugal charging pumps. Accordingly, for a RCP seal LOCA to occur after a loss of ACCW (LACCW), the operator had to fail to trip the RCPs, or the CCPs failed to provide RCP seal cooling. Hence, the most severe impact of a LACCW was a RCP seal LOCA, so this loss was covered by the worksheet of small LOCA, and the worksheet of LACCW was deleted.

4. Since the AFW pumps do not depend on ECW and, hence, do not depend on NSCW, the three AFW pumps were given credit in the worksheet for loss of 2 pumps in each train of NSCW (LNSCW).

Table 1: Summary of Benchmarking Results for Vogtle Units 1 and 2
Internal Events CDF is 1.71E-5/year
RAW Thresholds are W = 1.06, Y = 1.59, and R = 6.85

No.	Component Out of Service or Failed Operator Action	SDP Worksheet Results (Before)	Basic Event Name	Internal RAW	Plant CDF Color	SDP Worksheet Results (After)	Comments
	Component						
1	Class 1E AC bus A fails	Red (2) (over by 1)	1ACBSAA02----F 1ACBSAA02----M	205.8	Red (3)	Red (3) (match)	
2	Diesel generator of bus A fails	Yellow (match)	1DGDGG4001---A 1DGDGG4001---M 1DGDGG4001---X	1.997	Yellow	Yellow (match)	
3	Vital 125 VDC bus A fails	Red (2) (over by 1)	1DCBSAD1-----F 1DCBSAD1-----M	43.73	Red (3)	Red (3) (match)	
4	Battery of bus A fails	Red (4) (over by 1)	1DCBYAD1B----F 1DCBYAD1B----M	2.095	Yellow	Yellow (match)	
5	Battery charger of bus A fails	Red (4) (over by 3)	1DCBCAD1CA---F 1DCBCAD1CA---M	1.000	Green	Yellow (over by 2)	
6	One pump of ACCW fails	Yellow (over by 1)	1XCPMP4-001--A 1XCPMP4-001--M 1XCPMP4-001--X	1.435	White	White (match)	
7	One accumulator fails	Yellow (over by 1)	1ATTKV6002---R	1.217	White	Yellow (over by 1)	
8	One MDP of AFW fails	Red (4) (over by 1)	1AFPMP4003---A 1AFPMP4003---M 1AFPMP4003---X	2.697	Yellow	Yellow (match)	
9	TDP of AFW fails	Yellow (match)	1AFPTP4001---A 1AFPTP4001---M 1AFPTP4001—X	1.766	Yellow	Yellow (match)	
10	One pump of CCW fails	Yellow (over by 2)	1CCPMP4-001--A 1CCPMP4-001--M 1CCPMP4-001--X	1.000	Green	White (over by 1)	
11	One condensate pump fails	Green (match)	1CDPM-----001M 1CDPM-----001X 1CDPM001-----A	1.000	Green	Green (match)	

No.	Component Out of Service or Failed Operator Action	SDP Worksheet Results (Before)	Basic Event Name	Internal RAW	Plant CDF Color	SDP Worksheet Results (After)	Comments
12	One pump of MFW fails	Green (match)	1FWPT004-----X	1.000	Green	Green (match)	
13	One CVCS centrifugal charging pump fails	Yellow (over by 1)	1CPPMCCPA----A 1CPPMCCPA----M 1CPPMCCPA----T 1CPPMCCPA----X	1.434	White	White (match)	
14	One boric acid transfer pump fails	Green (match)	1BAPMBAA-----A 1BAPMBAA-----M 1BAPMBAA-----X	1.000	Green	Green (match)	
15	One pump of ECW fails	Red (3) (over by 3)	1ECPM001-----A 1ECPM001-----M 1ECPM001-----X	1.094	White	Yellow (over by 1)	
16	One air compressor of IA fails	Green (match)	1IACM501-----A 1IACM501-----M 1IACM501-----X	1.000	Green	Green (match)	
17	One Atmospheric Relief Valve (ARV) fails to open	Green (match)	1MSARVPV3000-D	1.000	Green	White (over by 1)	
18	One Main Steam Isolation Valve (MSIV) fails to close	Green (match)	1MSMSIV-3006AK	1.000	Green	Green (match)	
19	One standby pump of NSCW fails	Red (4) (over by 2)	1SWPMP4-005--A 1SWPMP4-005--M 1SWPMP4-005--X	1.380	White	Yellow (over by 1)	
20	One PORV fails to open	Yellow (over by 1)	1RCPORV0455A-D	1.489	White	White (match)	
21	One primary block valve fails to close	White (over by 1)	1RCMV8000A---K	1.021	Green	White (over by 1)	
22	One primary safety valve fails to open	White (match)	1RCPSV8010A--D	1.066	White	White (match)	
23	One RHR pump fails	Red (4) (over by 1)	1LPPMRHRA----A 1LPPMRHRA----M 1LPPMRHRA----X	5.343	Yellow	Red (4) (over by 1)	

No.	Component Out of Service or Failed Operator Action	SDP Worksheet Results (Before)	Basic Event Name	Internal RAW	Plant CDF Color	SDP Worksheet Results (After)	Comments
24	One SI pump fails	White (over by 1)	1SIPMSIA-----A 1SIPMSIA-----M 1SIPMSIA-----X	1.002	Green	Green (match)	
25	One pump of TPCCW fails	White (over by 1)	1TCPM001-----A 1TCPM001-----M 1TCPM001-----X	1.000	Green	Green (match)	
26	One pump of TPCW fails	White (over by 1)	1TPPM501-----A 1TPPM501-----M 1TPPM501-----X	1.001	Green	Green (match)	
27	AMSAC fails	White (over by 1)	AMSAC	1.001	Green	White (over by 1)	
28	One PORV fails to close	Yellow (over by 1)	1RCPORV0455A-K	1.562	White	Yellow (over by 1)	
	Operator Actions						
29	Operator fails to conduct Feed/Bleed	Red (4) (over by 1)	OAB----------H OAB_SI-------H OAB_TR-------H	2.586	Yellow	Yellow (match)	
30	Operator fails to switchover in HPR	Red (4) (over by 1)	OAR_HPATA----H OAR_HPATB----H OAR_HPML-----H OAR_HPSBO----H OAR_HPSG-----H OAR_HPSL-----H OAR_HPSLA----H OAR_HPSLB----H OAR_HPSSI----H OAR_HPSSO----H OAR_HPTR-----H	4.996	Yellow	Red (4) (over by 1)	

No.	Component Out of Service or Failed Operator Action	SDP Worksheet Results (Before)	Basic Event Name	Internal RAW	Plant CDF Color	SDP Worksheet Results (After)	Comments
31	Operator fails to switchover in LPR	Red (3) (over by 2)	OAR-LPMLA----H OAR_LPLL-----H OAR_LPMLB----H OAR_LPSL-----H OAR_LPSLC----H OAR_LPSLD----H	5.562	Yellow	Red (3) (over by 2)	
32	Operator fails to recover AC power in < 1 hour after a LOOP	White (match)	1HR-1	1.083	White	White (match)	
33	Operator fails to recover AC power in < 5 hours after a LOOP	Yellow (over by 2)	XHR-61 XHR-62 XHR-63	1.004	Green	Yellow (over by 2)	
34	Operator fails to depressurize RCS using SGs to less than setpoint of relief valves of SG after SGTR	White (match)	OAD_SGR------H	1.093	White	White (match)	
35	Operator fails to conduct emergency boration after ATWS	White (over by 1)	OA-OBR-------H	1.002	Green	White (over by 1)	
36	Operator fails to recover one NSCW pump after loss of NSCW	Red (4) (over by 1)	OA-OSW-------H	3.028	Yellow	Red (4) (over by 1)	
37	Operator fails to trip RCPs	Red (3) (over by 2)	OA-ORC-A-1---H	4.200	Yellow	White (under by 1)	
38	Operator fails to isolate affected SG	White (match)	OAI_SG-------H	1.094	White	White (match)	
39	Operator fails to terminate SI following MSLB	Green (under by 2)	OAT----------H	2.032	Yellow	Green (under by 2)	

Table 2: Comparative Summary of the Benchmarking Results - Vogtle Units 1 and 2

SDP Notebook gives...	SDP Notebook Before (Rev. 0)		SDP Notebook After (Rev. 1)	
	Number of Cases	Percentage	Number of Cases	Percentage
Underestimate by two colors	1	2.6	1	2.6
Underestimate by one color	0	0	1	2.6
More conservative by one color	19	48.7	12	30.8
More conservative by two colors	5	12.8	3	7.7
More conservative by three colors	2	5.1	0	0
Matched	12	30.8	22	56.4
Total	39	100.0	39	100.1 (1)

<u>Note:</u>

1. The total percentage is not exactly 100 because of rounding of the individual percentages.

3. PROPOSED REVISIONS TO THE REV. 0 SDP NOTEBOOK

Based on insights gained from the plant site visit, a set of revisions are proposed for the Rev. 0 SDP notebook. The proposed revisions are based on the licensee's comments on the Rev. 0 SDP notebook, better understanding of the current plant design features, consideration of additional recovery actions, use of revised Human Error Probabilities (HEPs) and initiator frequencies, and the results of benchmarking.

3.1 Specific Changes to the Rev. 0 SDP Notebook for the Vogtle Electric Generating Plant, Units 1 and 2

The NRC staff participating in the benchmarking and the licensee provided several comments on the Rev. 0 SDP Notebook. In addition, several major revisions that directly impacted the color assignments by the SDP evaluation were discussed with the licensee and their resolutions were identified in the meeting. Several significant changes that had an impact on the evaluation of the notebook were incorporated during the visit, including revised HEPs and initiator frequencies. The proposed revisions are discussed below:

1. The worksheet for "Loss of IA (LIA)" was removed from the notebook because all findings involving the compressors of IA are green regardless of the duration of the finding.

2. The worksheet for "Loss of One Train of Control Building (CB) ESF Electrical HVAC (HVAC)" was removed from the notebook because it causes the same impact as a loss of one 125 VDC bus (LBDC).

3. Table 1 and Table 2. Added footnote indicating that the licensee models two initiating events related to NSCW: "Loss of 2 Pumps in Each Train of NSCW" and "Total loss of NSCW." The former is modeled by a worksheet in this notebook, and the latter leads to core damage directly. Total loss of NSCW has a frequency of 5.52E-5/year. The NSCW provides cooling for the following components: EDGs, CCW heat exchangers, ACCW heat exchangers, ECW chillers, and ECCS (RHR, SIP, CCP) pump motor coolers and CS pump motor coolers. ACCW can continue for a short time (approximately half an hour) before system failure occurs. The ACCW provides cooling for the RCP thermal barrier and to the RCP bearing oil coolers. Hence, the result of a total loss of NSCW is a RCP seal LOCA that cannot be mitigated because the mitigating equipment is unavailable.

4. Table 2. Updated the plant internal event CDF (excluding internal floods) to 1.71E-5/year.

5. Table 2. Added footnote indicating that one train of Component Cooling Water (CCW) is normally running, and the other is in standby.

6. Table 2. 4.16 kV AC was removed from the support systems of the boric acid transfer pumps.

7. Table 2. Added footnote indicating that loss of one class 1E 4.16 kV bus does not cause a reactor trip. Accordingly, this loss is not modeled as an initiating event.

8. Table 2. Added footnote indicating that the fuel oil day tank can support the EDGs without the fuel transfer pumps during 2.6 hours. There is no gravity feed from the EDG fuel storage tank to the EDG fuel oil day tank.

9. Table 2. Added footnote indicating that without AC power, battery capacity is 4 hours with load shed.

10. Table 2. Added footnote indicating that there are two 100% battery chargers in each DC bus and one battery charger can handle all safety loads. On failure of one battery charger, the other battery charger automatically provides power to its associated DC bus. The inspection findings related to the batteries of DC buses 1AD1 and 1BD1 should be evaluated by assuming the loss of the associated DC bus when offsite power is not available (i.e., LOOP and LEAC worksheets), and increasing the frequency of loss of DC initiator by one order of magnitude. The inspection findings related to the batteries of DC buses 1CD1 and 1DD1 should be evaluated by assuming the loss of the associated DC bus when offsite power is not available (i.e., LOOP and LEAC worksheets).

11. Table 2. 4.16 kV AC was added to the support systems of the Essential Chilled Water (ECW).

12. Table 2. Added footnote indicating that the MSIVs fail closed on loss of DC or IA.

13. Table 2. 480 VAC was added to the support systems of the Nuclear Service Cooling Water (NSCW).

14. Table 2. Added footnote indicating that the Nuclear Service Cooling Water (NSCW) keeps running after a reactor trip or a safety injection signal. However, it is automatically tripped after a LOOP.

15. Table 2. Added footnote indicating that the primary block valves are normally open and have automatic re-closure on low pressure of the reactor coolant system.

16. Table 2. NSCW was removed from the support systems of the RHR/LPSI.

17. Table 2. In the row for RHR/LPSI, added footnote indicating that the CCW is only required for the RHR's heat exchangers.

18. Table 2. Added footnote indicating that room cooling is not required by the following systems: AFW, NSCW, RHR/LPSI, and SI.

19. Table 2. The column "Initiating Event" was updated to account for the changes in the worksheets, as described in this document.

20. In all worksheets that use Feed/Bleed, the success criteria for this function was revised according to updated information provided by the licensee.

21. In all worksheets that use the ARVs as one of the paths for steam relief, the success criteria was re-arranged to make it clearer to the reader as follows: "(AFW) to 2/4 SGs with (1/5 SG safety valves or 1/1 ARV) on each SG fed by AFW"

22. Transients With Loss of PCS (TPCS). The ARVs were added as a path for steam relief.

23. Small LOCA (SLOCA), Stuck-open PORV (SORV) and Loss of 2 Pumps in Each Train of NSCW (LNSCW). Added footnote indicating that the licensee distinguishes two types of RCS Cooldown/Depressurization: when high pressure injection is available (normal cooldown) and when it is not available (rapid cooldown for LPI). The licensee uses the same equipment and success criteria for both types of RCS Cooldown/ Depressurization, but different human error probabilities (HEPs). For normal cooldown, the licensee estimated a HEP = 3.7E-3, and for rapid cooldown for LPI, the licensee estimated a HEP = 7.7E-3.

24. Stuck-open PORV (SORV). Added new event tree developed specifically for SORV. The sequence numbers in the worksheet were updated to match those in the new event tree.

25. Loss of Offsite Power (LOOP). Added operator using 1/1 EDG from other unit to the safety function "Emergency AC Power (EAC)." Added footnote indicating that the licensee estimated a HEP = 0.2 for cross-tying the EDGs from the other unit. To account for dependencies, we gave a total credit of 1 multi-train system to this function.

26. Loss of Offsite Power (LOOP). The ARVs were added as a path for steam relief.

27. Loss of Offsite Power (LOOP). In the Rev. 0 notebook, our understanding was that the licensee did not credit the use of the safety injection pumps for feed and bleed in the sequences where EAC failed and AC power is later restored. In this scenario, 2/2 charging pumps were required. The licensee indicated during the benchmarking visit that the success criteria for feed and bleed had changed to 1/2 charging trains and 1/2 PORVs. The event tree and worksheet were changed to implement the licensee's current success criteria for feed and bleed.

28. Steam Generator Tube Rupture (SGTR). The equipment and success criteria used by the operator to isolate the affected SG were added: 1/2 MSIVs associated with the affected SG and AFW discharge valves.

29. Steam Generator Tube Rupture (SGTR). Added footnote indicating that the licensee does not credit the affected SG.

30. Anticipated Transients Without Scram (ATWS). The success criteria for steam relief was added: 4/4 SGs with 4/5 safety valves opening on each SG.

31. Loss of 2 Pumps in Each Train of NSCW (LNSCW). The structure of the event tree was modified because the Rev. 0 event tree modeled a total loss of NSCW. After loss of 2 pumps in each train of NSCW, the licensee credits establishing operation of one pump of NSCW. This recovery action provides cooling to one train of mitigating equipment, even though each NSCW pump has 50% capacity. If this recovery action fails, core damage follows due to an RCP seal LOCA that cannot be mitigated. If this recovery action is successful, but an RCP seal LOCA occurred because the RCPs were not tripped, this LOCA may be mitigated with one train of mitigating equipment.

32. Loss of 2 Pumps in Each Train of NSCW (LNSCW). The credit for the action "Plant staff recovers one NSCW pump to provide cooling to one train of mitigating equipment" was

changed from operator action = 2 to operator action = 3 because the licensee estimated a HEP = 3.9E-3.

33. Loss of One 125 VDC Bus (LBDC). The ARVs were added as a path for steam relief.

34. Loss of One 125 VDC Bus (LBDC). Since one primary PORV is unavailable, and feed and bleed using the SI pumps requires two PORVs, these pumps were removed from the equipment used to implement feed and bleed.

35. Loss of One 125 VDC Bus (LBDC). Enhanced footnote 1 to indicate that the frequency of loss of 125 VDC bus 1AD1 is 4.5E-3/year, and the frequency of loss of 125 VDC bus 1BD1 is the same. Hence, the frequency of loss of 125 VDC bus 1BD1 or 1AD1 is 9.0E-3/year.

36. Loss of One 125 VDC Bus (LBDC). Added footnote indicating that the TDAFW pump steam supply valve (HV-5106) is normally closed, and it is required to open. It is powered by the 125 VDC panel 1CD1M which is powered by the 125 VDC bus 1CD1. Hence, after loss of 125 VDC bus 1AD1 or bus 1BD1, this valve may be powered by the 125 VDC bus 1CD1.

3.2 Generic Change in IMC 0609 for Guidance to NRC Inspectors

Based on the lessons from this benchmarking, a recommendation for improving 0609 is as follows:

– The "rule" 1.3 of 0609 indicates that "For inspection findings that involve the unavailability of one train of a multi-train, normally cross-tied support system that increases the likelihood of an initiating event, increase the Initiating Event Likelihood by one order of magnitude for the associated special initiator." After observations during benchmarking of Vogtle and other plants, we suggest that for systems having two or more trains, this "rule" be modified so that the Initiating Event Likelihood for the associated special initiator is increased by two orders of magnitude when the unavailable train is normally in standby.

– For the loss of a battery charger of a DC bus, the rules for SDP evaluation assume that the associated DC bus will be lost as a result of the failure of the battery charger because the associated battery will discharge under normal loads, and the rules require that each worksheet specified by Table 2 (of the notebook) for the equipment powered by the affected DC train be solved considering this equipment unavailable. On the other hand, the loss of the charger at Vogtle is annunciated in the main control room and hence this loss would not cause the loss of its associated DC bus. Accordingly, it is recommended that the rule for SDP evaluation of a battery charger be revised to account for the possibility that the associated DC bus will not be lost as a result of the failure of the battery charger. This issue also was observed while benchmarking the Seabrook and Farley plants.

3.3 Generic Change to the SDP Notebook

No generic change to the SDP notebook was identified.

4. DISCUSSION ON EXTERNAL EVENTS

The licensee does not have a PRA model for external events.

5. LIST OF PARTICIPANTS

Rudolph Bernhard	Nuclear Regulatory Commission/Region II
Peter Wilson	Nuclear Regulatory Commission/Office of Nuclear Reactor Regulation
Anees Farruk	Southern Company
Young G. Jo	Southern Company
Owen M. Scott	Southern Company
Roger A. Hayes	Southern Company
John A. Schroeder	Idaho National Engineering and Environmental Laboratory
Gerardo Martinez-Guridi	Brookhaven National Laboratory